A HYBRIDIZED MODEL OF SPATIAL PRESENSE AND GUIDED-IMAGERY THERAPY TECHNIQUE FOR IMAGE-BASED VIRTUAL REALITY IN SELF-THERAPY

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Abstrak

Pengalaman pengguna (UX) adalah elemen penting dalam kejayaan produk interaktif seperti aplikasi realiti maya (VR). Salah satu aspek UX dalam VR ialah rasa kehadiran yang merujuk kepada perasaan "berada di sana" dalam persekitaran maya. Kajian ini memberi tumpuan kepada mewujudkan rasa kehadiran ruang dalam alat VR untuk terapi kendiri, khususnya untuk keadaan tekanan. Tekanan ialah isu kesihatan mental yang lazim dalam masyarakat, dan Terapi Imejan Berpandu (GIT) ialah salah satu kaedah biasa untuk menguruskannya. Teknologi VR boleh menyokong kaedah ini dengan mewujudkan persekitaran maya, sebagai alternatif kepada kaedah tradisional. Kajian sedia ada telah menggunakan Model Kehadiran Spatial (SPM) untuk membangunkan alat VR, manakala GIT telah digunakan sebagai alat rawatan untuk masalah psikologi. Walau bagaimanapun, tiada kajian yang menggabungkan SPM dan GIT dalam terapi kendiri untuk mengurangkan tekanan. Oleh itu, kajian ini mencadangkan model hibrid untuk VR berasaskan Imej (IBVR) yang menggabungkan SPM dan GIT untuk terapi kendiri (SP-GIT4IBVRST). Kaedah Penyelidikan Sains Reka Bentuk (DSRM) telah diguna pakai. Pembangunan model telah melalui dua proses utama iaitu reka bentuk model dan pengesahan model. Analisis kandungan dan analisis perbandingan digunakan untuk mengenal pasti komponen model, yang kemudiannya disahkan melalui penilaian pakar. Kemudian model itu diuji melalui penilaian pengguna terhadap prototaip terapi kendiri IBVR berdasarkan tiga aspek utama iaitu kehadiran spatial, pengalaman pengguna dan keberkesanan. Keputusan menunjukkan bahawa pengguna mempunyai pengalaman positif dengan alat terapi kendiri IBVR dan komponen-komponen bagi model hibrid SP-GIT4IBVRST adalah memenuhi keperluan kajian ini. Model hibrid yang dicadangkan boleh menjadi rujukan untuk pembangun dan pereka bentuk dalam mencipta alat IBVR untuk terapi diri, yang boleh menyokong promosi kesejahteraan mental yang sihat untuk masyarakat dan manusia secara umum.

Kata Kunci: Realiti maya, Kehadiran spatial, Terapi imejan berpandu, Pengalaman pengguna, Tekanan.

Abstract

User experience (UX) is an important element in the success of interactive products such as virtual reality (VR) applications. One aspect of UX in VR is the sense of presence, which refers to the feeling of "being there" in the virtual environment. This study focuses on creating a sense of spatial presence in VR tools for self-therapy, specifically for stress conditions. Stress is a prevalent mental health issue in society, and Guided Imagery Therapy (GIT) is one of the common methods for managing it. VR technology can support this method by creating a virtual environment, as an alternative to the traditional methods. Existing studies have applied the Spatial Presence Model (SPM) to develop VR tools, while GIT has been used as a treatment tool for psychological problems. However, no studies have combined SPM and GIT in self-therapy to reduce stress. Therefore, this study proposes a hybrid model for Image-based VR (IBVR) that combines SPM and GIT for self-therapy (SP-GIT4IBVRST). The Design Science Research Methodology (DSRM) was adopted. The model development has gone through two main processes, namely model design and model validation. Content analysis and comparative analysis were used to identify the components of the model, which were then verified through expert review. Then the model was tested through user evaluation of the IBVR self-therapy prototype based on three main aspects, which are spatial presence, user experience and effectiveness. The results indicate that users had a positive experience with the IBVR self-therapy tool and that the components of the SP-GIT4IBVRST hybrid model met the needs of this study. The proposed hybrid model can serve as a reference for developers and designers in creating IBVR tools for self-therapy, which can support the promotion of healthy mental well-being for society and humanity in general.

Keywords: Virtual reality, Spatial presence, Guided imagery therapy, User experience, Stress.

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"Al-Fatihah for Allahyarham Zaiyadi bin Taib and Muhammad Fahim Ilmi bin Mohd Fairuz"

Mohd Fairuz bin Zaiyadi
Universiti Utara Malaysia
2024

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List of Abbreviations

BP	Blood Pressure
CBT	Cognitive Behaviour Therapy
DSRM	Design Science Research Methodology
GBVR	Geometry-based Virtual Reality
GEQ	Games Experience Questionnaire
GIT	Guided Imagery Therapy
HCI	Human-Computer Interaction
IBVR	Image-based Virtual Reality
ITC-SOPI	International Test Commission - Sense of Presence Inventory
PANAS	Positive and Negative Effect Schedule
PERF	Primary Egocentric Reference Frame
SPES	Spatial Presence Experience Scale
SSM	Spatial Situational Model
UEQ	User Experience Questionnaire
UX	User Experience
VR	Virtual Reality
DASS	Depression, Anxiety, Stress Scales

CHAPTER 1

INTRODUCTION

1.1 Research Background

In any multimedia or interactive product, the interfaces have to attract users and deliver a stimulating user experience, as well as the characteristics of being easy to be used and learned because the success of an interactive product is determined by the user experience (Norman, 1988). User experience (UX) has been an important concept that is referring to the a person's overall involvement when interacting with a multimedia or interactive product, especially in terms of how easy or pleasing it is to use (Chilana, Ko, & Wobbrock, 2015). For example, the content of an image media can be used to promote a more exciting and engaging user experience as it can evoke an emotional response from the users (Sutcliffe, 2012). In multimedia knowledge, UX design provides guidance on concepts and workflows for the creation of the design and implementation of interactive products (Roth, 2017). UX has become the core of the design of various multimedia applications such as games (Solano et al., 2019; Wong & Ghavifekr, 2018), mobile applications (Weichbroth, 2020; Nik Ahmad & Hussaini, 2021), websites, augmented reality (AR) (Hashim, Idris, & Othman, 2018; Hashim, Idris, & Said, 2021; Hashim, Idris, & Said, 2022), virtual reality (VR) (Chi & Idris, 2021) and so on.

Virtual reality (VR) is a technology or tool in multimedia created to induce user experience characteristics so that users can feel presence and immersion during their interaction with the VR tool (Chilana et al., 2015; Lin, Fernandez, & Gregor, 2012;

Liszio & Masuch, 2017). The sense of presence is considered as part of the elements in generating and evaluating UX characteristics in VR applications (Lorenz et al., 2018; Tcha-Tokey et al., 2018). With these characteristics, VR can increase user satisfaction and offer unique experiences compared to traditional computer interfaces (Shelstad et al., 2017).

The sense of presence in VR refers to the user's feeling of "being there" in a computer-generated virtual world environment (Martín-Gutiérrez, Mora, Añorbe-Díaz, & González-Marrero, 2017). It also refers to the feeling of immersion and experience in virtual environments (Yang et al., 2021). Through the sense of presence, VR has the capability to enhance spatial perception and design activities, providing users with a novel way to engage with digital content (Kim & Hyun, 2022). The ability of VR to evoke awe and presence in experimental settings underscores its potential for creating impactful experiences (Chirico et al., 2018). Moreover, VR has been investigated for its effects on reducing psychological stress and other applications such as in language learning (Yang et al., 2021; Pinto et al., 2019).

Fundamentally, VR can be classified into two main types namely geometry-based VR (GBVR) and image-based VR (IBVR). Technically, GBVR is capable of producing a high level of presence as it provides high interactivity (Casati & Pasquinelli, 2005; Luciani, Urma, Marlière, & Chevrier, 2004). However, for GBVR, the process to produce a realistic virtual environment is time-consuming (Casati & Pasquinelli, 2005). For that reason, IBVR is considered an alternative to GBVR because it takes less time to develop.

Basically, IBVR is described as a virtual environment developed with a number of photographs stitched together (Xiao, 2000) with certain tools and techniques. Although no geometric programming is involved, IBVR is able to produce a quality realistic virtual environment (Chen, 1995) using low computer processing performance. Although there are limitations of its interaction functions compared to GBVR applications, it is important to ensure that the user can feel the presence in the IBVR environment. The sense of presence is one of the factors that influence the potential of VR to be applied in various fields including health, medicine, science, education, cultural heritage, manufacturing and entertainment (Martín-Gutiérrez, Mora, Añorbe-Díaz, & González-Marrero, 2017). In the field of medicine and health, VR has been utilized for treating psychological disorders with virtual reality exposure therapy, offering a secure and controlled setting at a reduced expense. It is the concept of presence that has contributed to the effectiveness of VR for therapeutic purposes.

In the case of this study, the subject for the VR application is the problem of stress which is also considered as a type of psychological disorder. Stress originates from the perception of an expectation towards the environment and that expectation needs to be adapted to efforts and actions (Lebel, 2013). During times of stress, individuals frequently encounter adverse emotions like depression, tension, and anxiety, which can trigger physical reactions that harm their well-being. These reactions can ultimately diminish performance and work quality, subsequently affecting the productivity of an organization or institution (Mawanza, 2017; Subha & Shakil, 2009). Therefore, properly managing stress is crucial in preventing the development of psychological and behavioural disorders.

One of the traditional psychotherapy approaches to managing stress is by using imagery or imaginary therapy techniques (Latif, Ismail, & Zainudin, 2015; Robinson, Segal, Segal, & Smith, 2019), which is also known as Guided Imagery Therapy (GIT). In this type of therapy, client is instructed and guided by a therapist to imagine a relaxing scene or experience (Overholser, 1991). However, there are instances where clients find it difficult to imagine scenarios or images that are depicted, as a result of their mentally influencing life experiences. This situation on the other hand can cause them to feel uncomfortable (Owen, 2010). At times, clients may misunderstand the therapist's guidance and as a result, they may create negative scenarios in their minds (Nadia & Dayang, 2018). Therefore, rather than relying on a client's imagination and memory, IBVR offers an alternative approach by providing images that promote relaxation and positive emotions. The calm virtual environment in IBVR can help to provide relaxation and assist users in managing stress.

Accordingly, this study proposes using IBVR for self-therapy as an alternative stress intervention method. Self-therapy is a psychotherapy approach carried out by a person on their own, without the intervention of an actual therapist (King, Orr, Poulsen, Giacomantonio, & Haden, 2017). The IBVR application offers a proactive approach to stress management, empowering individuals to take control of their mental well-being before requiring the aid of a professional. In this study, a hybrid design model for the development of self-therapy IBVR is proposed by integrating elements of spatial presence and GIT. In the next sub-topics, the motivation of the study is elaborated, followed by problem statements, research gaps, research questions and objectives, scope and significance of the study as well as the theoretical and research framework.

1.2 Research Motivation

The motivation of conducting this study was triggered by several factors that revolve around social and technological perspectives. The following sub-section discuss these factors in detail.

1.2.1 Current Mental Health Problems in Malaysia

In Malaysia, mental health problems has become one of the main issues among the society as the number of diseases associated with mental health has increased. According to the National Health and Morbidity Survey in 2017, 29% of Malaysians suffer from depression and anxiety disorders. This percentage is increased compared to 2011 with 12% (Institute for Public Health, 2018). Figure 1.1 illustrates the results of a survey that is concerned with the state of mental health among teenagers in Malaysia. The figure shows that there is actually a problem in mental health across the country.

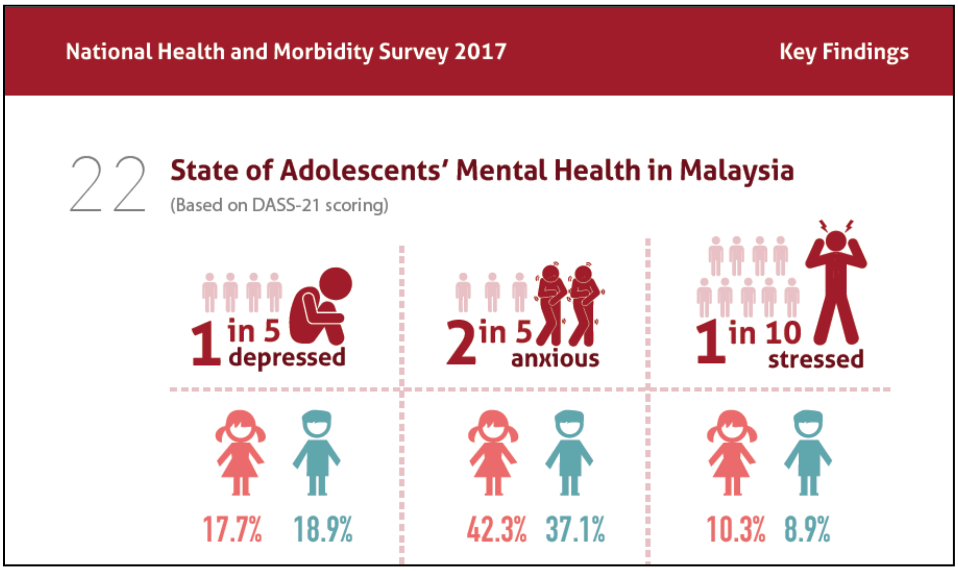


Figure 1.1. National Health and Morbidity Survey in 2017

A report by Star in 2018 also highlighted that by 2020 depression will become the main mental illness among Malaysians caused by work and family pressure which is expected to increase (The Star, 2018). While in 2022, Berita Harian Online reported that the statistics of individuals receiving support through the Psychosocial Support Service Helpline (MHPSS) which is an initiative under the National Mental Health Center of Excellence, Ministry of Health Malaysia (KKM) increased five (5) times for the year 2022 compared to 2020 (Sulaiman, 2022).

Therefore, it is imperative that measures are taken to mitigate the severity of mental health issues in Malaysia, as this could have a significant impact on the well-being and productivity of society. There have been several approaches taken by different parties to overcome this situation, which have subsequently yielded considerable results. Nevertheless, this study believes that the use of technology, especially VR can provide an alternative as part of an intervention approach to mental health problems. In the case of this study, it focuses on the problem of stress as it can be a major contributor to other mental illnesses such as depression, anxiety and others. Incorporating suitable VR elements and features can effectively promote a sense of calm, thereby assisting individuals in managing and conquering stress.

1.2.2 Government Plans and Initiatives

The Malaysian government has long prioritized the welfare of its people, particularly in terms of their physical and mental health. This objective is reflected in the Mid-Term Review of the Eleventh Malaysia Plan, which is a comprehensive strategy spanning the years 2018 to 2020 and is focused around six critical pillars as illustrated in Figure 1.2. These pillars are aimed at addressing the diverse needs of the Malaysian populace.

Figure 1.2. Six Pillars of the Mid-Term Review of Eleventh Malaysia Plan

According to the Mid-Term Review of the Eleventh Malaysia Plan report, Pillar II is concerning about the enhancement of inclusive development and wellbeing that also includes plans and strategies on enhancing the healthcare delivery system. Among others, the strategies also consist of action plans on mental health problems that is constructed to promote consciousness on mental health. The action plans cover six main areas in mental health, namely mental healthcare and services, cross sector collaboration, human resource development, mental health promotion within communities as well as research and surveillance (Minister of Economic Affairs, 2018).

The government continues to prioritize the mental health of its citizens by allocating a substantial amount of RM34.5 million in the 2023 budget towards establishing the

National Mental Health Centre of Excellence (NCEMH) and enhancing mental health and psychosocial support services (Ministry of Finance Malaysia, 2023). This demonstrates a heightened commitment of the government to addressing mental health issues with greater attention and resources. Thus, this study is trying to come out with a solution through the utilization of VR tool for the purpose of therapy that could be in line with the government initiatives on promoting mental health and providing preventive measures for the communities.

1.2.3 Advancement of Virtual Reality Technology in Mental Health

Through literature reviews, various works has been done in exploring the use of VR as a tool in treating mental health problems such as phobias, anxiety and depression (Liszio & Masuch, 2017; Geraets, Van Der Stouwe, Pot-Kolder, & Veling, 2021). In those application, VR has been used as an exposure therapy to help the patients in overcoming their mental problems in more controlled situations. Other than that, VR could also be used for relaxation purposes in stress situation (Eswaran, Veezhinathan, Balasubramanian, & Taneja, 2018; Latif et al., 2015; Nadia & Dayang, 2018; Pallavicini et al., 2016) through the calmness characteristics of the virtual environment presented in VR application (Dayang et al., 2011). In line with that, this research is trying to take advantage of the advancement of VR technology and application in the field of psychology or mental health, especially in the intervention of stress.

1.2.4 Summary of Research Motivation

Mental health problems associated with stress have been on the rise in Malaysia, alarming both the public and the government. Studies have consistently reported a surge in such cases every year, which has led the government to prioritize the implementation of measures that promote mental health awareness and improve the overall well-being of its people. This pressing issue and the recent advancements in virtual reality technology have prompted this study to be implemented, looking into the efficacy of utilizing VR as a therapeutic tool to tackle stress-related issues.

As mentioned earlier in this chapter, this study proposes the development of a hybridized model for IBVR in self-therapy that integrates spatial presence and GIT. Nevertheless, research on the utilization of IBVR in rehabilitation or therapies is still in its infancy compared to GBVR. Thus, apart from the exploration and analysis of existing literatures, a preliminary study is conducted to further investigate the capability and potential of IBVR to be used in therapy. The next section describes the aim, procedures and results of the preliminary study.

1.3 Preliminary Study

Through literatures and existing studies, it is found that VR technology has been successfully applied for therapeutic purposes. However, most studies use a highly interactive type of VR developed in the form of GBVR. Thus, a preliminary study is being conducted to determine the potential and practicality of IBVR as a stress-relieving mechanism, despite the fact that it has less interactive characteristics when compared to GBVR.

1.3.1 Methods

For conducting the preliminary study, an IBVR application was developed as a prototype for the purpose of obtaining users' reaction on IBVR. This application features a variety of panoramic views and natural sounds which have been seamlessly integrated, as well as other functions like menus, buttons and hotspots for users' interaction. The study took place in Universiti Utara Malaysia and was conducted upon a number of 50 students that comprised of undergraduate and postgraduate students, located at the laboratory and library area. Table 1.1 shows some details of the respondents involved in the preliminary study.

Table 1.1

Details of Respondents for Preliminary Study

Items	**Details**
Age	18 to 45
Number of Male Students	25
Number of Female Students	25
Number of Undergraduate Students	29
Number of Postgraduate Students	21

The study was carried out during the study week and selection of respondents were based on convenience sampling method. For postgraduate students, they were selected among those who were preparing for their viva sessions. Participants were provided with a laptop that had the IBVR application installed, along with a headphone and a mouse. Prior to using the IBVR application, the respondents were given some explanation about the application. Then, readings of their heartbeat pulse and blood pressure (BP) were recorded. After engaging with the IBVR application for a period of time, their BP and heartbeat pulse readings were taken gain to gauge the application's impact on these participants.

1.3.2 Findings

Researchers have found a connection between BP and heartbeat pulse and relaxation and stress. Santaella et al. (2006) discovered that relaxation and exercise has a positive effect on hypotension by reducing systolic and diastolic BP in a state of mental stress. Kep (2018) also stated that progressive relaxation can lower systolic and diastolic BP levels for patients with hypertension.

Also, there is a significant association between BP and stress which is proven through several studies showing that BP levels during stressful situations are higher than normal situations (Gasperin, Netuveli, Dias-da-Costa, & Pattussi, 2009; Mayo Clinic, 2022; Rau, 2006; Suter, Maire, Holtz, & Vetter, 1997). Table 1.2 shows the result of the respondents' BP and heartbeat pulse. Then Table 1.3 summarizes the results of systolic BP, diastolic BP and heartbeat pulse of the respondents during the preliminary study.

Table 1.2

Respondents' BP and Heartbeat Pulse (before and after interaction)

No	Student	Year	Age	Gender	Systolic bp before (mmHG)	Systolic bp after (mmHG)	Diastolic bp before (mmHG)	Diastolic bp after (mmHG)	Heartbeat pulse/min before	Heartbeat pulse/min after
1	Undergraduate	3	20	M	120	111	75	68	74	70
2	Postgraduate	PhD	44	M	122	140	70	68	64	60
3	Postgraduate	PhD	35	F	116	114	66	65	88	86
4	Undergraduate	2	21	M	124	102	79	70	62	59
5	Postgraduate	PhD	34	M	121	140	83	80	65	60
6	Postgraduate	PhD	36	F	107	106	60	60	80	79
7	Undergraduate	2	22	F	125	113	80	77	76	71
8	Undergraduate	2	21	M	122	120	78	71	66	62
9	Postgraduate	PhD	32	F	114	114	66	64	82	79
10	Postgraduate	PhD	39	M	124	140	83	80	70	65
11	Undergraduate	F	18	M	115	116	70	69	70	70
12	Undergraduate	3	21	F	124	102	79	70	62	59
13	Postgraduate	Master	36	M	120	107	65	61	82	80
14	Undergraduate	F	18	F	113	109	66	64	68	64
15	Postgraduate	PhD	37	M	121	102	65	59	59	55
16	Postgraduate	PhD	37	M	108	101	65	64	85	80
17	Postgraduate	PhD	37	F	100	100	70	70	83	80
18	Undergraduate	3	22	M	129	125	67	54	67	61
19	Undergraduate	F	18	F	115	116	70	69	70	70
20	Postgraduate	Master	35	M	124	140	80	80	60	60
21	Postgraduate	PhD	40	F	121	145	85	83	75	73
22	Undergraduate	F	18	F	120	104	60	50	61	59
23	Undergraduate	F	18	F	119	110	65	61	69	64
24	Postgraduate	Master	36	M	119	114	76	74	87	85
25	Postgraduate	PhD	36	M	117	100	70	60	80	78
26	Undergraduate	3	23	M	113	109	66	64	68	64

Table 1.2 continued

27	Undergraduate	2	22	F	124	122	76	68	79	70
28	Postgraduate	PhD	36	F	123	115	70	65	83	80
29	Undergraduate	F	18	F	113	109	66	64	68	64
30	Undergraduate	F	18	F	120	112	65	50	63	61
31	Postgraduate	Master	34	M	121	109	76	74	89	80
32	Undergraduate	F	18	F	115	116	70	69	70	70
33	Undergraduate	3	22	M	125	110	66	52	69	61
34	Undergraduate	3	22	F	122	109	78	71	70	65
35	Postgraduate	PhD	40	M	124	145	85	83	81	80
36	Undergraduate	2	21	F	122	120	78	71	66	62
37	Undergraduate	F	18	F	114	108	65	63	83	72
38	Undergraduate	2	21	F	128	101	72	64	58	44
39	Undergraduate	F	18	M	113	109	66	64	68	64
40	Undergraduate	2	22	F	129	125	67	54	67	61
41	Undergraduate		18	M	117	100	60	50	61	49
42	Undergraduate	2	20	F	121	108	67	56	66	54
43	Undergraduate	3	22	M	125	110	66	52	69	61
44	Undergraduate	3	22	M	122	109	78	71	70	65
45	Undergraduate	F	18	M	119	110	70	54	68	53
46	Undergraduate	F	18	M	114	106	70	69	64	52
47	Postgraduate	PhD	35	M	118	140	80	80	60	60
48	Postgraduate	PhD	45	F	100	100	60	60	80	78
49	Postgraduate	PhD	42	F	118	114	66	68	88	83
50	Postgraduate	PhD	39	F	110	109	76	74	85	80

Table 1.3

Respondents BP and Heartbeat Pulse after Using IBVR Application

Items	**Percentage of Reduction**
Systolic BP	74% (37 out of 50 respondents)
Diastolic BP	88% (44 out of 50 respondents)
Heartbeat Pulse	90% (45 out of 50 respondents)

Referring to Table 1.3, it shows that the level of BP and heartbeat pulse of the respondents decrease accordingly after using the IBVR application. Out of 50 students who involved in the preliminary study, 74% of them have a reduction in the systolic BP and 88% reduce their diastolic BP after interacting with the application. Meanwhile, 90 % of the respondents are experiencing a decrease in their heartbeat pulse.

After analysing the data, it can be concluded that utilizing the IBVR application, with its distinctive features, can prove to be advantageous for users' emotional well-being. By fostering a sense of relaxation, the application may effectively aid in alleviating stress levels. This substantiates the initial objective of utilizing IBVR for self-therapy, which was aimed at reducing stress. Nevertheless, the main focus of this study is on the spatial presence criteria of the IBVR that could evoke the sense of being physically present in the virtual environment. It is expected that the sense of spatial presence support the therapeutic functions of the IBVR that could create the relaxation and further decrease the stress. Hence, the next sub-section will describe on the problem background of this study which concentrates on the theoretical problems that lead to the generation of research questions and objectives.

1.4 Problem Background

In experiencing presence, the way how the users' mind can consider a virtual environment as if it were a real environment is crucial (Biocca, 2003; Wirth et al., 2007). It is one of the critical factors and requirements for any mediated environment such as VR. There are several different types of presence introduced in the literature which are sense of presence, telepresence, physical presence, spatial presence and social presence (Santarcangelo et al., 2010). Nonetheless, the one that is relevant to IBVR application in this study is the spatial presence which applies the cognitive theory (Nadia, 2017). It is related to the human mind which concerned with the spatial of display (Wirth et al., 2007) that describes on how the users' mind believe the virtual environment as a spatial environment, in which the users could feel that they are physically present in the environment.

For the purpose of this study, eight most prominent existing models of spatial presence are selected as reference and they are summarized in Table 1.4 (more elaboration in chapter two). These models and theories are considered as the basis for this study in identifying problems and gaps, as well as potential solutions. Referring to table 1.4, the models by Slater et al. (1996) and Nicovich (2005) were developed with the aims of creating spatial presence for highly interactive or immersive VR. This may be due to the fact that immersive VR has high interactivity, thus it can easily evoke spatial presence. However, this is not the case of this study as it focuses on creating spatial presence for IBVR, even though it has low interactivity.

Table 1.4

Summary of Spatial Presence Theory

Authors	Theories' Component	Description	Strengths	Weaknesses	Suitability to the Study
Steuer (1992)	Vividness	The richness of a mediated environment representation	Introduces the mapping between vividness and interactivity	The emphasis is more on mapping but less explanation on other elements that can produce spatial presence	The theory focuses more on human psychology elements to produce spatial presents, whereas this study is focusing more on media or application
	Interactivity	The users' participation in modifying the form and content of a mediated environment in real time			
	Mapping	The match between the machine input and output channels and the human			
Slater et al. (1996)	Mapping	The match between perception and representation system of the users with the sensory channels of the media environment	Introduces the mapping between equipment fidelity and user characteristics	The cause of this phenomenon is the interaction that uses the human organs optimally	The theory is more on Immersive VR whereas this study focuses on IBVR
	Egocentric	The match between the point of view of the user's self-representation and the virtual world (First-person view)			
	User Characteristics	The user's spatial presence subjective experience is structured by the user's representation system and mental model			

Table 1.4 continued.

Lombard & Ditton (1997)	Transportation	Attention of users, from the real environment to the synthetic environment	Most of the presence models are conceptualized from this theory	This theory does not clearly explain the direction of transportation, realism and immersion that can form spatial presence	The theory is not focusing on spatial presence as it combines presence and social presence
	Realism	User’s acceptance of the synthetic items			
	Immersion	User feels the naturalness of the synthetic environments			
Draper et al. (1998)	Attention	The user's sensory perception is directed from real environmental signals to stimuli mediated environment signals by attention sources	Introduces the attentional model	Lack of description of the spatial information that needs to be seen by the user in order to create spatial presence	The theory is not sufficient to maintain a spatial presence experience
Schubert et al. (1999)	Embodied cognition	A mental representation to describe actions or possible actions that can be performed in a virtual environment	Clear description of human psychology that can lead to spatial presence	No clear description of the features that can produce spatial presence	The theory is more towards human psychology which contrast with this research that focuses on media or applications.
Nicovich, (2005)	Realism	Fidelity of the environment	Clear explanation on the features that can create spatial presence	Only applied for high interactivity that focus on video games	The theory is more on application with high interactivity, whereas this study is focusing on IBVR that apply low interactivity.
	Interactivity	Degree of the interaction			
	Consistency	Consistency of the display			

Table 1.4 continued.

Wirth et al. (2007)	Two-Level-Model of Spatial Presence (Spatial Situation and Spatial Presence)	The creation of a sense of spatial presence is based on several perceptual and cognitive processes, in addition to user and media factors	The model is adaptable to all kind of media	Lack of information on how to map the user's senses and the mediated environment to evoke Spatial Presence	The model is suitable for IBVR as it is adaptable to all kind of media, but need additional elements for this study
Riva et al., (2011)	Interactivity	The action from the user is similar with the action in the real world	Introduces the mapping between perception and action	The mapping between perception and action is not explained in detail.	The model and its explanation is not clear, thus difficult to be applied to this study
Nadia, (2017)	Interactivity	Interaction and navigation	The model is specifically for IBVR and the features are elaborated accordingly	Less information on the specific items for each features in the model that can create Spatial Presence and it is not specifically tailored for self-therapy	The model is specific for creating spatial presence in IBVR, hence suitable with this study. However, it is not adequate for self-therapy based on GIT.
	Perceptual realism	Panoramic view, harmonious combination and story line			
	Calmness	Primary Egocentric Reference Frame (PERF)			

Meanwhile, Steuer (1992) and Schubert et al. (1999) created their spatial presence models by concentrating on the association of human psychology elements, which were put as the main factor for producing spatial presence among users. On the other hand, the aims and scope of this study is to identify the media factors that can help users to feel spatial presence when interacting with the application, instead of the human factors.

Other than that, Draper et al. (1998) has proposed attention as a key component of creating spatial presence, but has not specify on the information that needs to be processed to gain attention. It results in insufficient clue to evoke spatial presence. Besides that, the model by Wirth et al. (2007) and Riva et al. (2011) have shallow explanation on the elements in the models that can foster spatial presence. Therefore, these models or theories are not significantly appropriate to be the base of this study as they have small number of elements and inadequate elaboration.

However, the model that shows a certain degree of relevance to the current study is the spatial presence model by Wirth et al. (2007). Basically, this model was developed as a guide to create a spatial presence in any type of media that involves interaction between media and people. Wirth's model has attracted much attention from other researchers who have made appropriate improvements and applications. One of the studies that has applied the Wirth model was a study initiated by Nadia Diyana (2017), who has developed a spatial presence model for IBVR applications. Basically, Nadia has proposed a model for IBVR application development that integrates components and elements to generate a sense of spatial presence in an IBVR environment. This clearly shows that the model by Nadia is closely related to this study which proposes the integration of spatial presence in developing an IBVR for self-therapy. Therefore, the model of spatial presence for IBVR developed by Nadia is taken into account as the basis for the development of the hybrid model proposed in this study.

As mentioned earlier, the main objective of this study is to develop a hybrid model that integrates the spatial presence model and GIT technique for IBVR self-therapy application. Regarding GIT, the normal practice typically involve instruction from the therapist in guiding the patient to imagine being in a relaxing situation or scene. It can also be done by having someone to read a pre-prepared script or by using a pre-recorded narration that contains direction on the imagination. The images could be something common and simple that can help to turn off the stress responses which include walking along the beach with gentle ocean waves, being on the mountains or sitting by the river. The relaxation experience can be enhanced by increasing the sensory information in the imagination. The more senses involve in the imagery, the more feeling of being really there in the imagination will be experienced. It can be in a form of a detailed descriptions of the scene, which integrate the senses like visuals, sounds, smells and feels (Prabu & Subhash, 2015). This is conceptually similar to spatial presence in which user is expected to feel of being located in the virtual environment.

1.5 Problem Statement

Accordingly, in order to develop an IBVR tool for self-therapy purposes by applying GIT technique, the application should apply the characteristics of the technique that requires a detailed description of the scene, specifically on the visuals and sounds, with the help of a guide or narration using pre-recorded voice (Prabu & Subhash, 2015). This is to ensure that users can feel like really being in the environment (spatial presence), hence giving the relaxation impression and turning off the stress response.

While, the spatial presence model for IBVR created by Nadia Diyana (2017) has suggested three main components to create a sense of spatial presence for IBVR application namely interactivity, perceptual realism and calmness. However, the model does not provide specific details of the characteristics of each of the proposed components. Instead, it is a general model for the production of spatial presence in IBVR applications. For that reason, in order to implement a design model for IBVR in self-therapy using the spatial presence and GIT technique, an extended model with more detailed elements and components is necessary.

1.6 Research Gap

In dealing with stress, GIT has traditionally been applied as one of the treatments or approaches carried out by therapists to overcome psychological disorders including stress. But not everyone is able to have a one-on-one meeting with a therapist for a number of reasons. So, this study suggests a different approach to manage stress that is considered as a preventive measure by proposing the application of IBVR for self-therapy based on the GIT technique. With this method, people can do self-intervention to reduce stress without having to see a therapist directly. However, the success and effectiveness of the IBVR application for this purpose is believed to be partially determined by the spatial presence element inherent in the application.

At present, spatial presence and GIT are two distinct concepts that have been used separately in specific situations. However, this research strives to integrate both concepts in a comprehensive and inclusive environment. The ultimate goal is to combine the spatial presence model and the GIT technique to enhance IBVR for self-therapy. By doing so, the study aims to provide a more effective and personalized self-therapy experience.

1.7 Proposed Solution

Based on the statement of problems and gaps that have been stated, this study proposes a hybrid model for the design and development of IBVR in self-therapy. This model consists of elements in the theory of spatial presence, combined with features in GIT therapy techniques to develop IBVR applications aimed at reducing stress. First, the concepts of VR therapy, spatial presence and GIT need to be explored to identify the relevant components and elements for the construction of the proposed hybrid model. Then the model should be evaluated through certain methods to verify the appropriateness of the proposed components and the effectiveness of the IBVR self-therapy tool. This model is expected to benefit application developers in designing and developing effective IBVR tools for therapeutic purposes.

1.8 Research Questions

Therefore, this leads to the following research questions that need to be considered in implementing the study:

i) What are the appropriate components to be integrated into the hybridized model of spatial presence and GIT technique for IBVR in self-therapy?

ii) How to construct the hybridized model of spatial presence and GIT technique for IBVR in self-therapy?

iii) How to validate the hybridized model of spatial presence and GIT technique for IBVR in self-therapy?

1.9 Research Objectives

This study aims to propose a novel hybrid model for the development of an IBVR app that employs spatial presence and GIT technique, which can be effectively used for self-therapy. Based on the research questions stated above, several objectives are outlined below as the basis of implementation to achieve the main goals of this study:

i) To determine the appropriate components in the hybridized model of spatial presence and GIT technique for IBVR in self-therapy.

ii) To construct the hybridized model of spatial presence and GIT technique for IBVR in self-therapy.

iii) To develop a prototype based on the hybridized model of spatial presence and GIT technique for IBVR in self-therapy for evaluation purposes.

iv) To evaluate the hybridized model of spatial presence and GIT technique for IBVR in self-therapy, in terms of spatial presence, user experience and its effectiveness through user testing.

1.10 Research Scope

In particular, the implementation of this study is limited to a specific scope that has been set to ensure that the objectives of the study can be achieved within the time frame and geographical constraints. The following points explain the scope of the study as illustrated in Figure 1.2.

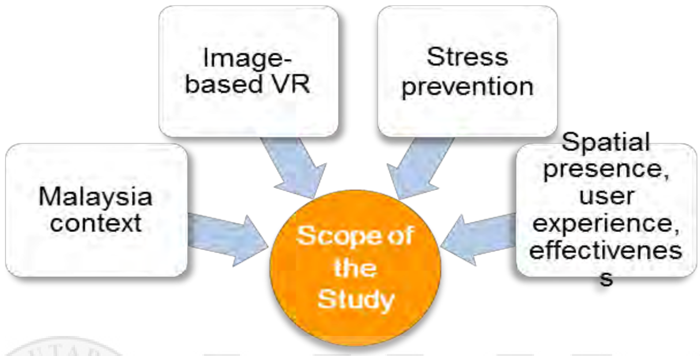


Figure 1.3 Scope of the Study

i) This study will be conducted in the Malaysian context. This reflects the selection of respondents and places involved, which will be located in Malaysia.

ii) The prototype of the proposed model will be developed based on the following criteria:

- Generally, there are two types of VR namely Geometry-based VR (GBVR) and Image-based VR (IBVR). For this study, IBVR will be the preferred type of VR as the development is less complicated and low cost.
- The evaluation of the prototype will only focus on the spatial presence characteristics, user experience and effectiveness.

- The application of IBVR will be focusing on stress prevention, rather than other mental health problems like depression, anxiety and phobia.

1.11 Significance of the Research

The aim of this study is to develop a model for IBVR self-therapy tool development that concentrates on the theory of spatial presence as the foundation, which incorporates the GIT approach to produce a self-therapy tool for the use of reducing stress among the society. The results of the study will provide significant benefits to many parties in various ways. The following sub-topics discuss on the significance of the study.

1.11.1 Human Mental Wellbeing

As mentioned previously, wellbeing of the people has been one of the priority of the government as it has become one of the main components or pillars in the Eleventh Malaysia Plan for the year of 2018 until 2020. Among others, the government's plan for inclusive development and wellbeing also includes strategies to overcome mental health. The 2023 budget has also indicated the government commitment in addressing and uplifting the mental health issues by a large allocation. Therefore, this study is in line with the government's vision and initiative as it could provide an alternative approach in overcoming the mental health problems, especially those related to stress. This subsequently promotes a healthy lifestyle for the wellbeing of the society and humanity in general.

1.11.2 Human Productivity

According to Dean (as cited in Mawanza, 2017), illnesses related to stress are the most significant factor for low productivity levels in organisations. Therefore, efforts has to be made in order to manage the stress so that it will not affect the human performance and productivity. Managing stress can be done in many ways either clinically or individually using the methods that has been introduced in the psychological approaches. However, this study is proposing an alternative through the development of a model that can be used by developers to develop a technologically based approach for the purpose of stress intervention. The application could be one of the way to reduce the stress level hence increasing human productivity.

1.11.3 Technology-based Stress Intervention

In addition to existing traditional methods, this study proposes a technology-based stress intervention method with the use of IBVR application. This method can help people to reduce the level of stress they experience on a daily basis by experiencing a relaxing environment in the IBVR application. This is a measure to prevent the stressful situation from becoming more serious. This can also be one of the support methods in the government's measures to deal with the problem of stress among the people. Also, through this study, a hybrid model for self-therapy IBVR tool is developed that combines spatial presence and GIT components. This hybrid model can be a guide for application designers and developers to produce IBVR applications that are specific to be used as an alternative solution in relieving stress.

1.12 Research and Theoretical Framework

This study was conducted based on the framework as illustrated in figure 1.3. It displays the activities, concepts and theories involved in the implementation of this study. It provides guidance and answers on what and how to do certain activities in each phase of the study. It also shows the theories and concepts that need to be explained as a basis to achieve the objectives of the study.

In the first phase, research problem and scope are identified through analysis of literature in the area of virtual reality, spatial presence, guided imagery therapy and self-therapy. Besides that, a preliminary study is conducted to look on the applicability of virtual reality technology as the intervention measure to reduce stress. In the second phase, content analysis and comparative analysis is carried out on existing models that has been selected. The purpose of these analysis is to discover the components and elements of the proposed design model for IBVR self-therapy, prior to expert consultation for verification. Then, in the third phase, the hybrid model of spatial presence model and GIT for IBVR in self-therapy is designed and developed by integrating all the outcome of analysis from the previous phase. Then the model is validated using expert review method before it is applied in the development of a prototype. Later in the fourth phase, the developed prototype is utilized for evaluation by conducting a user experience testing using the instruments identified earlier during the literature analysis. Finally in the fifth phase, results from the evaluation are analysed and concluded to unsure that it is in line with the research questions and objectives, before completing the final report or thesis and generating publications.

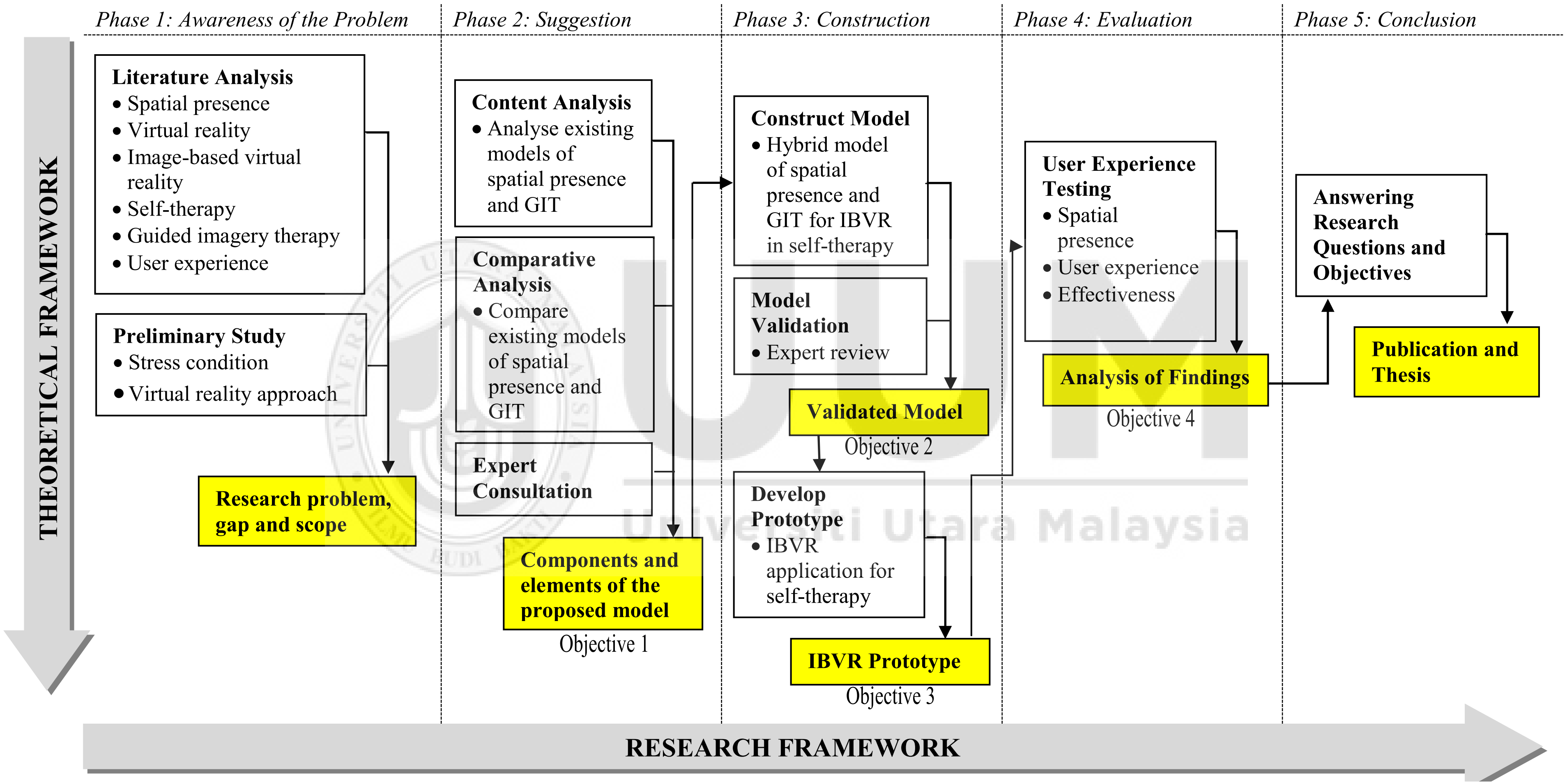


Figure 1.4. Research and Theoretical Framework

1.13 Operational Definition and Terminologies

The following definitions describe on the common operational terminologies used throughout this proposal to give a clear understanding and focus of the study.

a) Virtual Reality

Virtual reality is referring to the artificial environment application that is developed using software or computer technology and it is accepted and believed as a real environment by the user through certain characteristics and interactivity elements.

b) Image-Based Virtual Reality

Image-based virtual reality refers to a type of virtual reality application that is developed with the combination of selected images that are stitched together to form a 360 degrees view of virtual environment in which the user can interact with.

c) Spatial Presence

Spatial presence is a type of sense that can be experienced by the user when interacting with virtual reality application. It refers to user's perception of the virtual environment which makes it appears that he/she is being there in the environment that is distinct from the real environment in the physical world.

d) Self-therapy

Self-therapy is a concept that refers to the approach of treating one's own emotional or psychological problems without the intervention of therapist or psychologist. In this study, the technique for self-therapy is focusing on the application of virtual reality technology.

e) Guided Imagery Therapy

Guided imagery therapy is a cognitive-behavioural technique in stress management that is used to help individuals to learn and control their behaviours by learning to relax through imagination using guided imagery where they are guided by an instructor. It can also be done using audio recordings or using the inner voice and imagination.

1.14 Thesis Structure

This research proposal comprises three main parts, separated in three different chapters that elaborate the sources and activities involve in this study. The overview of the content in each of the chapters are as follows.

Chapter 1: Introduction

The first chapter starts with the background and motivation that led to the implementation of the study. It also gives an explanation on the preliminary study to formulate and strengthen the research problem. It is proceeded with the clarification of the problem statement, research gap, questions and objectives. Then, the proposed solution is given, together with the scope of the study to make clear of the extent to which this study is conducted. It continues with the research significance to show the importance of this study to the real world. This chapter concludes with a review of the research and theoretical framework as well as an explanation of the operation terminology to aid in the understanding of this study.

Chapter 2: Literature Review

The second chapter provides the review of literatures on the main concepts, theories and previous works related to this study, which include reviews on user experience, virtual reality, image-based virtual reality, spatial presence, guided imagery therapy and self-therapy. Among others, it discusses and analyses on the existing spatial presence models and theories that are fundamental to the development of the proposed model. All reviews are followed with explanation on its' implication to this study.

Chapter 3: Research Methodology

The third chapter explicates on the methodology used throughout this study in achieving the objectives as defined earlier. The activities in the methodology are divided into five main phases and described comprehensively in this chapter. The description of the activities are also aligned with each of the research objectives.

Chapter 4: Model Construction

Specifically, this chapter reports on the model development process that includes the model design and validation. It also encompasses the description of activities to extract relevant elements and components for the model development, i.e. comparative analysis and content analysis. As a result, the proposed model was introduced and followed by a discussion on experts' reviews in the model validation process where a validated design model for IBVR self-therapy is presented. This result is the direct outcome of achieving the first and second objectives of the study.

Chapter 5: Prototype Development

This chapter outlines the process of creating a prototype for the IBVR self-therapy application. The proposed design model serves as a basis for the elements and components included in the development process. The development process is divided into three main stages: pre-development, development, and post-development. This chapter explains these stages by demonstrating how the prototype aligns with the design model. The prototype's construction demonstrates successful achievement of the study's third objective.

Chapter 6: User Evaluation

In this chapter, the main focus is on the user evaluation conducted as one of the components of this study. The goal of this evaluation is to evaluate the proposed design model through user testing, with particular emphasis on spatial presence, user experience and effectiveness. To provide a comprehensive analysis of the findings, this chapter will delve into the evaluation methods, including details on the demographic background of the participants, the experimental design, and the evaluation instruments used. Overall, the results of the user evaluation have successfully met the four objectives of this study.

Chapter 7: Conclusion

This final chapter concludes the study by taking into account the research objectives and how the research questions were being solved throughout the accomplishment of the study. Also, it explains on the contribution of the study to the body of knowledge as well as the limitations and recommendations for future works.

1.15 Summary

Virtual reality technology is capable of providing alternative solution for stress condition. This study is trying to look on the capability of IBVR for the intervention of stress, by focusing on the spatial presence element. Through literature analysis, preliminary study and other specific methods, a hybrid spatial presence model for IBVR in self-therapy is proposed based on the motivation, problem, objectives, scope and significance of the study and implemented according to a predefined set of activities or framework. The next chapter elaborates more on the literature analysis that underlies the identification of research problems, gap and objectives.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter provides a description and review of the existing literature related to this study which aims to build a theoretical framework as a basis for conducting the study. Concerning the first objective of this study, a review of the existing literature was performed to determine the most appropriate components to be included in the development of the proposed hybrid model of spatial presence and GIT for IBVR in self-therapy. This literature review covers key theories, models, and applications in related fields that include spatial presence, virtual reality (VR), image-based VR (IBVR), self-therapy, guided imagery therapy (GIT), and user experience (UX). These are further elaborated in the following sup-topics.

2.2 Spatial Presence (SP)

The original concept of presence by Minski 1980 has probably become more complex and multi-faceted, following research on presence that is maturing over time. This has inevitably caused a differentiation of concept of presence into several sub-concepts. Lee (2004) introduces presence as physical, social, and self- presence, while other scholars differentiates presence as Spatial Presence, Social Presence, and Co-Presence (IJsselsteijn, Ridder, Freeman, & Avons, 2000). However, the concept of spatial presence is more acceptable than the others and it can be seen from the attention given by most researchers. A possible factor is its close connection with the basis introduced by Minsky (1980) who considers that if the user feels like he is at the place of operation, then machine-mediated tele-operation can work effectively.

2.2.1 Spatial Presence Definition

Wirth et al. (2007) defined spatial presence as "a feeling of being bodily present in a mediated environment (self-location) and a feeling of being able to act in synthetic environment (possible action)". Self-location refers to the media user's experience in the displayed environment and how they personally feel physically present in that environment (Ravaja et al., 2005). Meanwhile, possible action refers to user response that is not dependent on external information (media-based) such as visual, audio, tactile or proprioceptive impulses and feedbacks (Won, Haans, Ijsselsteijn, & Bailenson, 2014).

Among others, spatial presence is also defined as 'a sense of being there' that occurs when a person's insight is unable to distinctly recognize the function of technology which makes the person feels like being in a physical environment that is different from the actual environment in the physical world (International Society for Presence Research, 2000). In other words, the level of presence experienced by the users does not totally depend on high technology equipment, but instead it is very much connected with the users' perceptions. Thus, spatial presence can also be described as a person's perception or illusion that he is placed in an environment conveyed by some kind of media technology (Biocca, 1997; Ijsselsteijn & Riva, 2003).

In the next sub-section, eight most prominent spatial presence theories and models are presented in order to elaborate the foundation that underlies the determination of theories and model as the basis of this study.

2.2.2 Spatial Presence Theories

There are several theories of spatial presence elaborated in this section, with reference to existing literature. These theories have some similarities in terms of the terms used to represent the elements that can generate spatial presence. However, the difference is in terms of definitions given by the researchers for terms including transportation, realism, immersion, interactivity and consistency. For example, Nicovich (2005) defines interactivity as the level of interaction. Meanwhile Riva, Waterworth, & Mantovani (2011) define it as actions from users that are similar to actions in the real world. Steuer (1992) defines it as the human ability to map between actions for applications and actions performed in the real world. While Schubert (2009) defines it as perception, memory and action. The next sub-topic provides an explanation of each selected theory, especially the theory that is taken as the basis for the development of the hybrid model proposed in this study.

2.2.2.1 Steuer (1992)

Steuer (1992) suggested that spatial presence is primarily developed based on two properties of a media system, namely vividness and interactivity. Vividness is referred to the richness of representation for a mediated environment as denoted by its formal characteristics. It is related to the communication between the mediated environment and the user. Generally, the more different senses integrated in a media system (visual, auditory, haptic senses and others), the higher the level of vividness obtained.

Meanwhile, the other factor that is considered as the determinants for creating spatial presence proposed by Steuer (1992) is interactivity. It is described as the level of engagement of users in the modification of the content and form of a mediated environment in real time. Most importantly, the degree of interactivity of media systems varies in terms of the system's ability to naturally map user input. Actually, the mapping connects both of the proposed determinants in this model which are vividness and interactivity. It suggests that media systems should respond to user input naturally in terms of timing and sensory stimulation.

2.2.2.2 Slater et al. (1996)

Slater et al. (1996) also emphasized the significance of mapping in creating the spatial presence. They suggested that the mapping in spatial presence involves a state of consciousness or feeling like being in a virtual environment psychologically, with equivalent modes of behaviour. This psychological state is the starting point for users to be more inclined to the virtual environment and to interpret the environment as immersive. This creates a mapping between user perceptions and the environment that is displayed on the screen. However, the mapping is depend on the equipment fidelity as well as user background.

Other than the media factors, Slater and colleagues also consider user characteristics as crucial part in the generation of the experience of spatial presence. They claim that users' mental models and representation systems (i.e. visual, auditory, and kinaesthetic) will affect their subjective experience of spatial presence. For instance, users with representation system that predominantly auditory will essentially interpret spatiality through auditory spatial cues produced by the environment, while users with more on visual representation system will be depending on the graphical details available in the virtual environment.

2.2.2.3 Lombard and Ditton (1997)

The theory by Lombard and Ditton (1997) conceptualizes most of other spatial presence theories. Their theory is composed of six concept of presence which are transportation, realism, immersion, social richness, medium as social actor and social actor within a medium. The theory was originally used for Temple Presence Inventory (TPI) questionnaire (Lombard, Ditton, & Weinstein, 2009).

The concept of transportation represent the movement of the user's focus from the real environment to the virtual environment. It also exemplifies the importance of the user ignorance on the real environment, which then leads to the "suspension of disbelief" that the user is in place other than he or she is really located. This concept needs user to experience the process of being in the virtual environment together with the elements in the virtual environment.

While the concept of realism describes the user's acceptance of synthetic objects, events and people as real entities. This concept ensures that a person experiences presence based on realism factors such as the events in the movie plot, in which the user's mind considered those events are real during the time he/she is watching the movie, even though the events are not real.

Then the concept of immersion is defined as the experience of the user after feeling comfortable with the virtual reality equipment or when the user is engaged with the virtual environment. The concept of immersion of the virtual reality equipment is used to provoke the user's presence experience. It produces the human sensors and influences the human minds to feel the naturalness of the synthetic environment (Diemer et al., 2015). This is how the immersion can 'involve, absorb, engage and engross' the user to experience presence.

2.2.2.4 Draper et al. (1998)

Draper et al. (1998) suggested an attentional model of spatial presence that defines attention as a key component of creating spatial presence as it can transform all human sensors to focus on the mediated environment rather than the real environment. The more attentional resources that a user devotes to, the greater the identification with the computer-mediated environment hence stronger sense of telepresence. However, this model has not specify the input that the user needs to processed to gain attention, but only emphasizing on the attention element that is sufficient to evoke spatial presence. As a whole, attention seems to be an important element for creating spatial presence experience as claimed by Draper et al. (1998), but it seems that attention alone is not sufficient to interpret the "feeling of being there" for inducing spatial presence.

2.2.2.5 Schubert et al. (1999)

According to Schubert et al. (1999), spatial presence is conceptualized as embodied cognition that refers to the mental representation of actions or possible actions in the virtual environment. Their concept of spatial presence involve user's thinking of action that is controlled by the mind when interacting with virtual environment.

Glenberg (1997) mentioned that users need to use the memory of the real world experience when using the virtual reality applications. This memory allows users to use them with their creative improvisation that needs to be done in the virtual environment. Action based on the memory can be caused by the object in the virtual environment. For instance, the user will open the door if he/she is comfortable with the situation but will not open the door if he/she is scared of what will be behind it. This action or stimulus is caused by user's interpretation on the virtual environment which defines as mental model. In other words, mental models are based on individual perceptions and memory model that has been incorporated into the user's mind. Consequently, users will be able to respond based on objects in the virtual environment, thus produce the spatial presence experience.

2.2.2.6 Nicovich (2005)

The author introduced three main parts of the theory to induce sense of presence among users. The first part is environmental fidelity of the applications that describes on the goodness of the virtual environment presentation. Realism is considered as the contributor to the presentation in order to induce user's experience on spatial presence. The representation of the displayed environment is characterised by vividness and quality, besides sensory and information factors.

The second part is degree of interaction that influences on the goodness of user interaction with the virtual environment. This concept is important in the process of designing and preparing the most suitable strategy for the interaction of the user with the presentation. Correspondingly, the specification of good interactivity includes the degree of representation, interaction, control and modifiability.

The third part of the theory is consistency of the display that concentrates on all sensory input in order to make sure that the presentation remains the same. The interaction between user and the presentation need to be existed from the start until the end. For instance, if the user makes any changes to an object's location, then the changes should also apply accordingly throughout the environment. If the changes are discontinued at some point, then the environment would seems to be not real to the user.

2.2.2.7 Wirth et al., (2007)

Wirth et al. (2007) developed a spatial presence model with two level that provides an illustration and explanation on the generation of Spatial Presence. They claim that the model is not only adaptable for virtual reality, but it can also be applied to all kind of media including those with low immersion like films and books. It consists of processes for perceptual and cognitive, as well as users and media factors, as shown in Figure 2.1.

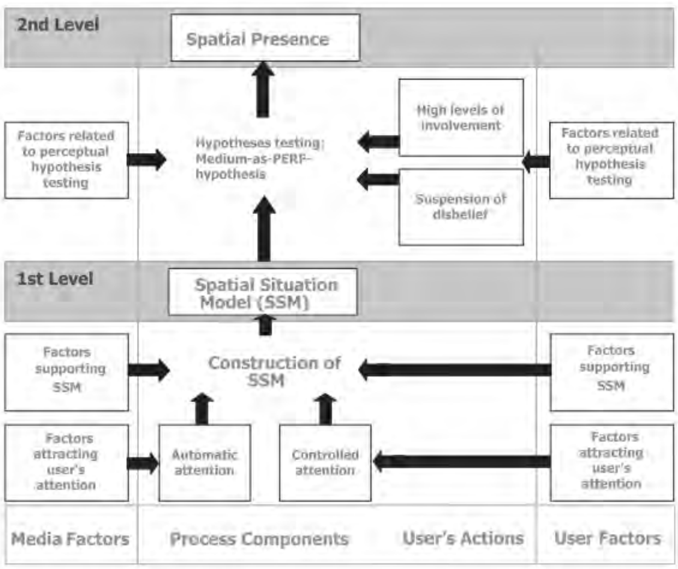


Figure 2.1. Spatial Presence Theoretical Model by Wirth et al. (2007)

Basically, the two-level-model of Wirth et al. (2007) proposed two processes in the production of spatial presence. The first level is the steps of constructing a spatial situational model (SSM), before proceeding the second level which is the spatial presence construction. In the first level, mental model of users is established as the pre-condition for the sensation of spatial situational model. Once this level is accomplished, the users will define their primary egocentric reference frame (PERF) in the second level to be spatially present in a synthetic environment. At this stage, user's mental model is developed based on error-free consistent and evident synthetic environment. Eventually, the spatial presence theoretical model is proposed with the dimensionality and characteristics determinants of spatial presence.

2.2.2.8 Riva et al. (2011)

This model is developed with the aim to induce presence in a mediated environment at its maximal. In this model, spatial presence experience is allocated as proto-presence and determined by various form of a medium. This model is about the incorporation between perception and action that involves the identification of the user's specific purpose. If a user can carry out action that is based on his/her perception, then presence will develop in his/her mind. Instead, if the user fail to recognize the specific purpose which support his/her action, then the level of presence will decrease. The way the users perform their action in the mediated environment should be similar with the way they perform their action in the real world. Also, the model also suggests that in order to produce spatial presence, it has to be supported with specific tools to mediate users' activity in the mediated environment.

2.2.2.9 Summary on Spatial Presence Theories

Lombard & Ditton (1997) spatial presence theory is not specifically focus on spatial presence but this theory is for presence and social presence. Thus this theory is improvised by the spatial presence researchers to produce spatial presence theory. The theory of spatial presence, originally proposed by Nicovich in 2005, is not applicable to the current research study. This is because the IBVR application used in this study has low interactivity, which makes the theory irrelevant. The spatial presence theory from Riva et al. (2011) focus on the application's factors, but there is lack of detailed description about the relationship or directions among the variables. Meanwhile, the spatial presence theories by Draper et al. (1998), Steuer (1992), Slater et al. (1996), and Schubert et al. (1999) are more concerned with human psychology, which is different from this research that focuses only on the application factors that can produce spatial presence.

Meanwhile, the theoretical model of spatial presence from Wirth et al., (2007) claimed that the role media and human factors are crucial in creating spatial presence experience. This model also explains in detail about the process involving the direction and parts on the variables. It clearly presented the directions for the user in order to experience spatial presence. Additionally, this theoretical model describes about the relationships and flow among variables and the parts between media factors and human factors, which can produce and enhance user's experience of spatial presence. It can also be applied to all kind of media or low immersive media. As a result, the spatial presence theoretical model from Wirth et al. (2007) is considered as the most suitable model to be adapted in the development of a hybrid design model for IBVR in self-therapy.

2.2.3 Related Works on Wirth Spatial Presence Theory

As mention in prior section, the theoretical model of spatial presence from Wirth et al., (2007) is suited to be adapted in this study, for constructing the spatial presence model for IBVR. Accordingly, this section provides some reviews on existing works that apply spatial presence theory from (Wirth et al., 2003) which was then presented in a model by Wirth et al. (2007). Since the introduction of the theory in 2003, it has been continuously enhanced and validated by other researchers until the year of 2017, as presented in Table 2.1.

According to the table, the first research that applies this theory was carried out by Vorderer et al. (2004). They carry out a study on this spatial presence theory using movies and virtual environments. They found that once the user experiences attention allocation (AA), SSM will also be adapted directly. The distinction between Vorderer et al. (2004) studies and Wirth et al. (2003) lies in the features that generated the SSM. Wirth et al. (2003) stated that the attributes to enhance user's SSM include the factors that attract attention and support SSM. Among others, it also include automatic and controlled attention, as well as human factors. Moreover, Vorderer et al. (2004) claimed that there is no need for PERF-hypothesis as mediator between spatial situational model and spatial presence. However, PERF-hypothesis is important as the creator from spatial situational model to produce spatial presence as mentioned by Wirth et al. (2003).

Then, Wirth et al. (2007) presented a diagram that connects to the spatial presence theory from Wirth et al. (2003). They highlight about the feeling of being in the virtual environment after going through the PERF level (Wirth et al., 2007). They also mentioned that unconscious spatial cognition is the cause for spatial presence and that the user reacts to the probable actions in the virtual environment (Schubert, 2009). The authors describe spatial presence as the feeling of being not only in virtual environments or mediated real (remote) environments, but also in real environments (Schubert, 2009).

Table 2.1

Related Works on Selected Spatial Presence Theory

Author	**Contribution**	**Theory**
Wirth et al., (2003)	Theory introduction	Mental model with 2 formation
Vorderer et al., (2004)	Theory confirmation	Exclude PERF in the model
Wirth et al., (2007)	Theoretical Model	Illustrated diagram
Sacau et al., (2008)	Theory enhancement	Propose individual factors
Wu, (2011)	Theory confirmation	Spatial situational Model
Lukowska, (2011)	Theory confirmation	Formation on spatial presence
Hofer et al., (2012)	Theory confirmation	Validating users factors
Wirth et al., (2012)	Theory enhancement	Proposed Emotion
Hartman et al., (2015)	Theory confirmation	2 factors in spatial presence
Nadia (2017)	Theory enhancement	Proposed model for IBVR

Besides, Sacau et al. (2008) also suggested a few other factors that can be used to measure spatial presence experience of the user. Firstly, the authors proposed two individual factors that can induce user's SSM which are domain specific interest and spatial visual imagery. Secondly, they also proposed absorption as the other individual factor that can induce user's spatial presence experience. Apart from that, the authors also emphasised on PERF as a condition that can produce spatial presence experience.

Besides investigating human factor, Wu (2011) had investigated the media factor and four factors that could evoke user's spatial situational model. The four factors are direct real, direct virtual, indirect real and indirect virtual. The result shows that these factors are related to spatial situational model. In media factor part, personal experience, attitude, gaming skill and congruence were tested. However, user gaming skill and congruence user interface can erect and induce user's spatial situational model. A study involving the features of the application that can create SSM is only from Wu (2011). From this research, it shows that the congruence of user interface is required in producing SSM. This criterion is not only involved items in the user interface but also the user's convenience is also required to generate SSM.

Lukowska (2011) conducted a study about the production of spatial presence from physical environment to the environment of the virtual world. Fundamentally, the author indicated that attention to VR application makes a user feel the presence. However, auditory signal in the physical environment will distract the user's feels in which the attention moves from the virtual environment to physical environment. But if the user ignores the auditory signal, then the attention will shift back to virtual environment. This model presented two main elements; absorption level and the efficacy of shifting. Absorption level refers to the impact of affecting the threshold level of perception on a detection process. While efficacy of shifting refers the influence of the process in mediated environment to feel the presence.

Wirth et al. (2012) then proceed with another enhancement of the model of Wirth et al. (2007). The authors proposed the factors of emotional involvement and trait absorption in enhancing spatial presence theoretical model. They stated that these factors produce a formation process in developing presence experience of the user. Nonetheless, considering and applying these factors in the theoretical model of spatial presence needs further investigation.

Besides enhancement of the theory, Hofer et al, (2012) conducted a study to validate the model by using structural equation modelling, where some items of the variable are accepted and some are discarded. As part of the study, an addition to the user experience factors of spatial presence is also proposed. These factors are the emotional involvement and absorption trait which they claimed to be capable of producing the users' spatial presence experience. These addition were also validated and proven to be an important role in creating spatial presence. This validation has also indicated and supported the concept in Wirth et al. (2007) theoretical model which consist of two parts, spatial situational model and spatial presence.

Other than that, spatial presence theory by Wirth et al (2003) is continued by Hartmann et.al, (2016) by developing a new spatial presence questionnaire based on this theory. The questionnaire is named as Spatial Presence Experience Scale (SPES) and can be used in a variety of media. The latest implementation of Wirth spatial presence theory is done by Nadia (2017) who managed to develop a model of spatial presence for IBVR as in Figure 2.2. The model has only focused on the second level (spatial presence) of the spatial presence theoretical model from Wirth et al, (2003) which adapts only two parts which are media factors and process component. In particular, the model consists of five variables which are spatial situational, interactivity, perceptual realism, calmness and spatial presence.

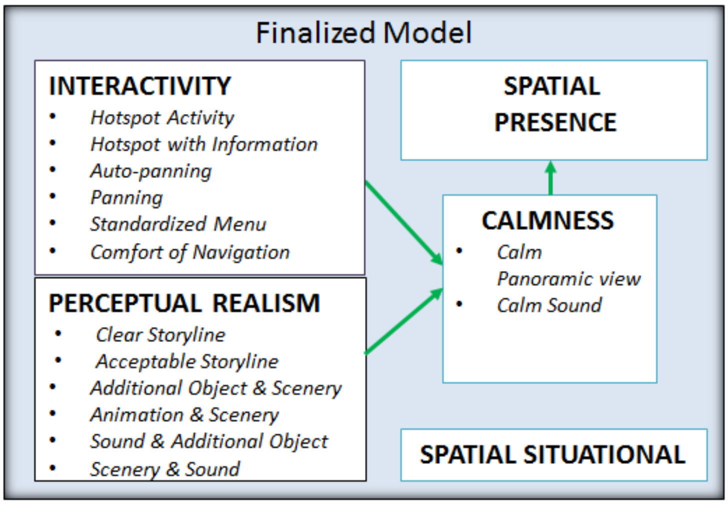


Figure 2.2. Spatial Presence Model for IBVR by Nadia (2017)

2.2.3.1 Summary on Related Works of Spatial Presence Theoretical Model

Since the introduction of spatial presence theoretical model by Wirth et al. (2003, 2007), it has been studied by several researchers for different aims and purposes. Their studies focuses whether on the model parts that include components and user actions (Lukowska, 2011; Sacau et al., 2008; Vorderer et al., 2004; Wirth, Hofer, & Schramm, 2012), spatial situational (Wu, 2011), questionnaire development (Vorderer et al.,2004 and Hartmann, 2015) or development of new model (Nadia, 2017).

For this study, the spatial presence model for IBVR developed by Nadia (2017) is adapted to be the basis for the development of hybridized model for IBVR in self-therapy. This is because the model by Nadia (2017) fits very well to this study as it is particularly developed for IBVR application and it contains relevant components for the development of the suggested hybrid design model. The following sub-topic will elaborate on VR, that includes IBVR and its' characteristics.

2.3 Virtual Reality

The integration of multiple media that include text, voice, video, image, and data, has created significant functionalities in the communication of users in various services. Moreover, the advances in computer graphics and communication technologies has further upgraded the possibility of creating state-of-the-art multimedia applications that are seamlessly unlimited. These capabilities have paved the way in improving the user interfaces in conventional applications as well as developing sophisticated applications such as virtual reality and augmented reality (Dan, Feldman, & Serpanos, 1998).

By taking advantage of the advancements of multimedia technology, Ivan Sutherland (1965) came out with the idea of making the (virtual) world in the windows to look real, sound real, feel real, and react naturally to the users' interactions with the virtual world (Mazuryk & Gervautz, 1999; Sutherland, 1965). Users can interact with virtual environment in various ways, such as visual, sound and haptic, using special input and output devices to get a real experience. However, the term Virtual Reality has only been introduced and coined in 1989 by Jaron Lanier with the purpose of varying the concepts. Since its' introduction, the emergence of technologies supporting the sensory stimulation for VR has considerably increased in huge amount (Anthes, García-Hernández, Wiedemann, & Kranzlmüller, 2016).

Virtual reality is defined as "an artificial environment which is experienced through sensory stimuli (such as sights and sounds) provided by a computer and in which one's actions partially determine what happens in the environment" (Merriam-Webster, 2019). Meanwhile, Jason Jerald (2016) in his book defined virtual reality as “a computer-generated digital environment that can be experienced and interacted with as if that environment were real” (Jerald, 2016). In other words, VR is basically imagination or simulation of the real environment that can be experienced and seen visually. It is represented in the form of three dimensions of width, height, and depth that may possibly include interactive experiences in real-time with various forms of feedback such as visual, sound and tactile (Okechukwu & Udoka, 2011).

2.3.1 Types of VR

Fundamentally, VR can be classified into two types of applications which has been introduces previously namely GBVR) and IBVR. GBVR is capable of providing high interactivities for the users, hence attracted most researches on the concept of presence as it can produce sense of presence with high intensity (Casati & Pasquinelli, 2005; Luciani et al., 2004). Even so, developing a synthetic environment in GBVR with realistic features is time consuming (Casati & Pasquinelli, 2005).

Alternatively, IBVR provides a promising solution for reducing time consumption. Its development involves stitching together a collection of photographs or images to create a synthetic environment (Xiao, 2000). This VR application creates a 360-degree panoramic view by stitching together multiple photographs using specialized software (Chen, 1995; Arif et al., 2009). The resulting panorama is a wide image that captures as much as the human eye can see (Thompson, 2006). Even with limited processing power, the application can still create a realistic virtual environment that users can explore without the need for geometric programming (Chen, 1995). With these features, IBVR application development takes less time than GBVR applications. This is due to the unique characteristics of IBVR to create immersive experiences using pre-existing images and videos rather than building 3D models. As a result, IBVR development can be a more cost-effective option to create virtual experiences. Table 2.2 shows the comparison between GBVR and IBVR.

Table 2.2

Comparison between GBVR and IBVR

Geometry-based VR (GBVR)	Image-based VR (IBVR)
• High interaction function • High computational cost • Time consuming	• Low interaction function • Low computational cost • Less time consuming

2.3.1.1 Image-Based VR (IBVR)

The terminologies used to describe IBVR varies from different authors according to their respective study, as summarized in Table 2.2. From the table, most of the authors described IBVR emphasizing on realistic panoramic views and interaction function as the main elements. Hence, it can be summarized that IBVR is basically referring to VR application that combine a number of realistic panoramic virtual environment in which the users can interact with.

Table 2.3

Descriptions of IBVR

Author	Description
Chen (1995)	A virtual environment that is composed of 360-degree cylindrical panoramic images which are digitally warped On-The-Fly, simulating camera panning and zooming, produced with a specialized camera or with a regular camera by stitching the overlapping photographs taken.
Xiong & Turkowski (1997)	An environment developed by multiple images, produced using a camera or a 3D computer graphics. It can be represented in two types of representations; (i) single node 2D (represented by a panorama, around one nodal point) and (ii) light field 4D (represented in a pre-defined 3D volume).

Table 2.3 continued.

Xiao (2000)	An advancement of virtual reality and computer graphics that embed telepresence and high-end user interface which implies immersion, interaction and imagination.
Bradley et al. (2005)	A cubic 360 degree panorama developed using a camera with high-resolution multi-sensor and rendered using a hardware-accelerated graphical techniques.

2.3.1.2 Image Types in IBVR

As explained previously, one of the main features of IBVR is the panoramic view, besides the interaction or navigation function. The different types of images that can be generated in the panoramic view give advantage in developing the virtual environments. The three most common types of images for developing panoramic views are cylindrical, spherical and cubical (Brosz & Samavati, 2010; CompuPhase, 2000; Pereira & Gheisari, 2019; Thompson, 2006).

a) Cylindrical Panorama

The cylindrical panoramic image is shaped like a cylinder, as shown in figure 2.2 (Chen, 1995). User view this image as sitting in a cylinder (Thompson, 2006) where the user could see a curved shape with 360 degree panoramic view.

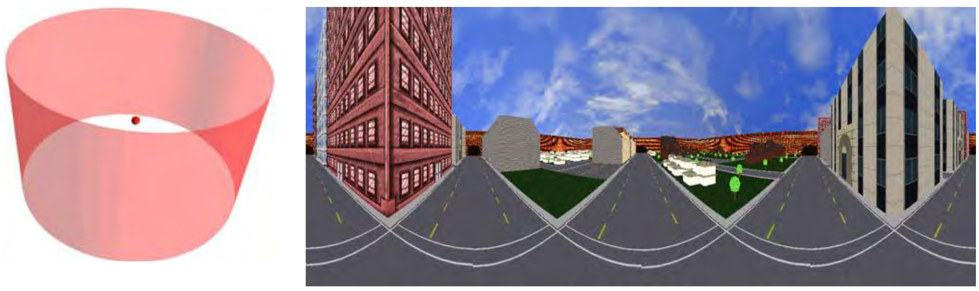


Figure 2.3. Cylindrical Panorama

b) Spherical Panorama

The representation of spherical image is in equirectangular format with 360 degrees view on the horizontal axis and 180 degrees on the vertical axis, as shown in figure 2.3 (Brosz & Samavati, 2010; Thompson, 2006). It is viewed as if it is projected onto the inside of a sphere, using a special slide projector. The spherical type of panorama is more effective than cylindrical type for large vertical field of panoramas view (Thompson, 2006).

Figure 2.4. Spherical Panorama

c) Cubical Panorama

The last type panoramic image is the cubical panorama (figure 2.4), introduced by QuickTime 5. It is created as if projecting onto a cube with an open top and bottom (Brosz & Samavati, 2010), in which the user can view straight up and down (Bradley, Brunton, Fiala, & Roth, 2005). Technically, the cubical panorama is a sequence of four or six perspective projections (each rotated 90 degrees around the up axis from its neighbour) (Brosz & Samavati, 2010; Thompson, 2006). It is the most effective panoramic image that appears ordinary to the human eyes as it has no horizontal curves or perspective distortion (Thompson, 2006).

Figure 2.5. Cubical Panorama

2.3.1.3 Navigation Function in IBVR

In addition to the realistic panoramic images that gives realism to the virtual environment, another important feature of IBVR in creating a virtual world is the navigation function. Mainly, there are three functions for navigation in IBVR that help the user in exploring or navigating through the virtual environment, namely (i) panning and tilting, (ii) zooming in and out and, (iii) hot-spot (CompuPhase, 2000). Panning and zooming are basic tools for navigation or exploration of 2D and 3D information in IBVR environment (Cooper, Reimann, Cronin, & Noessel, 2014).

a) Panning and Tilting

The panning function provides a user the ability to control or view the images in a rotation to a certain degree, vertically or horizontally. For instance, in cylindrical panorama, the panning function is a rotation towards left or right in certain degrees. With wider view margins, it makes the users to feel like looking around in a rotation of 360 degrees, similar to looking at actual environment. Panning can be applied in all types of panoramic image in IBVR.

On the other hand, tilting is a function that allows users to control the directions of viewing the panoramic image in IBVR, whether up or down. It makes the users feel like they are looking up or down in a rotation of 180 degrees, similar to the real environment. However, tilting function can only be applied in cubical and spherical panorama.

b) Zoom in/out

In particular, the zoom-in function is used to enlarge the image or see the image more clearly. Meanwhile, the zoom out function is used to shrink the image display. In the transition between zooming in and out, there are three processes involved, as mentioned by Thompson (2006). First, the viewing orientation of the source view is progressively modified to a specified orientation. Second, it slowly zoom in/out of the view until it reaches the specified zooming factor. Third, the transition is shifted to the view of panorama with specified viewing orientation of the destination.

c) Hot-spot

The third IBVR navigation function is hot-spot. This function is used to find specific area in the virtual environment for the purpose of performing specific actions or navigation (Chen, 1995; Chiang et al., 1997). To perform an action, the hot spot function allows the user to move from one environment to another (Chen, 1995; Geng, Pan, Li, & Yang, 2000), which works like a virtual tour (Geng et al., 2000). As for navigation actions, the hot-spot function is used to zoom in and out to see the scene in the virtual environment more clearly. In addition, the hot spot also works for other purposes of navigation as well.

2.3.1.4 Summary on IBVR

Basically, IBVR has two important features which are realistic virtual environments and interaction functions. The application of diverse virtual environments and interaction functions in IBVR is able to provide a great experience to users in exploring the application of self-therapy. Although IBVR basically has limitations in terms of interactivity when compared to GBVR, it is able to create a good user experience by emphasizing the element of spatial presence. To create a sense of spatial presence, it doesn't have to be highly interactive application, but the user should experience the presence of the spatial environment (Bleumers, Broeck, Lievens, & Pierson, 2012; Wirth et al., 2007). In the next section, some VR application are reviewed to delve into the progress and application of VR in various field, specifically in mental health.

2.3.2 VR Application

For many years, VR technology has been greatly developed and implemented in many field as applications that can overcome various problems in different situations. The scope of VR technology has been extended beyond academic research. Diverse sectors such as information technology, training aids technology, structural designing and biomedical engineering are investing remarkably in this field either for research purposes or for the development of various VR-based products to give benefits to users as well as gaining profits. The current advances in VR have made it available to the broad consumer market and are expanding across diverse fields including education, entertainment and health (Hartmann & Fox, 2019). The following sub-topics give a brief elaboration on the application of VR in heritage and architecture, military, entertainment, education and medical.

2.3.2.1 VR in Heritage and Architecture

VR technology could be utilized as an experimental tool to support the activity of preservation and conservation, in increasing the public's sensitivity and understanding of historic sites (Hassan, 2016; Saha et al., 2021). Setyawati et al. (2019) has conducted a study to implement a digital conservation for Pathok Negoro Mosque, one of the Javanese Islamic mosque built in the 1700s. They created a VR applications for the mosque by developing a prototype of the building in 3D model and providing virtual tours. The aim is to archive the space for the purpose of preservation (Setyawati, Asyifa, Putro, & Ischak, 2019).

Other than that, Yang, Yen and Cheng (2015) conducted a study on implementing digital preservation tool for historic buildings in China. They focused on the traditional Chinese wood connection structure technique of the Taipei Xia Hai City God Temple building and Dougong. The study used Virtual Reality, Augmented Reality, and Digital Scanning technology as the methods in the digital preservation (Yang, Yen, & Cheng, 2015). Zhang et al. (2018) has also developed a VR-based learning application for architectural students to study about how to construct Dougong, the unique Chinese traditional architecture, by interacting with the virtual model (Zhang, Wang, Chen, & Gao, 2018).

Wolf et al. (2017) conducted an experiment to investigate the perception of virtual architecture through the use of VR-based architectural prototype under various conditions and interaction scenarios that implement typical actions in the architecture field. With the aim to understand the sensation of presence and immersion, the study found that 3D virtual experience is more perceivable than 2D screen and moving through walking in the VR environment give more natural feeling than using mouse and keyboard as the mode of interaction (Wolf, Khalil, Knierim, & Funk, 2017).

2.3.2.2 VR in Military

Military is considered as one of the most important fields of application for virtual reality technology. In fact, it is one of the earliest application and widely used virtual reality technologies (Liu, Zhang, Hou, & Wang, 2018; Herdayatamma, 2022). VR has shown its' benefits and significance in military training and national defence construction. Using simulation technology, military training and exercises do not need to be limited to factors like weather conditions, locations, hardware, cost and other constraints, thus optimizing the efficiency in military learning.

One of the VR applications in military is in the shooting training (Lucero-Urresta, Buele, Córdova, & Varela-Aldás, 2021; Loachamín-Valencia, Mejía-Guerrero, Álvarez, Cárdenas-Delgado, & Calderón, 2023). Zhang et al. (2019) introduced the main technologies and factors in developing a virtual range which provides recognition of equipment, shooting training and other features. It is done by integrating equipment of VR and matching the firearms simulation. The target modes and environments for the shooting exercises are varies. The data gathered from each session can be analysed, sorted out and set, to produce more effective training methods and can be adjusted according to the trainees demands. Ahmadizadeh and Taheri (2019) has also used VR in their study among novice shooters in a military university to examine the efficacy of brain-training (neuro-feedback) and virtual-reality training through the use of actual and virtual shooting training. Similarly, Bhagat, Liou and Chang (2016) developed a serious game-based learning environment with a 3D VR real-world firing range program to train student in military live firing in immersive training exercise.

Other than that, VR has also been utilized as a simulation program for military virtual training (Harris et al., 2023). It mainly used for the development of combat skills by simulating real vehicle, real soldier or real combat environment, either for single or group soldier. It can also be used by the commander for decision making and understanding possible consequences in order to provide the best combat plan. Meanwhile, in the design and development of weapon, VR technology is employed to produce demonstration to operate the weapon systems in the virtual combat environment for testing and integrating design ideas into the weapons. The use of VR can speed up the weapon development cycle and provide reasonable assessment of its operational effectiveness (Liu et al., 2018).

2.3.2.3 VR in Entertainment

Entertainment is considered as the key to the mass adoption of VR, as a result of the compelling user experiences provided by the VR technology. In fact, gaming as one of the entertainment genres, often attract early adopters of technology (Hartmann & Fox, 2019). At the present time, there are many VR games available in the market which cover variety of game scenarios and challenges such as Superhot VR (shooting game), Beat Saber (dancing game), Gran Turismo Sport (racing game) and

Until Dawn (horror game) and many others (Gurwin, 2019; Hood, Knapp, & Grilliopoulos, 2019; Vincent, 2019; Gerling et al., 2020).

Apart from that, there are also other studies on VR games application conducted for the purpose of research and development. Among of them is the study by Wedoff et al. (2019) who developed a VR game called Virtual Showdown that is available for youth with visual impairment that allows them to move their body in real time and use their sense of hearing to detect and strike a ball against a challenger. Meanwhile, Krekhov, Cmentowski and Kruger (2018) have focused their study on the development of VR games with animal role, ranging from third person companion mode to first person full-body tracking. The study shows that body ownership can also be applied virtually to animals, which open up the possibilities to other novel virtual animal game mechanics. Among others, Arnold, Khot and Mueller (2018) designed a VR game called "You Better Eat to survive" that instructs the users to eat real food in order survive and escape form a virtual island. In this study, they have proved that cooperative eating can also be a compelling technique of interaction to elevate experiences in VR.

Besides gaming, the application of VR in entertainment has successfully emerged in several other fields. For example, VR applications in social activities like VRChat, AltspaceVR, and Facebook Spaces, allow users to meet and interact in the virtual social platform (Hartmann & Fox, 2019). Other than that, VR applications for location-based entertainment has grown rapidly. It is basically a place of business that hosts VR experiences in which users can physically interact with the environment and has been set up as independent businesses or within entertainment complexes, movie theatres, and museums (Sag, 2019). For instance, the Bigscreen application enables users to do traditional media experiences, such as watching movie and at the same time having social interaction with other users.

However, the application of VR in gaming has not only restricted to entertainment purposes, but has been extended to various fields, generally with the function of training or learning through gaming, typically referred as edutainment or serious games (Cruz-Neira, Fernández, & Portalés, 2018).

2.3.2.4 VR in Education

Current technological revolutions have made the access to virtual reality becomes easier for everyone especially by the rapid adoption of smartphones by the society (Freina & Ott, 2015). With that, VR offers a very high potential in education by making the learning activities become more motivating and engaging, which apply a constructivist approach of learning that allow the students to freely interact with the virtual objects as well as other students. This experience results in the improvement of their learning (Martín-Gutiérrez et al., 2017; Sun & Peng, 2020) and provide promising benefits to the students, institutions and business entities.

The characteristics and capabilities of VR has been utilized in many educational areas including engineering, language, psychology, medical, architectural, and many others (Soliman, Pesyridis, Dalaymani-Zad, Gronfula, & Kourmpetis, 2021; Kumar et al., 2021). Among the many examples, Cheng, Yang and Andersen (2017) proposed a 3D virtual reality video game for learning Japanese language and culture, played using the Oculus Rift. They were investigating on the possibility of implementing VR technology in teaching cultural interaction such as bowing in Japanese greetings through embodiment. Their study suggested that VR technology could be beneficial in leveraging cultural physical interaction, thus enhance the language learning with VR games.

In another example, Sharma et al. (2018) introduced an application of immersive VR for the learning of DNA concept that shows the DNA double helix structure, which is very similar to the actual structure, thus emphasizing the complexities. The VR application provides an illustrative and engaging experience for the students that allows them to interact with it, and improving their understanding on the subject.

Meanwhile, Gulec et al. (2018) proposed an interactive VR application for software developers to obtain experience on the software development tasks through virtual training environment. The VR application provides users with simulated development process in which they can interact with virtual personalities, roles and characters from the real software development organization. The study indicated that a VR-based software development training tool could significantly improve the experience of software developers and has a great prospect for training activities in software organizations. Similarly, Singh (2017) conducted a study on the use of virtual reality to teach students on computer programming introductory concepts in a 3D interactive environment. Through the situated contextual information and operations that are associated with physical actions, the application is expected to benefits the students by stimulating extensive learning.

Other than that, Zhao et al. (2019) explored on the utilization of interactive and immersive VR technologies to design and develop a new integrated approach for engineering students to understand problem solving in manufacturing through a VR simulation game. It involved activities like designing a product based on a given manufacturing requirements. They concluded that the VR simulation game would give a more engaging learning experience to the students.

2.3.2.5 VR in Health Care

VR or three-dimensional virtual world have emerged as a technology that offers many advantages to the health care sector. It offers improved experiences to the users in terms of information and education, skill-building, group support, and individual consultation in the field of medical and health. Ghanbarzadeh et al. (2014) employed a systematic literature review on the application VR in the areas of health care for the purpose of characterizing different areas of VR application in health and medical context and put them into relevant categories. Eventually, they concluded that the application of VR in health care can be categorized into six main topics namely treatment, modelling, evaluation, lifestyle, academic education, and professional education. Specifically, the application of VR for treatment is performed in two context which are psychological (Geraets, Van Der Stouwe, Pot-Kolder, & Veling, 2021; Elphinston, Vaezipour, Fowler, Russell, & Sterling, 2022) and physiological treatment (Gao et al., 2020; Gougeh & Falk, 2022).

Particularly, in the area of psychological health care, there are many studies has been conducted with the purpose of providing intervention and alternative approach for the treatment of mental related illness. Pallavicini et al. (2016) also conducted a systematic review to explore the studies that was implemented to test the VR-based stress management training programs for military personnel, in terms its effectiveness. They observed that VR can definitely be utilized to reduce perceived stress levels and negative affect in military personnel through interactive stress management training. One example is the study by Stetz et al. (2007) who tested a VR training on 25 soldiers in which the soldiers were being shown with a virtual environment while performing tasks in a stressful combat casualty environment. Findings of the study indicated that the virtual environment is capable of increasing the level of post treatment anxiety and dysphoria.

Another example of VR application in mental or psychological health is a study by Eswaran et al. (2018) which aims at understanding the effectiveness of VR in mitigating mental stress among the students of Biomedical Engineering who were divided into normal and mildly stressed groups. The participants were subjected to a forest-like virtual environment where they can interact with environment and listen to diverse natural sounds. After the therapy, the result shows that there was a sense of relaxation in each group, as well as an increase in their task performance. Other than that, Dayang et al. (2011) presented a web-based IBVR application for relieving stress, which was created according to the concept of guided imagery therapy. The application integrates images, sound, music and talk-therapy to enhance realism and emulate a therapy session. The evaluation of the application was done in terms of its usability using SUS questionnaire and the result showed that the system was easy to use.

Apart from that, Gamito et al. (2015) applied a cognitive training for stroke patients using VR-based serious games with the aim of evaluating the effectiveness of a VR application for neuropsychological rehabilitation. The application was developed with the integration of attention and memory tasks that consist of daily life activities and the result shows significant improvement in terms of attention and memory functions of the participants. The findings further support the use of VR applications for cognitive training in neuropsychological rehabilitation.

2.3.2.6 Implications of VR Application to This Study

As described in previous sub-sections, VR technology has been around for many years and it has been applied in various domains. The capability and advancements of VR technology has made in potentially implemented and spanned in many other areas of human's life, particularly in health and wellbeing. The application of VR in mental health or psychology is proven to be one of the promising alternative in the intervention of mental related problems.

This study is proposing a hybridized model for IBVR in self-therapy, integrating spatial presence and GIT. Despite the fact that study on the use of IBVR for stress reduction with guided imagery therapy is already available (Dayang et al., 2011), however the study has not focused on spatial presence and the evaluation was not using user experience aspects. In fact, the study by Dayang et al. (2011) was developed as a general framework, instead of a specific model of IBVR for use as self-therapy purposes, as proposed in this study.

2.4 Self-therapy

Self-therapy can have several different definitions, similar to the wide range of various forms of psychotherapy. Generally, the term self-therapy refers to an approach of psychotherapy that can be conducted by oneself, without the intervention of assistance of a therapist (King et al., 2017). Whereas, self-therapy by Merriam Webster is defined as one self's therapeutic intervention especially for the intention of coping with emotional problems.

Other than that, the term self-help has also been used with similar interpretation. It basically refers to approaches for self-improvement with the utilization of technologies (such as books, CDs, DVDs and websites) with less or no input from the therapist (Lewis, Pearce, & Bisson, 2012). Moreover, compared to professional face-to-face counselling, the self-therapy has some degree of advantages as it is more convenient, less cost and has no time constraints (NHS, 2019).

2.4.1 Current Practices in Self-therapy

The practices and approaches for self-therapy or self-help include the use of technologies like CDs, DVDs and websites, as well as specific programs conducted for providing guidance in doing self-therapy. One of the example is the Self-therapy Journey website which contains various online resources (books, audio, video, quizzes) that can be accessed by anyone for the purpose of self-therapy. Another approach is called as guided self-therapy that can be a helpful intervention for dealing with daily occurrences that might lead to moderate or mild anxiety. It can be very useful to apply the self-therapy as not everyone can have access to a therapist instantly (Cuijpers, Donker, Van Straten, Li, & Andersson, 2010).

Other than that, cognitive behaviour therapy (CBT) can also be implemented for self-therapy or self-help. One of the techniques in CBT that can be utilized for self-therapy is called the imagery therapy. This technique has long been used in the ancient and modern world as a therapeutic approach. It can be utilized to bring relaxation, meditation, improve mood states and reduce distress (Vivyan, 2009; Jain & Fonagy, 2018). Similarly, Robinson et al. (2019) has also suggested the use of guided imagery as one of the relaxation techniques for stress relief.

2.4.2 Guided Imagery Therapy

Prabu and Subhash (2015) refer the term "guided imagery" as the techniques where the unconscious mind elements are triggered to appear as images in the conscious mind through. It is implemented through diverse techniques which include simple visualization and direct suggestion using imagery, metaphor and story-telling, fantasy exploration and game playing, dream interpretation, drawing, and active imagination. It has been proven capable of decreasing stress, relaxing the body and efficiently assist people in managing their emotions better (Prabu & Subhash, 2015; Jain & Fonagy, 2018; Blackwell, 2021).

Among others, the potential of guided imagery in reducing stress has also been investigated by Jallo et al. (2014) as they studied on the efficacy of guided imagery intervention for stress reduction in pregnant African American women. The result of their study suggested that guided imagery is possibly an effective intervention for reducing stress and anxiety.

Fundamentally, GIT refers to rehabilitation element with procedures of passive relaxation that is carried out in quiet and awake states (Overholser, 1991). In the GIT session, the therapist instructs and guides the patient to imagine a scene or experience that is relaxing. In normal practice, patients are instructed to imagine of 'being in' a location of their preference (Nadia & Dayang, 2018). This would result in the relaxation sensed by the patient. However, Nadia and Dayang (2018) also stated that there is a possibility the patient misunderstand the instructions by the therapist during the therapy session. In fact, the patient can possibly imagine scenarios that can negatively affect them instead.

Alternatively, this study proposed a solution using VR technology as alternative for self-therapy purposes by using IBVR, taking GIT technique as the basis. In addition, Prabu and Subhash (2015) also stated that imagery therapy is capable to be used as a self-therapy tool through the use of imagery books and tapes available for patients to use the techniques themselves.

2.4.3 Summary on Self-therapy

Self-therapy is an element that gives opportunity for anyone to address mental health-related issues and undertake self-intervention. This alternative approach supports in minimizing stress, as well as anxiety and depression without having to meet in person with a therapist which can be troublesome in certain conditions. One of the traditional techniques that has been clinically used to reduce stress is called guided imagery therapy (GIT). During a GIT session, the therapist guides the patient to imagine a relaxing scenarios or images. This will give a sense of relaxation to the patient and decrease stress. Current technology and mediums such as books, tapes, CDs and computer applications such as VR have increased the potential of GIT to be used as one of the self-therapy methods. Nonetheless, a clinical approach and intervention from real therapist should be the main solution for any mental illness.

2.5 User Experience (UX)

Garret (2010) stressed that user experience is incorporated in every product used by people which includes all sort of products like newspaper, ketchup bottles, reclining armchairs, cardigan sweaters and more. It is concerning the people's feeling about a product and their pleasure or satisfaction when using it, holding it, looking at it and opening or closing it. The most vital aspect of user experience is the quality of the experience that people have, whether it is a quick, leisure, integrated and others (Law, Roto, Hassenzahl, Vermeeren, & Kort, 2009).

User Experience is frequently accredited to Don Norman, the famous design researcher who was the UX Architect while working at Apple Computer in the mid-1990s. He was considered as the one who responsible for harmonizing the human interface and industrial design process (Macdonald, 2015). The term user experience (UX) generally refers to all aspects of users interaction with a company and its' services or products (Norman & Nielsen, 2019). It focuses on the impact of the interaction of any product, system, service or interactive object on user perception (Forlizzi & Betterbee, 2004; Walsh, Petrie, & Odutola, 2014). This is also in line with other studies saying that the experience occurs based on the users' behaviour as a result of the interaction process between the users and interactive products (Park, Han, Kim, Cho, & Park, 2011; Pucillo & Cascini, 2014; Tuch, Trusell, & Hornbaek, 2013).

Normally when anyone involves in any interaction with other parties, they will go through experience either positive or negative. They may also create a blend of perceptions, thoughts and feelings. Among other things, the concept of user experience is not only limited to a person's perceptions and responses from product, system or service, but it is also about the preferences, beliefs and emotions through physical and psychological responses. It also relates to the behaviours and accomplishments that occur before, during and after use (Carlsson & Sonesson, 2017). However, there must be a difference between the concept of UX and usability that only covers a system quality attribute in terms of whether the system is pleasant, efficient to use, easy to learn, and etc. (Dix, Finlay, Abowd, & Beale, 2004). In fact, UX is even a broader concept as claimed by Norman and Nielsen (2019).

Preece et al. (2015) pointed out that the growth and improvement of technologies has made user experience becomes more essential in stimulating positive feelings through the use of any interactive product. As the complexity of the technology grows, Tullis and Albert (2013) believed that user experience needs to be given more priority and attention as it will become an important part of the development process in order to produce a technology or interactive product that is efficient, easy to use and engaging for the users. As highlighted by Cooper et al. (2014), it is very important to make sure that the development of any interactive product takes into account the users' goals, needs and motivations as it can result in products that possess consistent user experience.

2.5.1 User Experience in Interactive Products

User experience is a multidimensional construct that determine the overall results of users' interaction over time with a system and service in a particular context (Robert & Lesage, 2011). Understanding user experience and its' elements is beneficial in providing a useful and usable interactive software as it is able to influence users' capability and satisfaction, through positive feelings (Kujala, Roto, Väänänen-Vainio-Mattila, Karapanos, & Sinnelä, 2011). Feedbacks and perceptions of the users are critically important in analysing their satisfaction and the usefulness of the developed application (Dix et al., 2004).

Despite the fact that user experience is a notion that include users' involvement and their interaction with a product or system, it is not a mere concept or terminology. Tullis and Albert (2013) mentioned that user experience should be something that is observable and measureable. They explain about UX metrics that are used to show the level of interaction between user and product being evaluated in terms of satisfaction (users' happy experience while performing the task), efficiency (amount of effort to complete task) and effectiveness (ability to complete task). Robert and Lesage (2011) also mentioned that UX is more concern on the sense making, aesthetics and emotions of a system when users interact with it.

Preece et al. (2015) highlighted that apart from usability aspects which focus on the criteria of easy to learn, effective to use and enjoyable, an interactive product must also meets the UX requirements, considering emotions and felt experiences which include desirable and undesirable ones, as shown in Table 2.3.

Table 2.4

Desirable and Undesirable Aspects of User Experience

Desirable Aspects		
Satisfying	Helpful	Fun
Enjoyable	Motivating	Provocative
Engaging	Challenging	Surprising
Pleasurable	Enhancing sociability	Rewarding
Exciting	Supporting creativity	Emotionally fulfilling
Entertaining	Cognitively stimulating	
Undesirable Aspects		
Boring	Unpleasant	Annoying
Frustrating	Patronizing	Childish
Making one feel guilty	Making one feel stupid	Cutesy

In practically evaluating user experience of interactive products, there are several evaluation methods introduced by different researchers or experts. One of them is the AttrakDiff questionnaire by Hassenzahl, Burmester, and Koller (2003) which comprises 28 items of adjective pairs that represent the pragmatic quality, hedonic quality (stimulation and identity), and attractiveness (Keskinen, 2015). Another example is the User Experience Questionnaire (UEQ) introduced by Laugwitz, Held, and Schrepp (2008) that consists of 26 items represented in opposite adjective pairs with seven rating scales. The questionnaire covers six factors namely attractiveness (overall impression of the product), efficiency (fast, organized), perspicuity (easy to learn, easy to understand), dependability (predictable, secure), stimulation (exiting, interesting), and novelty (creative, innovative) (Laugwitz, Held, & Schrepp, 2008; Schrepp, 2015).

Other than that, user experience is basically categorized into short-term usage and long-term usage based on time frames (Keskinen, 2015). However, not many user experience evaluation methods are customized for long-term usage as it involve high amount of resources (Karapanos, Martens, & Hassenzahl, 2012). Among the methods that are particularly designed for long-term evaluations are iScale which evaluate on the usefulness, ease of use and innovativeness of a product (Karapanos et al., 2012) and UX Curve which focuses on attractiveness, ease of use, utility and degree of usage (Kujala et al., 2011).

Besides quantitative ratings using questionnaires, user experience can also be evaluated or enhanced using the more subjective data through the implementation of interviews, observations and focus groups (Bargas-avila & Hornbæk, 2011). In the following sub-sections, some examples on the implementation of UX in web applications, digital games and virtual reality applications are given, apart from many other usage of UX in different domains.

2.5.1.1 UX in Web Applications

Positive web experiences can give a significant impact on the revenue of organizations (Djamasbi et al., 2015). In real applications such as in persuasive web application (Wan Nooraishya & Nazlena, 2018), user experience values of the applications are assessed based on its' pragmatic, hedonic and appeal quality through the use of Positive and Negative Effect Schedule (PANAS) instrument in a pre-post interaction approach. Similarly, Basri, Adnan and Baharin (2019) conducted an exploratory study to evaluate the user experience when using e-participation service in Malaysian e-government website through established and validated instruments from existing research that particularly measure the participants' perception on pragmatic and hedonic values of the website, besides other elements like the interaction experience, perceived enjoyment, perceived aesthetics and intensity of the flow.

In e-commerce applications for instance, customers always expect the hedonic quality, like the appealing visuals of the website designs as it can significantly provide pleasure and satisfaction to the customers when experiencing online shopping (Albayrak, Karasakal, Kocabulut, & Cengizci, 2019), besides the benefits of utilitarian, like comparing prices (Bilgihan & Bujisic, 2015; Bilgihan, Okumus, & Nusair, 2013). The measurement of hedonic quality of a website is according to users' evaluation regarding the pleasure experience of the website including the amount of fun and playfulness of the website (Bilgihan, 2016).

In line with that, Hellianto, Suziati and Komarudin (2019) developed a UX model on e-commerce website which consists of the factors that can increase the success rate of e-commerce business performance. They studied on three main quality variables as the factors that can affect the UX namely pragmatic, hedonic and user value. The pragmatic quality variable is in terms of directness, simplicity and informative. Meanwhile, the hedonic variable is from the aspect of simplicity and delicacy. In addition, pleasure and self-satisfaction are the biggest factor for UX, from the user value variable.

2.5.1.2 UX in Digital Game Applications

Bernhaupt (2015) summarizes the dimensions of user experience that has been addressed by other researchers in the domain of HCI and games which include aesthetics, emotions, stimulation, identification and others. Besides these elements, other constructs and factors that are important in evaluating games applications are immersion, fun, presence, involvement, engagement, playability, social play and flow (Bernhaupt, 2015). Similarly, Takatalo et al. (2010) has developed the Presence-Involvement-Flow Framework (PIFF) by integrating the vast amount of UX components. It has been constructed based on the psychological dimensions from the presence, involvement and flow concepts. The data acquisition in PIFF methods involves quantitative data gathering using the Experimental Virtual Environment Experience Questionnaire-Game (EVEQ-GP).

Meanwhile, Lima, Salgado and Freira (2015) has used Games Experience Questionnaire (GEQ) to measure the user experience elements in their study. It involved a group of students with two educational games in comparison to a mainstream racing game. The GEQ questionnaire is used to evaluate the UX of digital games from different factors which include immersion, tension, flow, competence, challenge, negative effect and positive effect. Brockmyer et al. (2009) also used GEQ to assess video games that was derived from factors of absorption, flow, presence and immersion.

2.5.1.3 UX in VR Applications

Virtual reality (VR) is a multimedia tool that creates an immersive user experience, inducing presence and interaction within the virtual world (Chilana et al., 2015; Lin, Fernandez, & Gregor, 2012; Liszio & Masuch, 2017). Among others, the development and evaluation of user experience (UX) characteristics in VR applications includes the consideration of the sense of presence (Kauhanen et al., 2017; Lorenz et al., 2018; Tcha-Tokey et al., 2018). In line with that, Park, Im, and Kim (2018) developed a VR fashion store that closely mimics a real shopping store and the UX evaluation was based on telepresence, perceived realism, emotions and motion sickness. Similarly, Bozgeyikli et al. (2018) studied on the effects of VR properties on UX of individuals with Autism and the experiment included presence as part of the survey questions. Also, Brade et al. (2017) investigated the relationship between presence and user experience, as well as usability, in real and virtual environments through a mobile navigation task. They discovered that in both situations, presence and user experience factors were partially correlated.

Apart from that, Lorenz et al. (2018) produced an online report regarding their research on presence and user experience in a VR environment under the influence of ethanol. They conducted a pre and post assessment in which they used presence and user experience questionnaires for gathering data. The presence questionnaire was intended to measure the sense of physical space, engagement, ecological validity and negative effects of the VR application using the International Test Commission – Sense of Presence Inventory (ITC-SOPI). Meanwhile, the user experience questionnaire was intended to measure the attractiveness, dependability, efficiency, novelty, perspicuity and stimulation of the application using the validated user experience questionnaire (UEQ) by Laugwitz et al. (2008).

On the other hand, Tcha-Tokey et al. (2018) proposed a user experience model for immersive virtual environment that consists of 10 components generated based on existing models which include presence, engagement, immersion, flow, usability, skill, emotion, experience consequence, judgement, and technology adoption (Figure 2.6). The model was validated through an immersive virtual environment questionnaire that was conducted upon a group of participants who were asked to use an edutainment application.

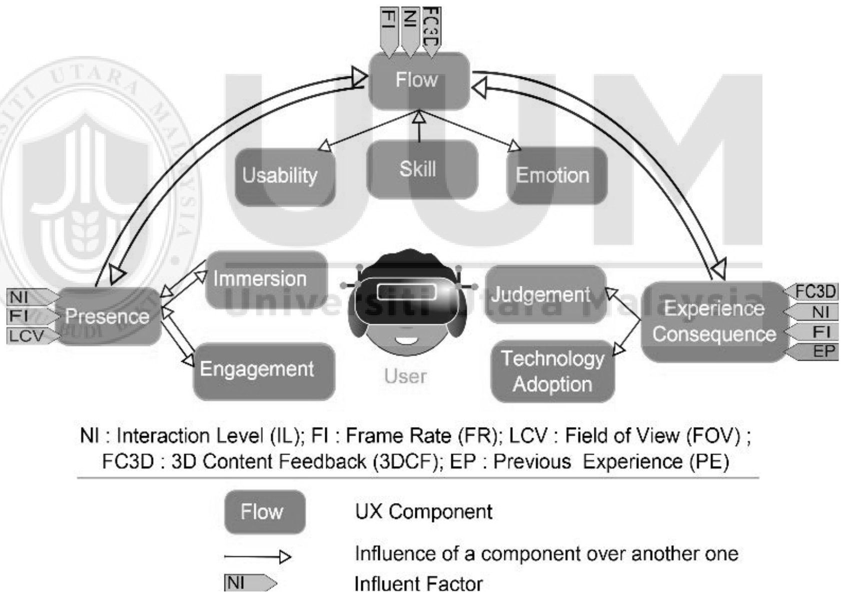


Figure 2.6. UX in Immersive Virtual Environment (Tcha-Tokey et al. 2018)

2.5.2 Implications of User Experience to This Study

According to the examples of user experience implementation in various domains as described above, it is clear that apart from the elements of usability or pragmatic of interactive applications, the emotional or hedonic aspect is one of the main criteria to be considered when designing or developing an interactive product that focuses on the emotions of the users when interacting with the applications. Apart from that, other aspects of user experience that are mostly related to VR applications are immersion and presence, among others. Thus, this study focuses on the element of presence as part of the user experience evaluation, adapting the existing presence questionnaire. Apart from that, user experience questionnaire (UEQ) is also adapted to evaluate the level of attractiveness, efficiency, stimulation and other criteria of the IBVR application proposed in this study.

2.6 Summary

This chapter contains a review on the main topics related to this study that includes spatial presence, VR, IBVR, self-therapy, guided imagery therapy and UX. The aim is to gain understandings and identifying the core elements for the development of the proposed model. It is also a method in clarifying the problems and gap of the study. The next chapter elaborates more on the methods and activities involve in conducting this study.

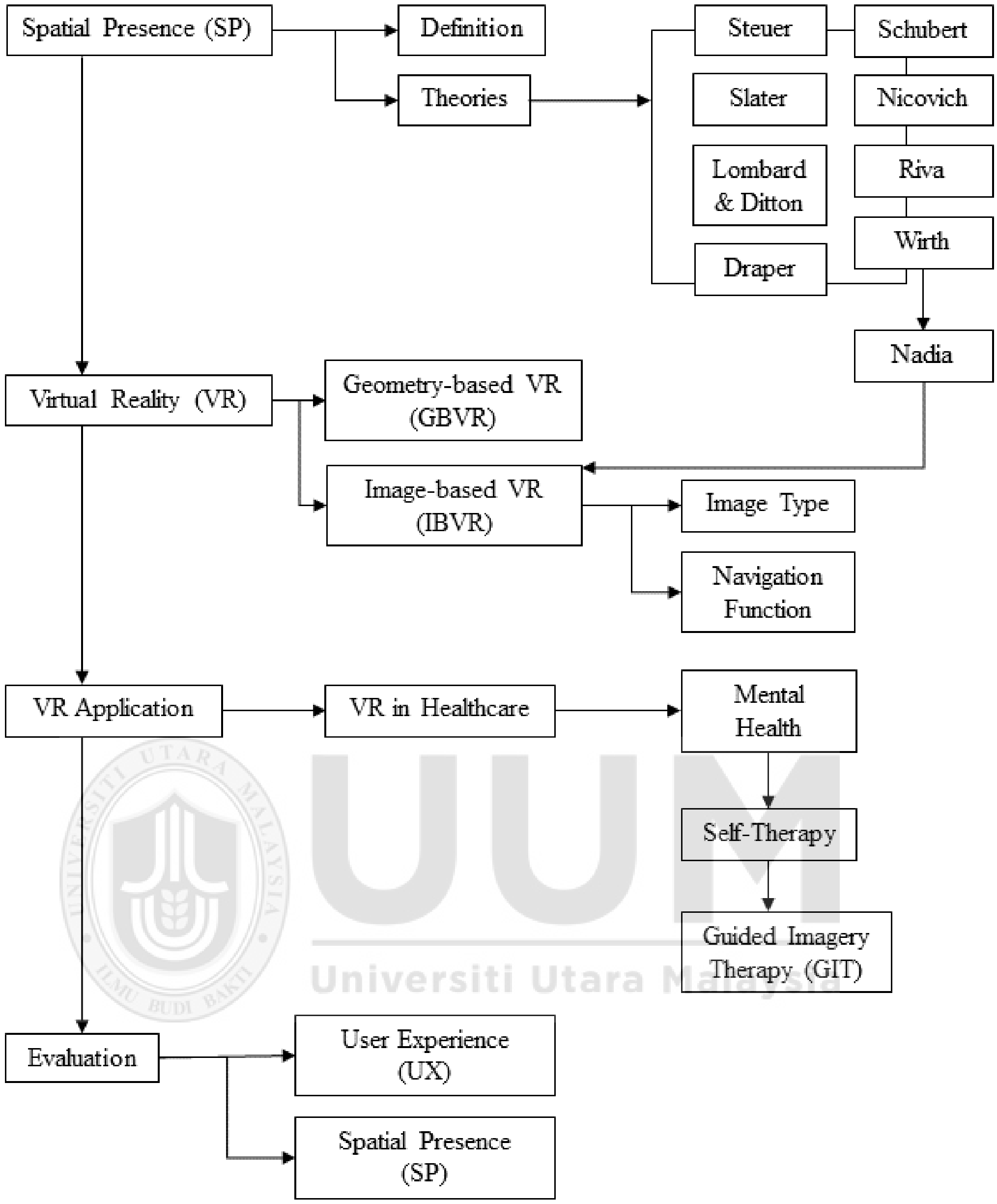


Figure 2.7. Overview of Literature Studies

CHAPTER 3

RESEARCH METHODOLOGY

3.1 Introduction

This chapter describes the overall processes conducted throughout this study in order to achieve the objectives outlined in Chapter One. In particular, this chapter discusses about the research design and the methodological approach adapted from an established design research approach in the information system discipline. The selection of the research methodology is based on the main aim of this study which is to develop a hybridized spatial presence model for IBVR in self-therapy. The rationales of implementing this methodology is provided in this chapter, followed by the elaboration on the activities and outcomes of the phases that contribute to the accomplishment of the research objectives.

3.2 Design Science Research Methodology

Design science research is described as a process that aims to produce effective artifacts with the application of knowledge from tasks or situations (March & Smith, 1995). Because of the problem-solving and performance improvement nature that it has, design science is considered as an improvement research by many. It commonly involves artifact and/or design theory creation as a method to enhance the current practices and also existing knowledge of research (Baskerville, Baiyere, Gregor, Hevner, & Rossi, 2018). Similarly, Peffers et al. (2007) mentioned that design science is of importance in a field or area that is oriented to the production of successful artifact. It could be in a form of conceptual actionable instructions such as constructs, model, frameworks and methods, as well as formal logical instructions like algorithms and instantiations like hardware and software implementations (Peffers, Rothenberger, Tuunanen, & Vaezi, 2012).

In a notable work by Hevner et al. (2004), they have proposed a set of guidelines which serves as a guide to aid researchers, reviewers, editors, and readers in understanding the requirements that should be addressed in some way, for the design science research to be performed effectively.

Table 3.1

Design Science Research Guidelines (Hevner, Ram, March, & Park, 2004)

Guidelines	**Descriptions**
Guideline 1: Design as an Artifact	Design-science research must produce a viable artifact in the form of a construct, a model, a method, or an instantiation.
Guideline 2: Problem Relevance	The objective of design-science research is to develop technology-based solutions to important and relevant business problems.
Guideline 3: Design Evaluation	The utility, quality, and efficacy of a design artifact must be rigorously demonstrated via well-executed evaluation methods.
Guideline 4: Research Contributions	Effective design-science research must provide clear and verifiable contributions in the areas of the design artifact, design foundations, and/or design methodologies.
Guideline 5: Research Rigor	Design-science research relies upon the application of rigorous methods in both the construction and evaluation of the design artifact.
Guideline 6: Design as a Search Process	The search for an effective artifact requires utilizing available means to reach desired ends while satisfying laws in the problem environment.
Guideline 7: Communication of Research	Design-science research must be presented effectively both to technology-oriented as well as management-oriented audiences.

According to Table 3.1, the guidelines for design science research as proposed by Hevner et al. (2004) consist of seven individual guidelines that basically function as a foundation for conducting design science research. As far as this study is concerned, all activities and outcomes significantly match with all the seven guidelines. In terms of artifacts, this study produced a design model for IBVR self-therapy, a technology-based solution to stress problems in society, through a pre-defined methods for the development and evaluation of the model. The model was presented to experts in VR technology and psychology for validation. In other words, this study reflects well with the guidelines and thus fits the design science research methodology.

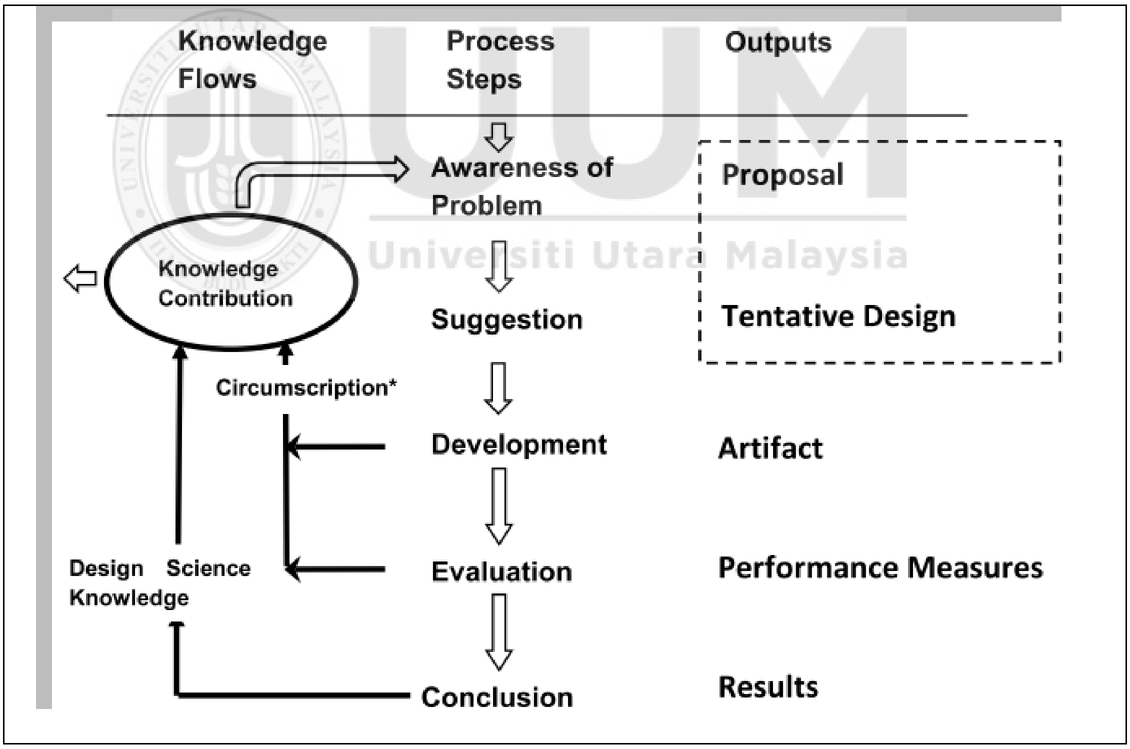


Figure 3.1. Design Science Research Process Model (DSR Cycle) (Vaishnavi, Keuchler, & Petter, 2004)

Basically, this study is adapting the design science research methodology (DSRM) for information systems that was introduced by Vaishnavi et al. (2004) which comprises five phases as illustrated in figure 3.1, namely (i) awareness of the problem, (ii) suggestion, (iii) construction, (iv) evaluation, and (v) conclusion. All of these phases is adapted as the framework in ensuring that this study is in line with the current practices and research knowledge. The following paragraphs elaborates on the rationales of using design science approach and the activities involved at each phase in more details.

3.3 The rationale of Using Design Science Research Methodology

As mentioned above, this study is adapting the design science approach as the methodology to achieve the research objectives through the implementation of several defined processes. Based on the explanation in previous sub-section, the rationales of using this approach are given as follows:

i) Design science approach is significant in a field that is oriented to working artifacts development that may consist of models, constructs, methods and instantiations intended to solve identified problems (Peffers, Tuunanen, Rothenberger, & Chatterjee, 2007). As in the case of this study, a hybridized model of spatial presence and GIT for IBVR in self-therapy is the final artifact.

ii) Design science provides a systematic approach in the process of constructing the artifacts (Mahfuzah, 2011).

iii) Design science approach involved the development and application of the artifact for the acquisition of knowledge and understanding of problems (Hevner et al., 2004).

iv) Design science comprises two principal activities, namely build and evaluate. Building is the process of developing an artifact for a determined purpose, while evaluation is the process of verifying the artifact successfulness (March & Smith, 1995). In relation to that, as mentioned earlier that this study is developing a hybridized model for IBVR in self-therapy as the artifact and it is evaluated comprehensively through user experience and spatial presence metrics.

Based on these rationales, DSRM is believed to be suitable and can be used for the implementation of this study due to its characteristics that meet the purpose and are appropriate in achieving the objectives of the study.

3.4 Phases in Methodology

Based on the typical design science research process model outlined by Vaishnavi et al. (2004) as illustrated in figure 3.1, adaptation of the model are developed accordingly taking into account the nature and objectives of this study. As mentioned earlier, DSRM for information system approach consists of five phases that basically work to develop artifacts and evaluate them thoroughly to ensure that the results meet the pre-determined objectives. Figure 3.2 shows the flow of the process carried out throughout this study. It is followed by sub-sections that provide more detail on the activities and outcomes of each phase, as well as the data and other resources involved.

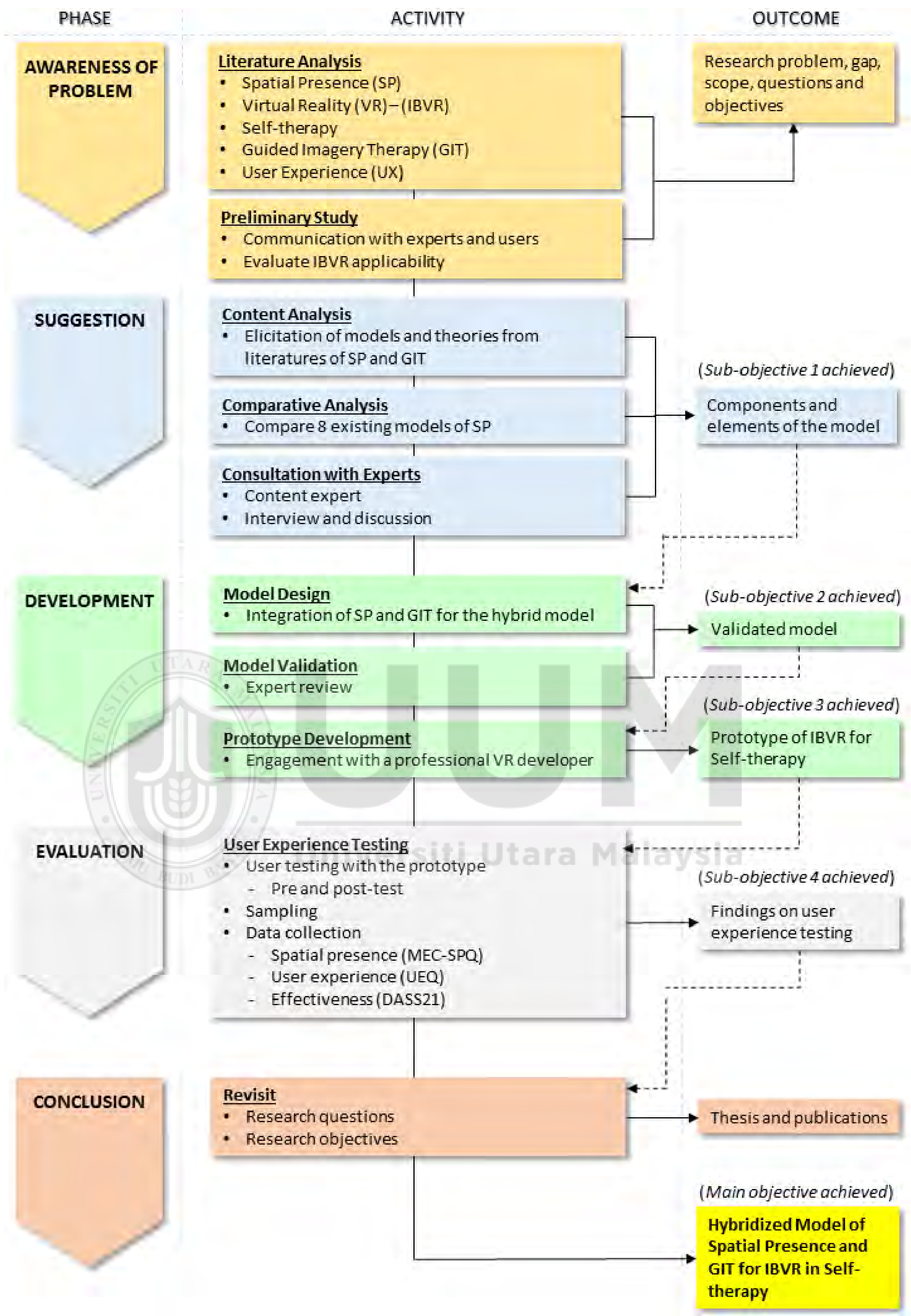


Figure 3.2. Phases and Activities of the Research Process

3.4.1 Phase 1: Awareness of the Problem

Figure 3.3 Phase 1 of the Research Process

In the first phase, the main goal is to identify the research problem to be solved through the study. The identified problem leads to the generation of research questions and objectives that become the core of the entire process and activities in this study. The process of identifying the research problem has involved two basic activities, namely literature analysis and preliminary research as illustrated in figure 3.3. In this phase as well, the scope of the study was determined in order to set the boundaries and limits of the implementation of this research. All of this is then put together and presented in a formal proposal that includes research problems and gaps, scope, questions and objectives. This has been discussed in the first chapter.

3.4.1.1 Literature Analysis

The purpose of literature analysis is to identify problems and gaps that need to be solved, as well as potential methods and techniques to solve those problems. Literature analysis was done through comprehensive reading and analysis of existing works from various sources including books, journal articles, proceedings, newspapers, magazines and real data. Analysis was done on resources related to virtual reality, image-based virtual reality, spatial presence, guided imagery therapy

(GIT) and self-therapy. The purpose is to find existing theories, approaches and models related to this study. The description and analysis for this literature is as provided in chapter two which includes subsections 2.1 until to 2.4.

In addition, this analysis also includes the topic of user experience (UX) because it is one of the evaluation methods used in the study to determine the level of user experience when interacting with the IBVR self-therapy tool prototype. Among other things, user testing also involves evaluating the spatial presence and effectiveness of the IBVR self-therapy tool on real users.

3.4.1.2 Preliminary Study

The preliminary study was conducted to strengthen the information and related concepts that have been obtained from the literature analysis. Basically, the main goal is to find out the IBVR applicability in managing stress. It was done by communicating with experts and users to get their reactions to the use of IBVR application as a therapy tool.

The preliminary study has involved experts in the field of psychology or counselling to obtain input related to stress issues and approaches that have been applied as a treatment for stress problems. It also includes their opinions and input on the use of VR technology as one of the approaches in dealing with stress. Meanwhile, user evaluation has involved pre-test and post-test for the use of the IBVR application conducted on them. The test results provide some indication of the potential and applicability of IBVR in stress interventions. The preliminary study activity has also been elaborated in details in the first chapter through section 1.3.

Above all, the activities in the first phase result in the identification of problems and gaps, which then lead to the generation of research questions and objectives. In particular, the practical problem of this study lies in the issue of stress in society which then leads to the introduction of self-therapy applications that provide alternative interventions for human social well-being in general. Meanwhile, the theoretical problem lies in the gap between the existing spatial presence model and GIT for the implementation of IBVR in supporting self-therapy. Next, in the second phase, the activities involved were focused on the process of identifying components and elements for the proposed hybrid model.

3.4.2 Phase 2: Suggestion

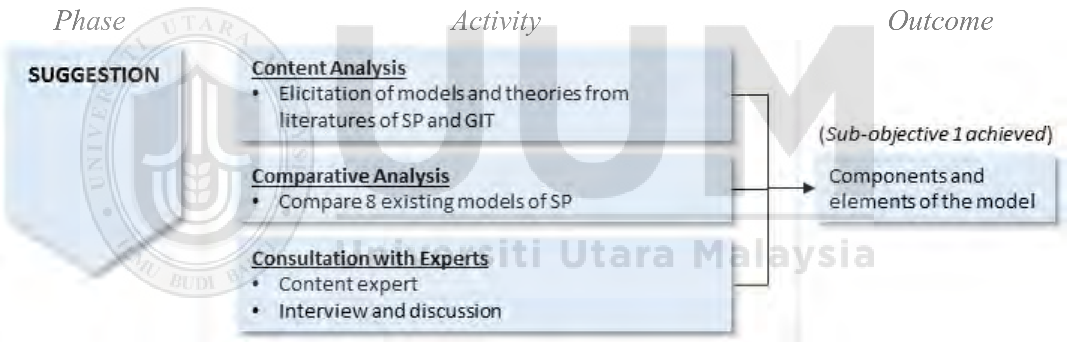


Figure 3.4. Phase 2 of the Research Process

During the second phase, solutions to the research problems and gaps identified in the first phase were proposed. This was accomplished through various activities, such as content analysis, comparative analysis, and consultation with experts, as visualized in Figure 3.4. The goal of these activities is to identify the necessary components and elements to create a hybrid model for IBVR in self-therapy, integrating spatial presence and GIT. The following subsections provide more in-depth information on each activity.

3.4.2.1 Content Analysis

Content analysis is an important step to extract knowledge related to this study from available sources, which can be obtained via various forms such as text, audio, video, and other informative sources (Preece et al., 2015). Compared to the initial literature analysis done in the first phase, this activity has involved a more in-depth analysis and literature elicitation that focuses on extracting existing concepts and theories of spatial presence, as well as practices in stress management, especially self-therapy and GIT. The purpose of the analysis is to identify the most relevant models and theories to be the foundation in determining the appropriate components and elements for development of the proposed hybrid model of spatial presence and GIT for IBVR in self-therapy. The selection of the models is based on the following justifications:

i) It is related to spatial presence and GIT

ii) It covers the fundamental principles of spatial presence and GIT

iii) It contains adequate description of spatial presence and GIT

As a result of the content analysis activity, eight models of spatial presence and ten models of GIT were selected, along with references on current practices in stress management specifically on self-therapy. This is also discussed in Chapter 4 through subsection 4.3.3. The selected models and theories were then used in the next step, which is the comparative analysis.

3.4.2.2 Comparative Analysis

The aim of comparative analysis is to compare existing models and theories to decide which components and elements that are feasible for the formation of the proposed model. As mentioned by Ariffin (2009), the conceptual models for different applications will probably have different requirements because they are used in different context with different technologies and possibly with diverse groups or types of users. Thus, comparative analysis is an activity that look into these differences, analysing on the similarities and dissimilarities in existing models that has been selected from the elicitation of the most prominent models in previous steps.

For comparative analysis, this study has implemented techniques applied by Ariffin (2009), Syamsul Bahrin (2011), Siti Mahfuzah (2011), Nurulnadwan (2015), and Siti Zulaiha (2017) in exploring, analysing and comparing spatial presence models that have been selected, as well as models and methods in stress management, especially GIT and self-therapy. The information extracted from the analysis is presented in a table. This result in the identification of appropriate components and elements for adaptation in the development of the proposed design model for IBVR in self-therapy. This is further explained in chapter four.

3.4.2.3 Consultation with Experts

After the components and elements for the model development have been identified, the next activity was consultation with the experts in order to obtain their response and inputs. The goal is to get official validation of the component and its suitability in the formation of the proposed model. The experts comments and recommendations are considerably crucial because the input is considered as reference in the decision making process during the model design and development (Hussein, Mahmud, Tap, & Jack, 2013; Preece et al., 2015).

The consultation involved interviews and discussions with two experts who are experienced in their respective field. The process basically involved gathering of ideas, agreement of concepts and reviews on the list of elements for the model development, gathered from previous phase. Eventually, at the end of the second phase, sub-objective 1 of the study was achieved that is to determine the appropriate components in the hybridized spatial presence model for IBVR in self-therapy. Next in the third phase, the components were integrated together through a predefined and concrete process of model development as described in the next sub-section.

3.4.3 Phase 3: Development

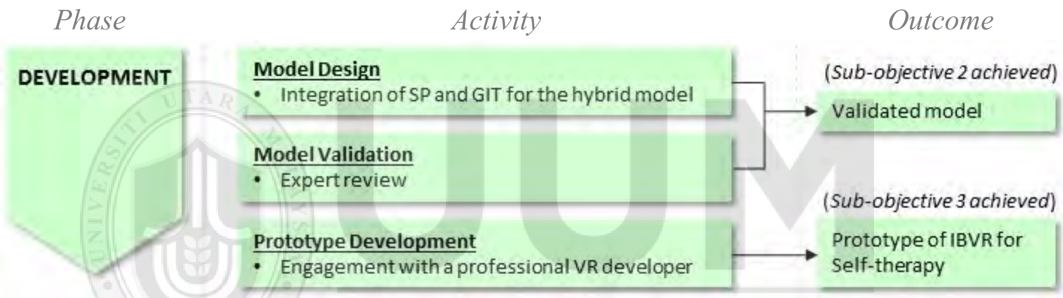


Figure 3.5. Phase 3 of the Research Process

The third phase is considered the focal point of the entire research process because the output of this phase is the main contribution of this study. In a design science research, the output could be in a form of design theories (Gregor & Jones, 2007), concepts, models, processes, instantiations (Hevner et al., 2004; March & Smith, 1995), frameworks or algorithms (Peffers et al., 2012). For this study, the main output is a design model that can be a guide in the development of IBVR applications for self-therapy, based on spatial presence theory and guided imagery therapy technique.

Referring to Figure 3.5, the development of the proposed model consist of three main activities which are model design, model validation and prototype development. Fundamentally, the model was designed based on the findings from previous phases, before it was validated through expert review to ensure its validity. Then, the model was translated into a working prototype for evaluation purposes.

3.4.3.1 Model Design

As presented in the Figure 3.5, the proposed model was designed by integrating components extracted from the selected spatial presence model as well as techniques in GIT to form a hybrid model for the development of IBVR in self-therapy. All the specified components and elements were systematically arranged to form the proposed model. A selected spatial presence model for IBVR was used as a basis in designing and developing the proposed model. Basically, the design and development of this model is an iterative process based on the input obtained from the validation and evaluation of the model, as described next.

3.4.3.2 Model Validation

Model validation is described as a set of processes or activities aimed at verifying whether the model works as expected or not. It also aims to ensure that the proposed model and its solution are effective and useful (Nurulnadwan, Ariffin, & Siti Mahfuzah, 2014; Peffers et al., 2007; Syamsul Bahrin, 2011). In addition, potential limitations and assumptions and their possible effects can also be identified through model validation (Mitchell, 2016).

In this study, model validation was conducted through qualitative approach using expert review method (Nurulnadwan, 2015; Siti Mahfuzah, 2011; Siti Zulaiha, 2017; Syamsul Bahrin, 2011) in order to verify that the proposed model is reliable and readable. Expert reviews is widely accepted as a significant way for improving the quality of a software and a complement testing method for other products as well (Weigers, 2002). In line with that, Shneiderman (2005) suggested that having between three to five experts in an expert review is sufficient.

This study has involved experts from application developers as well as academicians with more than five years of experience in different backgrounds including software engineering, virtual reality and human-computer interaction. The expert review process was carried out in several cycles involving different activities consisting of focus groups, interviews and questionnaires. Communication with the experts was conducted through face-to-face communication, emails and video calls. They were given a set of questions or instruments that consists of specific evaluation elements of the model. Subsequently, based on the feedback and result from the expert review activity, the model was refined accordingly before it was translated into a working prototype for user experience evaluation. The expert review process is further discussed in Chapter 4 through subsection 4.3.

3.4.3.3 Prototype Development

The development of prototype is typically done at the early stages of designing to support interface design, usability testing and other human factor activities. Prototype is technically an initial version that represent the 'look and feel' of a real system that aims at demonstrating the utility or suitability of the system. The use of prototype as a demonstration of a design can exhibit strong evidence to show that a design works and useful as intended. Among others, it can also provide some indication of the ability of the system to achieve the expected functionalities (Peffers et al., 2012).

Fundamentally, prototypes are divided into two types namely low-fidelity prototype and high-fidelity prototype. Low-fidelity prototype could be in the form of paper, cardboard or any material with the purpose of indicating the design direction. It could include elements of audio, visual, menus, colours and control location. It is very useful in analysing and generating requirements at the early stage of design, although the detail navigation and interaction are yet to be described at this stage. Meanwhile, high-fidelity prototype is an operated prototype with full navigation function in which users can interact with it as a real product.

In the course of this study, a low-fidelity prototype in the form of a storyboard was initially fashioned as the basis for the subsequent creation of a high-fidelity prototype for user experience evaluation in the next stage. Throughout this process, two methods for developing prototypes were employed, namely the throwaway and evolutionary prototypes. The throwaway method, as its name suggests, involves discarding the prototype once the necessary details are obtained, while the evolutionary prototype is continuously refined until it becomes the final product.

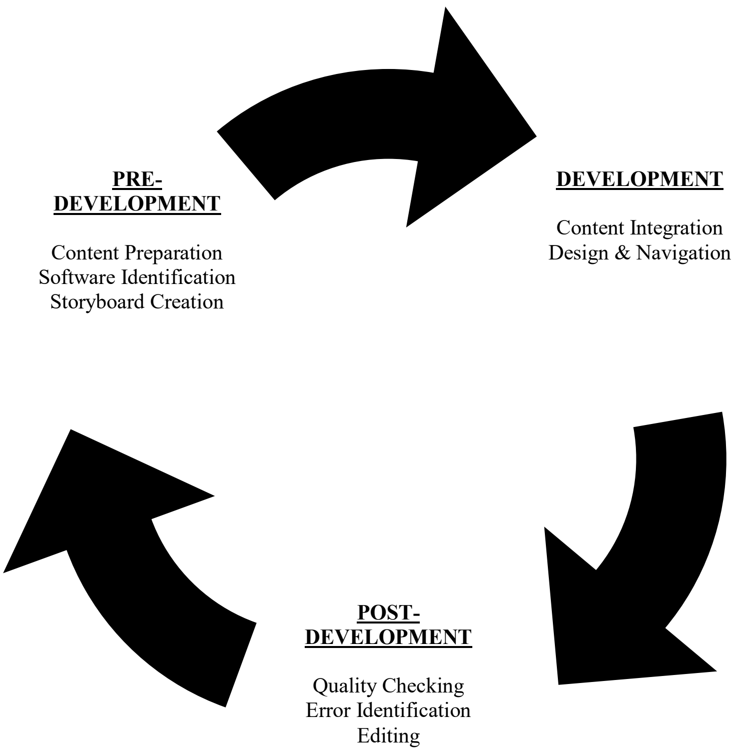


Figure 3.6. Prototype Development Cycle

For this particular study, a semi-working prototype was developed based on validated model components and elements. This was achieved through the use of the evolutionary prototyping method, which was employed in tandem with the software development cycles. The prototype development process consists of three main phases which are pre-development, development and post-development (Nurulnadwan, 2015; Siti Zulaiha, 2017; Syamsul Bahrin, 2011) as illustrated in Figure 3.6.

The pre-development phase incorporates the content preparation activity that include process of taking pictures or images and obtaining suitable sounds through recordings or from readily available sources, to be integrated into the prototype. This phase also involved the creation of a storyboard that visualize the screen layouts, flows, and navigation, integrating the interaction function and all other characteristics of IBVR for self-therapy that has been determined earlier in the model development phase. The software to be used for the prototype development was also determined in this phase.

In the development phase, a working prototype was developed using the selected software, based on the storyboard. All the content and elements prepared in the pre-development phase were integrated during the development of the prototype while properly considering the design and navigation features of the IBVR application for self-therapy. When it has finished, it was tested in the post-development phase to check quality and identify errors. Accordingly, editing was carried out based on the test results. The development process also involved external developers as a reference in ensuring the usability and validity of the development process, hence the prototype. Once completed, the prototype was used in the next phase of the study, which is evaluation.

Overall, the third phase of this study has produced a hybrid model of spatial presence and GIT for IBVR in self-therapy as proposed, together with a prototype of the IBVR tool. With the achievement of these two results, sub-objective 2 and sub-objective 3 of this study were achieved. In the following subsections, an explanation of the evaluation phase involving user experience testing is provided.

3.4.4 Phase 4: Evaluation

The evaluation of the proposed model was done through user experience (UX) testing, as illustrated in Figure 3.7. User feedback and perception is important to analyse the level of usability and user satisfaction with the developed application (Dix et al., 2004; Picard & Klein, 2002). The basis of user evaluation of a product is the way they see, feel and think when interacting with the product, whether it can promote a positive and enjoyable experience (Park et al., 2011; Tullis & Albert, 2013).

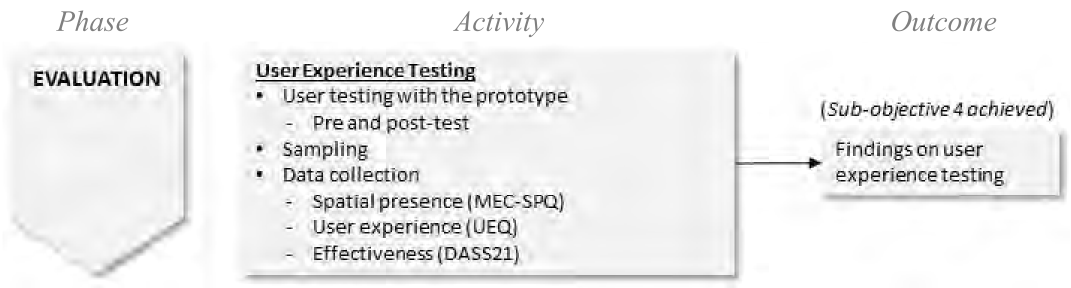


Figure 3.7. Phase 4 of the Research Process

For this study, the UX testing was conducted via the IBVR prototype, which applies the proposed hybrid model. The aim of this experimental testing is to evaluate on the spatial presence, user experience and effectiveness of the prototype, hence evaluating the model. Users were given the opportunity to use and interact with the IBVR prototype using a head mounted display (HMD) provided. After that, they were given a set of questionnaire to be answered. User feedback from the questionnaire was analysed quantitatively using descriptive analysis through the mean value of the test data obtained. This is further elaborated in Chapter 6.

In evaluating spatial presence, the users were tested through the Spatial Presence Metrics for IBVR (SPQ-IBVR) which was developed based on the Spatial Presence Model for IBVR by Nadia (2017). The items of the SPQ-IBVR comprise four key components of spatial presence namely calmness, interactivity, perceptual realism, and spatial presence itself. The items are intended to measure the appropriateness of the model components in generating the sense of spatial presence for the user during their interaction with IBVR self-therapy prototype.

While for evaluating user experience, a standard User Experience Questionnaire (UEQ) by Laugwitz et al. (2008) was utilised. It is a well-known and reliable method that has been used in the UX measurement of various applications (Hinderks, Schrepp, & Thomaschewski, 2018; Kusumo & Hartono, 2019; Davidavičienė, Raudeliūnienė, & Viršilaitė, 2020). However, this study implemented a short version of the UEQ (UEQ-S) due to the characteristic of the experiment of this study that involves several different measurements. This is line with the generic application scenarios in which only a very small number of items can be used to measure user experience, as outlined in the UEQ handbook (Schrepp, 2019).

On the other hand, evaluation on the effectiveness was done through the Depression, Anxiety and Stress Scale (DASS-21) to measure users stress level before (pre) and after (post) interacting with the IBVR prototype. The changes of the stress level between pre and post-test were compared in evaluating the effectiveness of the application for its intended purpose to reduce stress. The DASS-21 questionnaire is among the various instruments used to identify stress levels. The use of the DASS-21 questionnaire in this study is based on its credibility in various researches in various fields including VR therapy (Elbay, Kurtulmuş, Arpacıoğlu, & Karadere, 2020; Islam et al., 2020; Zaharuddin, Ibrahim, & Yusof, 2022).

The population for the UX testing was the students in selected higher institution. Random sampling was used in selecting those students who are having a normal, mild and medium stress level based on the DASS score (1-Normal, 2-Mild, 3-Medium, 4-Severe). However, students with severe stress level were not considered for this study and advised to seek for professional help from the therapist or counsellor. In addition, Roscoe (1975) suggested that sample size between 30 and 500 are appropriate for most research. Nevertheless, for simple experimental research with tight experimental controls, sample size as small as 10 to 20 are applicable for an effective research. In the case of this study, the experiment has involved 100 selected samples from a predetermined population.

The results of the UX testing were then analysed and scrutinized, hence achieving sub-objective 4 of the study which is to evaluate the proposed hybridized model of spatial presence and GIT for IBVR in self-therapy. Based on the results, final refinement of the proposed model was performed to visualize the model before the final model was confirmed and ready for utilization.

3.4.5 Phase 5: Conclusion

In the final phase of the study, all the findings gathered in the previous phases were concluded by referring back to the research questions and objectives of the study. After ensuring that all questions are answered and all objectives are achieved, a complete thesis has been produced in addition to several publications as part of the requirements and contribution to the body of knowledge. These activities of the final phase can be visualized as in Figure 3.8.

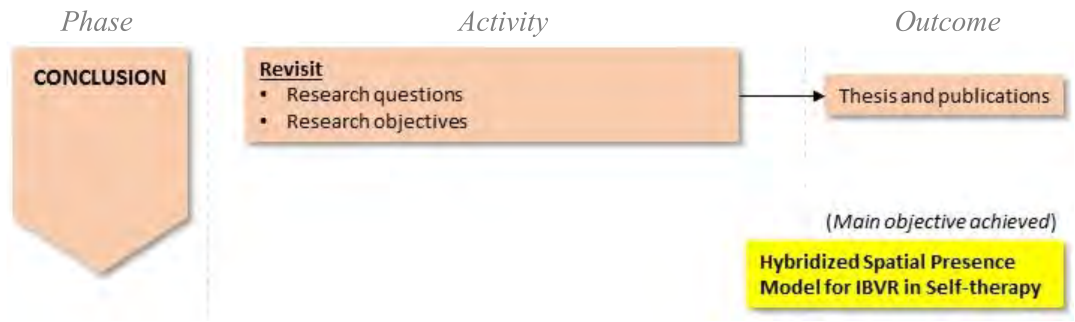


Figure 3.8. Phase 5 of the Research Process

Above all, this study's results are helpful for application developers looking to create IBVR tools for self-therapy to overcome stress. The proposed model's concepts and elements can also contribute to psychology research and development. The prototype created in this study can benefit the community of mental health by demonstrating the IBVR technology potential as a possible approach to stress management. Ultimately, it's hoped that these findings will improve society's well-being and increase productivity through mentally healthy human resources.

3.5 Summary

In summary, this chapter explains how the entire study was conducted based on the implementation of a methodology adapted from the Design Science Research Methodology (DSRM). The rationale for implementing the methodology is also explained for the purpose of justification and explanation. This chapter also elaborates on the processes of conducting the study from the beginning until the end that comprises five main phases which are: (i) awareness of the problem, (ii) suggestion, (iii) construction, (iv) evaluation and, (v) conclusion.

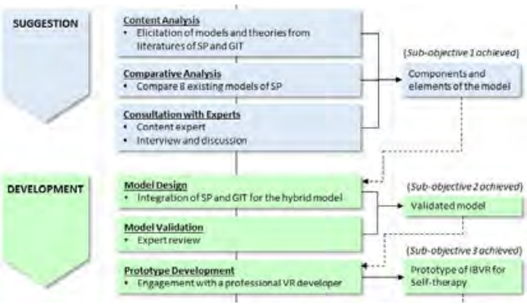
CHAPTER 4

MODEL CONSTRUCTION

4.1 Introduction

This chapter elaborates on the activities of constructing the hybridized model of spatial presence and GIT for IBVR in self-therapy. It includes model design and model validation, before it is proceeded with the development of a prototype for user evaluation, which is explained in the next chapter. As previously described, the proposed model has been designed based on the spatial presence model and GIT concept selected from existing studies, by integrating all the components and elements identified from those studies. The following subtopics provide more details on the model design and validation. This also includes some description on the models and components selected for the proposed hybrid model that will be referred to as SP-GIT4IBVRST hereafter.

4.2 Model Design



As mentioned earlier in previous chapter, the proposed model was designed and constructed based on the most relevant existing spatial presence model which has been selected through content analysis and comparative analysis that was carried out in phase two of this study. From the analysis, it was decided that the spatial presence model for IBVR (SPM4IBVR) by Nadia (2017) was chosen as the basis of this study because it was specifically built to generate sense of spatial presence in IBVR. The model was basically adapted from the spatial presence theoretical model by Wirth et al. (2007). It is also emphasized that the GIT technique, as one of the interventions in psychotherapy, has been chosen to be used in the proposed model as an approach to self-therapy. In this study, Nadia's SPM4IBVR was integrated with the GIT technique to form a hybrid model of spatial presence for IBVR in self-therapy (Figure 4.1).

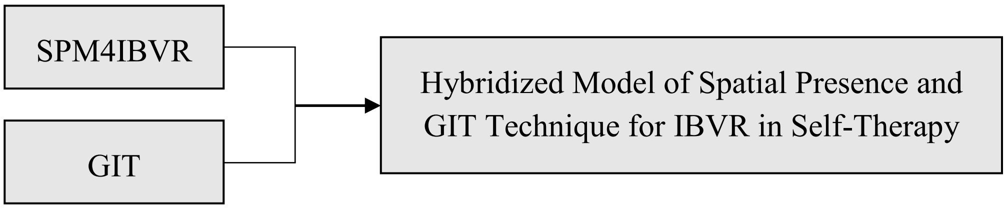
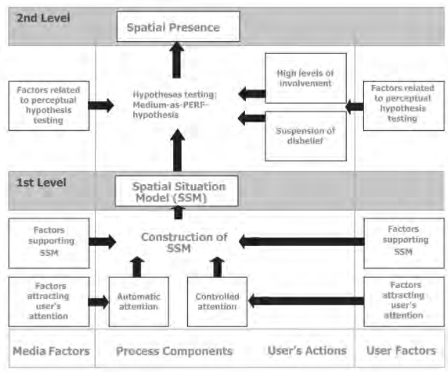


Figure 4.1. Hybridized Model Design

All components and elements of both SPM4IBVR and GIT were taken into account in designing and building the proposed model. In the next sub-topic, a brief description of the content of Wirth's theoretical model, Nadia's SPM4IBVR and GIT is provided. It then continues with a description of how these models have been used in the construction of the proposed SP-GIT4IBVRST design model.

4.2.1 Spatial Presence Theoretical Model (Wirth et al, 2007)



The Wirth's theoretical model is organized in two level and consist of two main factors that contribute to the existence of spatial presence, namely (1) media and (2) user (human). According to this model, the spatial situation model (SSM) needs to be achieved at the first level, as a pre-requisite for producing a sense of spatial presence at the second level of the model. The characteristics of both media and user factors determine the successfulness of achieving SSM and spatial presence. Also, another main component of the Wirth's model is the Primary Egocentric Reference Frame (PERF) which is the intermediate between SSM, media factors, user factors and spatial presence. A brief description of each of these components is given in the following paragraphs.

- Spatial Situational Model (SSM)
    - It refers to the user's mental representation of the mediated environment that leads to the recognition of the space in the environment.
    - It is based on the concept of attention allocation where only users who pay attention to the mediated environment will experience a spatial presence.
    - Factors that can attract the attention of users are the media and the users themselves.
    - User's attention can be triggered involuntarily or by the user's control.

- Primary Egocentric Reference Frame (PERF)
    - Spatial presence occurs through the confirmation the medium-as-PERF-hypothesis.
    - The plausibility and richness of SSM affects the perceptual test of the medium-as-PERF-hypothesis.
    - Other media and user factors can also support the medium-as-PERF-hypothesis testing.
    - Confirmation of the hypothesis testing implies that the mediated environment is accepted as the PERF and the users position themselves within the environment, hence spatial presence occurs.

- Media Factors
    - The media factors that can generate attention allocation are the form and content variables of the media. If the media can produce continuous and detailed information with several types of modalities, it should be able to attract user's automatic attention.
    - Media factors that support the construction of SSM is the spatial cues that can be in the form of visual, audio, haptic or text. The media that display a variety of concise, consistent and plausible spatial cues should evoke richer and consistent SSM.
    - The media factors that contribute to the formation of SSM also influence the medium-as-PERF-hypothesis testing.
    - Other media factors that can affect the result of the hypothesis testing are congruence across modalities, persistency, interactivity and realism.

- User Factors
    - User factors that can generate users' attention towards a media voluntarily is the domain-specific-interest of the users. It could affect their motivation towards a media and its content, even if there are no strong media factors.
    - User factors the support the construction of SSM is the spatial imagery (ability to produce vivid spatial images). Individuals with higher spatial imagery ability can increase the richness and consistency of the SSM.
    - User factors that can support the medium-as-PERF-hypothesis testing are involvement and suspension of disbelief.

Based on these components and the design of Wirth's theoretical model of spatial presence, Nadia (2017) has proposed and constructed a spatial presence model for IBVR (SPM4IBVR) with the main objective of enhancing spatial presence experience, specifically in IBVR applications. The next sub topic discuss in more details of the components and elements in SPM4IBVR.

4.2.2 Spatial Presence Model for IBVR (Nadia, 2017)

Nadia (2017) constructed her own version of spatial presence model for IBVR by adapting only certain part Wirth's theoretical model, as illustrated in Figure 4.2. Specifically, SPM4IBVR by Nadia (2017) is only adapting the second level of the Wirth's theoretical model and focusing on the media factors and process components. The other part of the Wirth's model is not included, as the scope of SPM4IBVR is only on the media factors that can evoke spatial presence, instead of user factors.

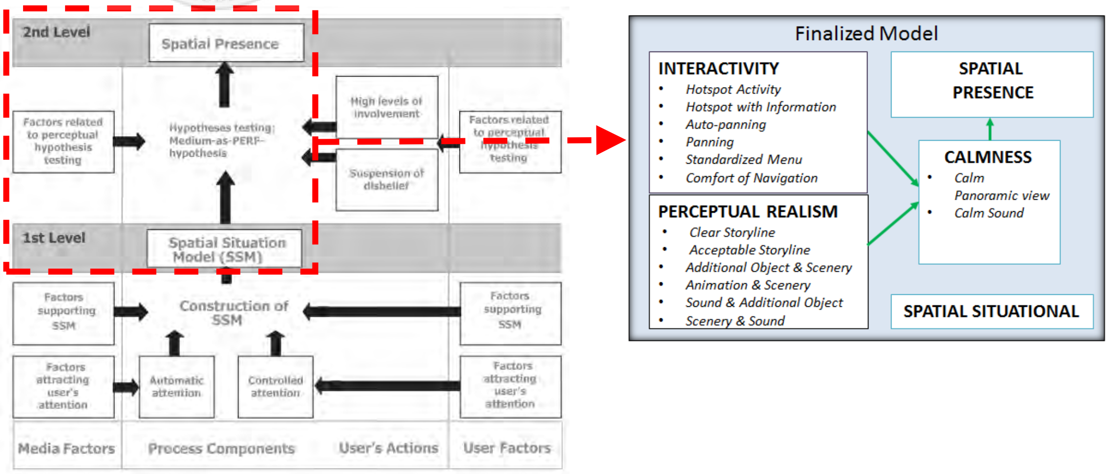


Figure 4.2. Scope of SPM4IBVR from Wirth's Theoretical Model (Nadia, 2017)

According to Nadia's SPM4IBVR, there are three major components that should be available in IBVR to enhance user's spatial presence experience, namely (1) interactivity, (2) perceptual realism and (3) calmness. Interactivity and perceptual realism is referring to the characteristics of IBVR that can contribute to the existence of spatial presence. While, calmness is the characteristic assigned as the PERF for creating special presence in IBVR. However, the model shows that there is no connection between SSM and PERF-hypothesis. It implies that the sense of spatial presence in IBVR can be experienced by the user without having to go through SSM. Table 4.1 shows the elements for the components in SPM4IBVR and they are briefly explained in the following paragraphs.

Table 4.1

Elements for the components in SPM4IBVR

Components	**Elements**
Interactivity	Hotspot activity, hotspot with information, auto panning, panning, standardized menu, comfort of navigation
Perceptual Realism	Clear storyline, acceptable storyline, additional object and scenery, animation and scenery, sound and additional object, scenery and sound
Calmness (PERF)	Calm panoramic view, calm sound

- Interactivity

It is divided into two categories; interaction function and overall navigation. Interaction function refers to the functions in the IBVR that enable users to interact with the application, which are panning and hotspot. Panning function is used to watch the IBVR panoramic virtual environment in 360 degrees. While the hotspot function gives users the ability to shuttle from one virtual environment to another.

Overall navigation refers to the overall functions and menus in the IBVR application, with the main focus on standardized menus and comfort of navigation. Menus in the virtual environment should be standardized and similar to other applications, to helps users to understand the IBVR application easily. Also, users should be given the comfort of navigation by providing unlimited time frame to navigate through the virtual environment.

- Perceptual realism

It is categorized into harmonious combination and storyline. The harmonious combination refers to the additional objects, recorded natural sounds and panoramic views that are integrated in IBVR application that could create perceptual realism. While storyline refers to the sequence of images that creates the environment in IBVR application. Clear and acceptable flow of the storyline contribute to perceptual realism thus support the spatial presence experience of the user.

- Calmness

It is defined as the PERF component which functioned as the intermediate to induce spatial presence. Nadia (2017) claimed that perceptual realism and interactivity alone cannot evoke spatial presence in IBVR. Instead, it should also have the calmness characteristic that includes calm panoramic view and calm sound. Clean and beautiful view of the environment, accompanied by the natural sound could also support user's calmness, thus generate the sense of spatial presence.

As a whole, the SPM4IBVR by Nadia (2017) has outlined the characteristics that an IBVR should have in order to enhance user's spatial presence experience when interacting with the application. For the purpose of this study, the characteristics from SPM4IBVR were integrated with the elements from GIT technique to form a hybridized model for IBVR in self-therapy. The next sub topic elaborates more on the elements of GIT, based on its' normal practices in psychotherapy.

4.2.3 Guided Imagery Therapy (GIT)

GIT technique is one of the traditional approach in the management or intervention of stress related problem (Latif et al., 2015; Robinson et al., 2019). The purpose of the therapy is to give the sensation of relaxation by asking the patient to imagine of 'being in' a favourite location (Nadia & Dayang, 2018). During the therapy, the client is instructed or guided by a therapist to imagine a relaxing scene or experiences (Overholser, 1991). Basically, the therapist will start with a brief breathing and relaxation exercises before giving instructions on the imagination. The therapist will then asked the patient to imagine peaceful images of nature with specific details, by involving multiple senses like visual, hearing, smell, touch and taste. Natural sound or background music could also be used to support the imagination. Therapist will give some suggestions for desired changes and coping strategies to the patient based on the problems to be solved.

Table 4.2 shows the GIT characteristics obtained from several existing studies related to psychotherapy using GIT techniques, in several different situations.

Table 4.2

Characteristics of GIT in Existing Studies

Author	Guide/ Script	Deep breathing	Relaxation exercise	Deepening Strategies	Multiple senses	Natural/ ambient sounds	Background music	Peaceful nature images	Variety of images	Specific details	Client experience/ preference	Suggestions for desired changes	Coping strategy	Logical sequence
Overholser (1991)	/	/	/	/	/			/	/	/	/			
Apóstolo (2009)	/	/	/		/	/	/	/						
Owen (2010)	/	/	/		/	/	/				/			/
Kim et al. (2012)	/	/	/							/		/		
Othman et al. (2013)	/	/	/		/		/	/		/		/		/
Jallo et al. (2014)	/	/	/		/				/	/		/		
Prabu (2015)	/	/			/	/		/		/				
Elias et al. (2015)	/			/	/							/	/	
Beck et al. (2015)	/		/				/						/	
Hosseini et al. (2016)	/					/		/				/		
Felix et al. (2019)	/	/	/					/				/		
Felix et al. (2018)	/	/	/		/	/	/			/				

From Table 4.2, it can be generalized that the most common practices or characteristics of GIT as demonstrated in existing studies are:

- Therapist guide/script
    - Therapist guides the patient to imagine a relaxing scene. It can also be in a form of pre-recorded audio and played during the therapy. The recorded audio is based on a prepared script.

- Deep breathing
    - Normally the guide or script starts with an instruction for the patient to do deep breathing technique before proceeding with the therapy.

- Relaxation exercise
    - Other than breathing technique, patients are also instructed to do some relaxation exercise before the imagination. The exercise could be a kind of muscular relaxation sequence.

- Multiple senses
    - The imagination may incorporate multiple senses in which the patient is guided to use all senses possible like vision, sound, touch, smell and taste, making the imagined scenes more realistic.

- Natural sound/ambient
    - The patient is asked to imagine the sound of the nature following the images. The natural sound can also be added as the background music during the therapy.

- Peaceful images of nature
    - The patient is guided to imagine the sceneries of peaceful nature.

- Specific details
    - The therapist provides a specific details of the images in the therapy so that it can assist the patient in their imagination.

- Suggestion for changes
    - The therapist give suggestions for desired changes to the patient in order to reduce the stress.

Besides these characteristics, there are also other factors that should be taken into consideration when applying GIT. As suggested by Owen (2010), the sequence of images provided in the imagination must be in a logical manner and orderly. He also mentioned that over-structuring of the use of words in the therapy script will interferes with the imagination. Instead, just few modifying words are adequate while giving the patient the capacity to decide and do the rest.

The next subtopic discusses the specification of components for the proposed hybrid model of spatial presence and GIT for IBVR in self-therapy. The components were extracted based on the characteristics of SPM4IBVR and GIT, as described above. These components were then integrated in the formation of the hybrid model proposed in this study.

4.2.4 Components of the Proposed Model

As noted from the outset, the scope of this study is to identify features of the virtual environment in IBVR that can induce a sense of spatial presence to users and provide a feeling of relaxation, thereby reducing stress. To achieve that, this study proposes the integration SPM4IBVR components (Nadia, 2017) and GIT features to construct a hybrid model for the development of IBVR specific to self-therapy. Thus, the components for the proposed hybridized model are the combination of elements from SPM4IBVR and GIT. Table 4.3 indicates that there are some similarities between the components of SPM4IBVR and GIT.

Table 4.3

Similarities between SPM4IBVR and GIT

SPM4IBVR	**GIT**
Scenery and sound	Multiple senses
Calm panoramic view	Peaceful images of nature
Calm sound	Natural sound
Clear storyline Acceptable storyline	Logical sequence
Additional object and scenery Animation and scenery Sound and additional object	Specific details

In GIT, patients are guided through the imagination by involving multiple senses like vision, sound, touch, taste and smell. While SPM4IBVR has included scenery and sound as part of model that could stimulate the vision and sound senses of the users. Despite the limited interactivity in IBVR from the use of static images, users can still feel the spatial presence through high quality and realistic photograph, supported with the natural sound as the background.

GIT technique also involves the use of peaceful nature images during the therapy. The patient is guided by the therapist to imagine peaceful views of nature, together with the natural sound of that nature to create relaxing scenes. This is in line with the element of calm panoramic view and calm sound that are included in SPM4IBVR under the component of calmness. It suggests that an IBVR with calm panoramic view and calm natural sound could evoke the sense of spatial presence to the user.

Other than that, as mentioned previously, Owen (2010) has suggested that the images provided during GIT must be logical and orderly to assist the patient in their imagination and avoid confusion. This characteristic is almost similar to the elements in SPM4IBVR that suggests for a clear and acceptable storyline in IBVR to stimulate users' spatial presence experience. The storyline is referring to the sequence of the virtual environment in IBVR which has the start, middle and end.

Another characteristic of GIT is the specific details of the images (Overholser, 1991; Prabu & Subhash, 2015). It is suggested that the guides comprise great details of images to assist the patient in creating vivid imagination. However, the guide should not be in the form of verbatim but just a general description of the imagery. Similarly, SPM4IBVR also suggested to include additional objects, animation and appropriate natural sound that is synchronize with the virtual environment to make the panoramic view in IBVR more realistic. These added details of the environment could enhance the spatial presence experience of the user.

Therefore, it can be summarized that most of the characteristics or elements of GIT are already available in SPM4IBVR. This shows that the model by Nadia (2017) is well suited for the development of the hybridized model for IBVR in self-therapy based on GIT technique. Nonetheless, there are also other elements in GIT that should be present in the model to make it even more specialized for self-therapy to relieve stress. Table 4.4 shows the list of other characteristics of GIT and SPM4IBVR not mentioned above.

Table 4.4

Other Characteristics of SPM4IBVR and GIT

SPM4IBVR	**GIT**
Hotspot activity	Therapist guide/script
Hotspot with information	Deep breathing
Auto panning, panning	Relaxation exercise
Standardized menu	Suggestion for changes
Comfort of navigation	

As can be seen in table 4.4, the other characteristic of GIT that is not available in SPM4IBVR is the therapist guide/script. Meanwhile, other features (i.e. deep breathing, relaxation exercises, suggestion for changes) refer to elements that need to be included in the therapy guide/script. To implement the IBVR therapy approach, therapist guidance is added to the model while maintaining the features of SPM4IBVR to enhance the experience of spatial presence and thereby relieve stress. For the purposes of this study, the therapist's guide is provided in the form of an audio recording script referred to as a narrative.

In the next sub topic, the proposed hybridized model of spatial presence and GIT technique for IBVR in self-therapy is elaborated, based on the components and elements discussed above.

4.2.5 The Initial Proposed Model

This study proposes a hybrid model for IBVR that is specifically designed for self-therapy. It basically integrates the components in SPM4IBVR (Nadia, 2017) and GIT technique. The SPM4IBVR by Nadia (2017) was adapted from Wirth's theoretical model of spatial presence (Wirth et al., 2007) and focuses only on the media factors that could enhance users' spatial presence experience. Wirth's et al. (2007) suggested that among the media factors which can effect and induce spatial presence experience of the users are interactivity, realism, persistency and congruence across modalities. Similarly, Nadia (2017) has categorized the characteristics of IBVR in SPM4IBVR into interactivity, realism and calmness.

In previous sub topic, it is highlighted that most of the characteristics of GIT are similar to that of the SPM4IBVR. This makes the spatial presence model by Nadia (2017) is highly significant and applicable for this study. With additional characteristics of GIT, an initial hybrid model for IBVR in self-therapy has been proposed and produced, as illustrated in figure 4.3. Then the following paragraphs provide brief descriptions on the components and elements of the proposed model. They are divided into four main categories which are scenery, sound, narration and function and navigation.

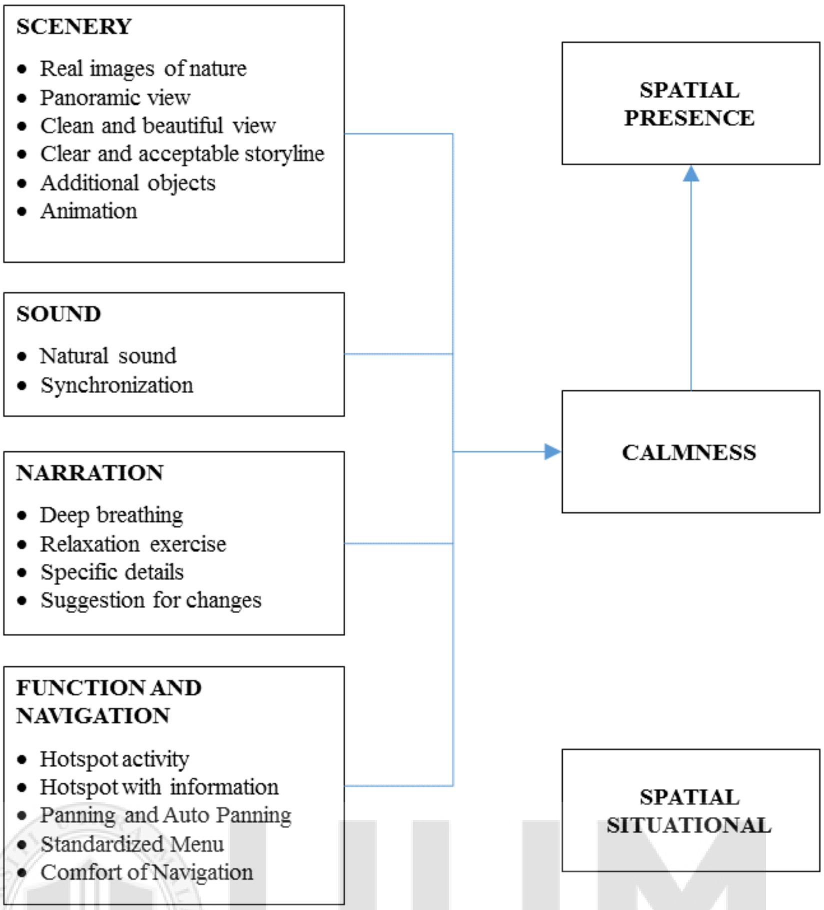


Figure 4.3. Initial Proposed Model

- Scenery

The scenery in the IBVR self-therapy environment should display real images of nature with beautiful and clean panoramic views. The images sequences (storyline) should be clear, acceptable, and easy to understand. The presence of additional objects in the panoramic view can enhance the user's feeling of being in a virtual environment. Additionally, the inclusion of simple animations in the environment can create a greater sense of presence for the user.

- Sound

The scenery in IBVR is a combination of photographs that display the real views of nature. The inclusion of natural sound could give more sense of presence, being located in the virtual environment. However, the natural sound must be presented in sync with the views as well as the additional objects that exist in the scenery.

- Narration

For therapy purposes, the therapist's recorded voice or narration should be included in the IBVR to assist the user in stress relief. Narration should contain common or standard elements in GIT i.e. deep breathing, relaxation exercises and suggestions for desired changes, based on the problem to be solved. The script in the narration can be made in a specific form about the environment to help the patient focus in the therapy process.

- Function and Navigation

A hotspot function in the IBVR allows users to change the views from one scene to another. It gives users the ability to explore and navigate through a virtual environment. A simple explanation or information should be added to the hot spot in order to make the user understand its function. Another important feature in IBVR is the panning function that allows the user to view the virtual environment from left to right and vice versa. Users can use the automatic panning function or manual panning according to their preference.

Among other things, the menu provided in the IBVR application should be in a standard format so that users can easily understand it. This can be achieved by creating menus or icons similar to other applications that users are familiar with. It is also important to ensure that users do not face any difficulties in using the navigation function to interact with IBVR, thus providing navigation comfort. This also includes time flexibility for users to navigate through the environment.

4.3 Model Validation

The aim of model validation is to verify that the proposed model meets the requirements and is reliable for implementation. As a result, the model validation process produces a validated version of the proposed design model before it is translated into a prototype for user evaluation. In this study, the model validation was conducted through expert review.

The expert review aims to evaluate the proposed design model in terms of relevancies of the proposed components and elements, readability and understandability of proposed model. The experts review the proposed model to identify any loopholes and areas for improvements to ensure that it is in line with the main objective. In this study, the model has gone through several cycles of expert review process with several different experts whose expertise are relevant to this study. Figure 4.4 illustrates the expert review process cycles.

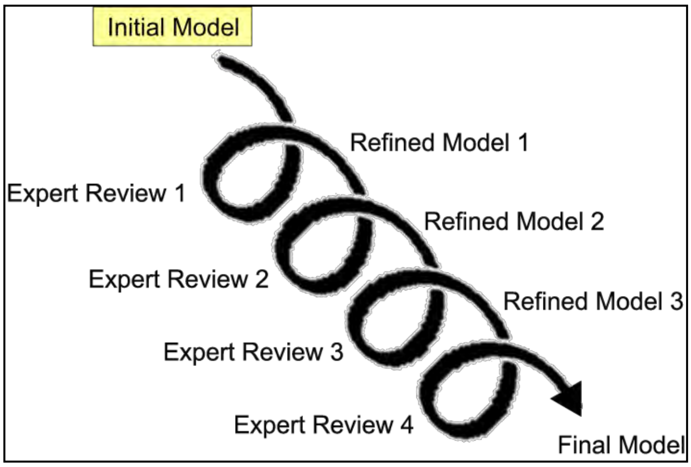


Figure 4.4. Expert Review Cycles

In each cycle, the experts were responsible for reviewing the proposed SP-GIT4IBVRST hybrid model and providing appropriate reviews and recommendations for improvement. The experts were selected based on the following criteria:

- Have academic qualification (Master/PhD) in related field, either in Multimedia (MM) or Human Computer Interaction (HCI) or Virtual Reality (VR) or Computer Science (CS) and/or
- Have experience in teaching/studying/researching/practicing MM or HCI or VR or CS field for at least 5 years

For this study, a total of six experts were involved voluntarily as reviewers for the proposed model. The number of experts is sufficient and it is in line with the statement of Schneiderman (1998) who stated that three to five experts is a satisfactory number for expert study. Table 4.5 shows the demographic profile of these experts.

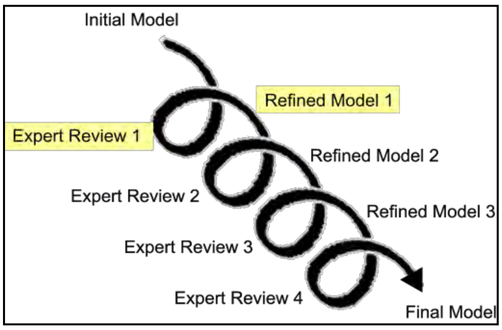
Table 4.5

Demographic Profile of the Experts

Expert	Gender	Education	Field of Expertise	Year of Experience	Affiliation
A	Female	PhD	Virtual Environment Design, HCI	29	Universiti Tenaga Nasional (UNITEN)
B	Female	Masters	Games development and testing, UI/UX, assistive technology	23	Universiti Tenaga Nasional (UNITEN)
C	Female	PhD	HCI – evaluation of usability and experience in interaction in various platform	18	Universiti Islam Antarabangsa Malaysia (UIAM)
D	Female	PhD	VR, Virtual Heritage, AR/XR	20	Universiti Utara Malaysia (UUM)
E	Female	PhD	VR	5	Universiti Utara Malaysia (UUM)
F	Male	PhD	HCI/UX	20	Universiti Utara Malaysia (UUM)

As can be seen from Table 4.5, the experts are mostly from the fields of VR and HCI with academic qualifications at the PhD and master's degree levels. Expert A and B, besides being an academician in higher learning institution, also have experience in VR design and development, including application in stress therapy. On the other hand, Expert C has deep experience in the field of HCI with a greater interest in evaluation methods for usability and user experience in various platforms, including VR. Meanwhile, through researches and industrial collaborations, expert D's experience is mostly focused on VR with interest in UX in VR design, development and evaluation. Expert E interest is more on VR, particularly in the development of IBVR for therapeutic purposes. While Expert E has convincing experiences and expertise in HCI/UX with a great number of researches and industrial involvements. These experts are highly relevant to this study and have really contributed to the improvement of the proposed design model.

4.3.1 First Cycle



The first cycle of the expert review were conducted with two experts who were available at the time of scheduled evaluation session. The procedure for the evaluation was very straight forward. The experts were gathered in a conducive dedicated room, equipped with audio/visual and discussion panel setting. The session was chunked into three parts: briefing, analysing, de-briefing.

In the briefing part, the experts were presented and given a description on the initial model that had been developed. They were briefed about the model, the users, and the context of use. They were allowed to ask questions for crystallization. Then, in the analysing part, the experts went through the model, and were allowed to ask questions for crystallization. Among questions they asked were on the characteristics of the users and the context of use, so that they could map with the model. Through the crystallization, experts have provided some comments and suggestions for improvement on the model. In the debriefing, this study recap all comments and recommendations outlined by the experts, to ensure the experts are satisfied. Then this study expressed appreciation on the experts' consultation.

Among the experts' comments include (1) the model should represent the actual structure of a GIT session to facilitate designers and application developers in developing IBVR applications specifically for therapeutic purposes. (2) the model should incorporate a standard virtual reality design model, (3) the model should have a clear structure, so that reading it has a clear flow, (4) every component in the model should be connected, (5) every component should have specific elements, and (6) the model should consider current advancement.

As a response to the first comment, this study refers to the existing literatures on GIT as highlighted in Table 4.2. Through the literatures, it is found that the most common structure of the therapy session can be organized in three parts as illustrated in Figure 4.5:

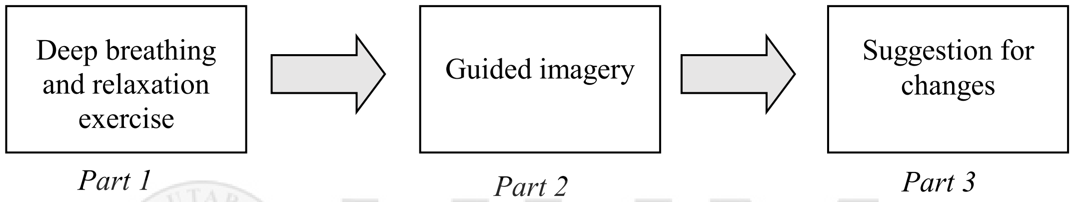


Figure 4.5. Common structure of GIT session

Part 1: Deep breathing and relaxation exercise

- Therapist asked the patient to do deep breathing and muscle relaxation in order to help the patient to stay focus and relax.

Part 2: Guided imagery

- Therapist asked the patient to imagine peaceful images of nature by involving multiple senses

Part 3: Suggestion for changes

- Therapist give suggestions to the patient for desired changes and coping strategies, based on the problems.

Secondly, for the recommendation on incorporating a standard VR design model, this study has incorporated the components for VR development based on several existing studies. A VR design model is necessary to be included in this study because the proposed model is intended to guide application developers in developing IBVR applications for stress therapy. Fundamentally, there are five (5) basic components of virtual reality that need to be applied in the proposed model of this study, as outlined in the literature (Bamodu & Ye, 2013; Gorski et al., 2017; Hanson & Shelton, 2008; Zhang, 2017). These components are shown in Figure 4.6 and are briefly described in the paragraphs that follow.

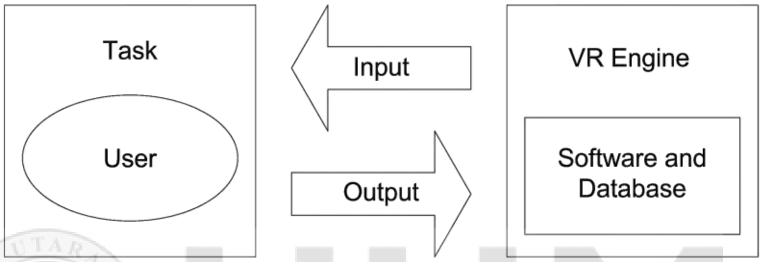


Figure 4.6. Standard VR System Components

1. Task
   - The activity as the main part of the virtual world, based on user's problem to be solved. In this study, the task consists of the exploration of the virtual environment based on the given instructions for the purpose of relieving stress.
2. User
   - The human or subject that interacts with the VR system. The user for this study will be those who may have problem with stress condition.
3. Input and output
   - Input: Data sent to the computer system based on user's interactions with the virtual environment

- Output: Computer rendering of the input from the user based on the interactions

4. Software and database
   - Modelling of the objects in the virtual environment and integration of all the pieces in the VR system
5. VR engine
   - The computer architecture to run the virtual environment

Next, to address the third and fourth comments related to the flow and connection between components, lines and arrows have been placed in the model, connecting related components to show the structure and relationship between those components in forming the proposed model. The structure and relationships are based on the concepts and theories derived from existing literatures. Whereas, for the fifth recommendation on specific elements for each component, this study has included and placed the relevant elements under each component in the model, which have been identified through comparative analysis of existing models.

Then, for the reviewer's final comment on current advancement, this study identifies the technologies for input and output in virtual reality that are relevant to this study, particularly for visual and audio. The most common output devices for displays in VR are the computer visual display unit and the head-mounted display (HMD) for visual, and headphones for audio. As for the interaction between user and the virtual environment, the most commonly used input devices are joysticks or controllers, instrumented gloves, keyboards and voice recognition (Okechukwu & oduka, 2011; Anthes et al., 2016). For this study, HMD and headphones are main output devices for visual display and audio. For input and interaction, the HMD is also equipped with head tracking ability as input for panning and auto panning functions. While the controller is used mainly for the selection of hotspot and menus, which is categorized under the type of tactile input.

Accordingly, with reference to the general structure of the GIT session and the basic components of the VR system as described above, the proposed initial model was refined as illustrated in Figure 4.7.

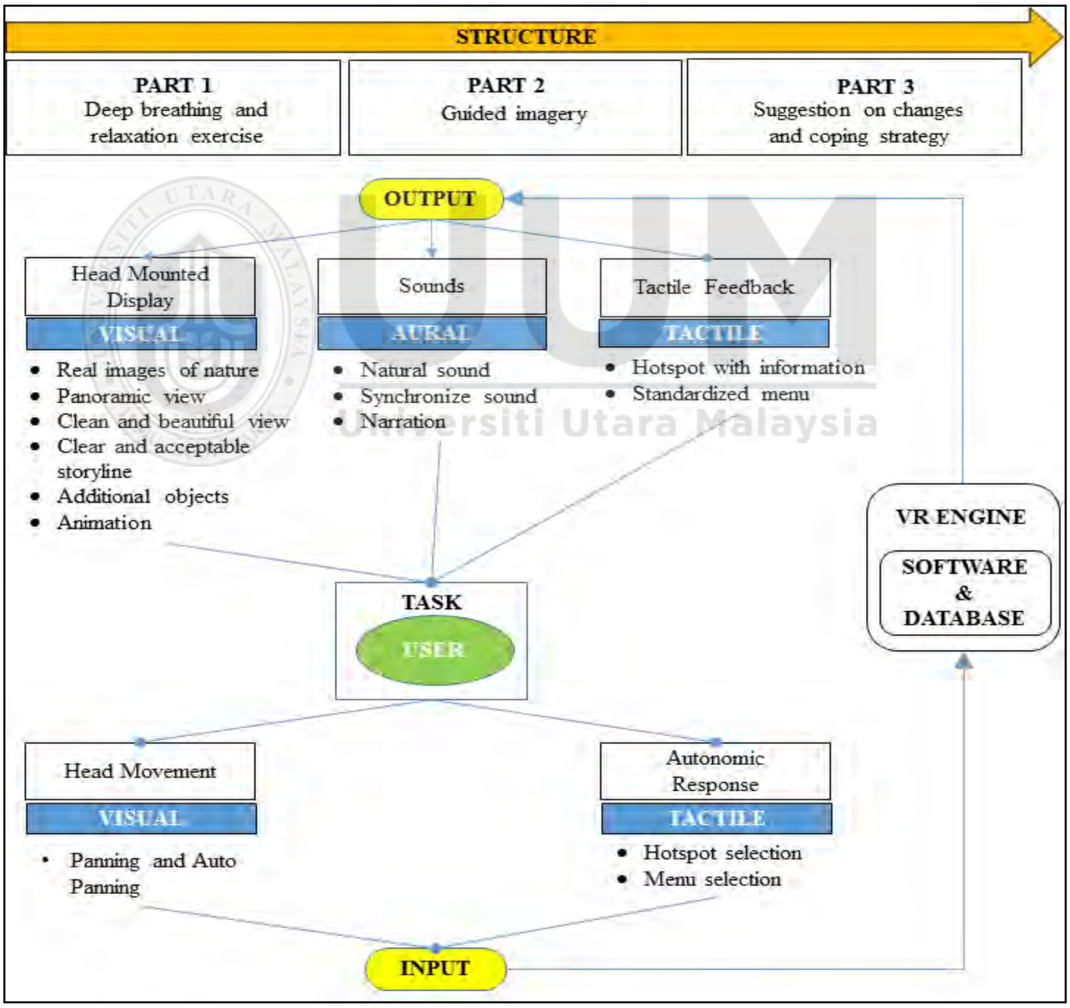
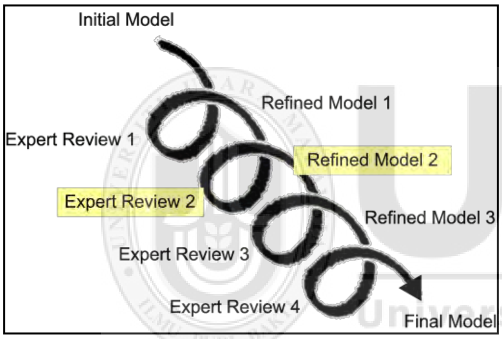


Figure 4.7. First Refined Model

Referring to the first refined model in Figure 4.7, it describes the features and requirements needed to build VR application for stress therapy based on the GIT method. This includes the structure of the actual GIT therapy session that is adapted as the structure for the IBVR self-therapy. Spatial presence features are the core elements in the model with the aim of creating a sense of spatial presence for the users to increase the level of application effectiveness. The model also sets the input and output characteristics of the virtual environment as the interaction between users and the IBVR application.

4.3.2 Second Cycle



After the first cycle of expert review, the refined model (Figure 4.7) was re-evaluated in the second cycle by the experts. Similarly, the aim of the re-evaluation is to identify any shortcomings in the model as well as improvements that can be made to ensure that it meets the objectives. The second evaluation was carried out through a workshop in which experts were invited to participate in the discussion.

During the workshop, experts were presented and explained about the refined model with the use of flipchart, whiteboard and audio/visual system. At the same time, they were encouraged to ask questions about the model for clarification. After that, the experts were given the opportunity to make analysis on the model that has been presented, based on the explanation given. More questions were asked by the experts while analysing, especially on the characteristics of the key components and elements of the model, as well as the flows and structure. From there, the experts have provided some suggestions and recommendations to be considered to improve the proposed model. Upon reaching the conclusion, this study expressed appreciation to the experts for their participation and consultation.

Overall, in the second evaluation, experts recommended that (1) the model should highlight the key elements that have been outlined, especially those related to SPM and GIT, and (2) the model should have a clearer flow and structure by showing appropriate and readable sequences to facilitate understanding of application designers and developers.

In response to the first recommendation, this study has revised and made major refinements, especially regarding the structure of the model by highlighting the elements of SPM and GIT to be more clear and significant in the model. This aims to make the model more relevant and meet the main objectives of this study. Conceptually, the model is constructed from four main components namely (1) Structure, (2) GIT, (3) SPM and, (4) VR System. Each of these components contains specific elements to support the effectiveness of IBVR applications for therapeutic purposes, as illustrated in Figure 4.8. These components and elements were generated based on the analysis conducted on existing literatures.

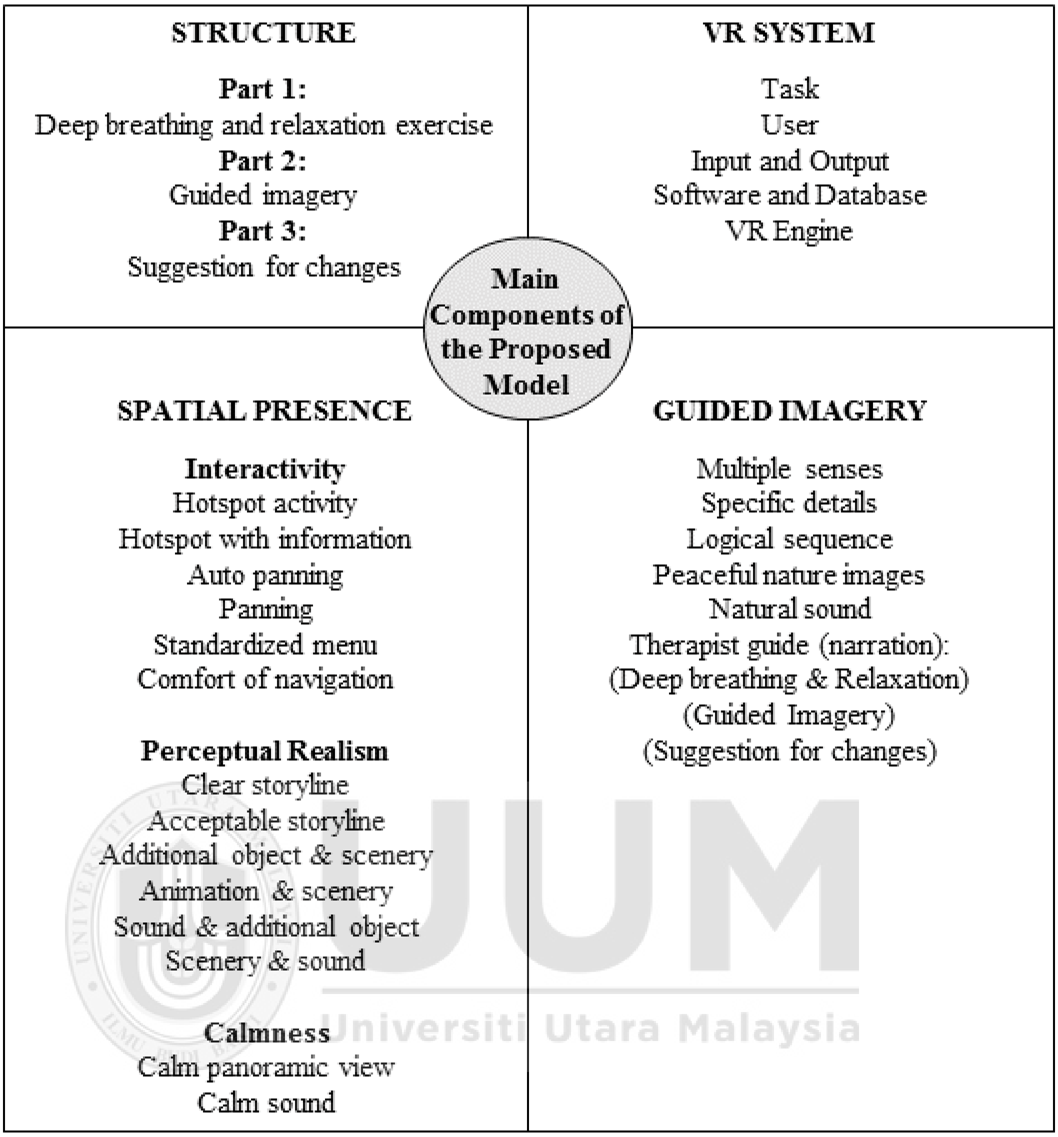


Figure 4.8. Components and Elements for the Proposed Model

While for the second recommendation from experts in terms of the flow and structure of the proposed model, this study has rearranged the design of the model taking into account the most suitable arrangement for all the components and elements in the model. This is done by identifying the relationships between components and showing the connections between those components. Figure 4.9 shows an illustration of the proposed model after being revised based on expert recommendations in the second evaluation cycle.

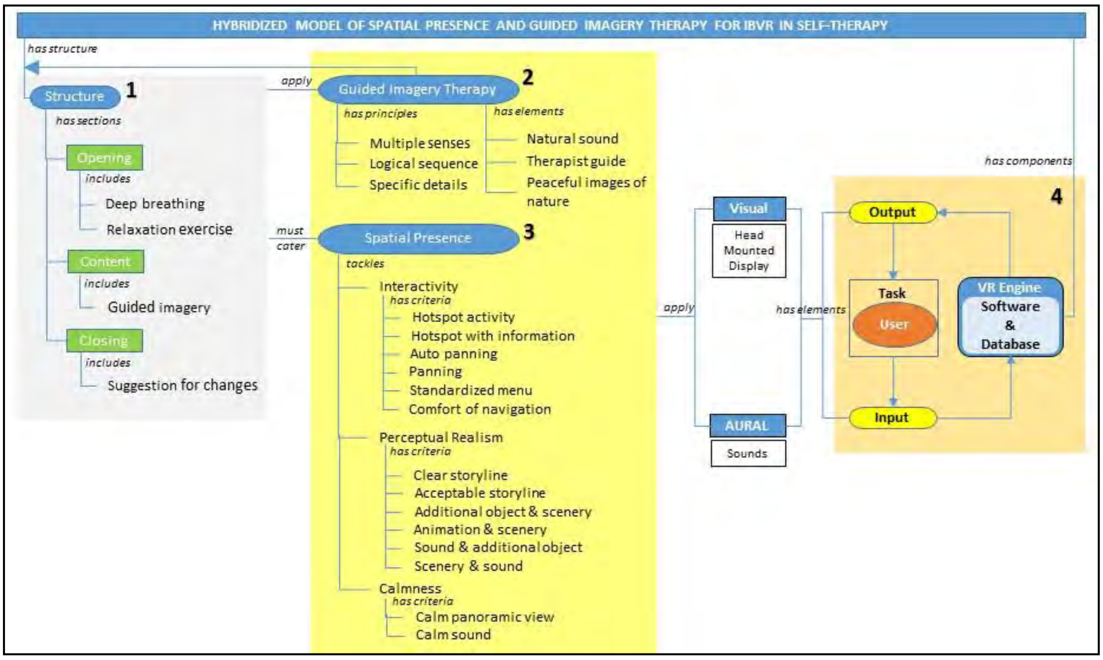
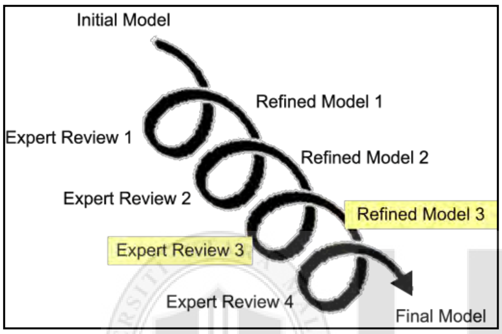


Figure 4.9. Second Refined Model

Referring to Figure 4.9, the proposed model consists of four major components as shown in Figure 4.8 which are numbered accordingly. The first one is the **Structure** component which indicates that the IBVR for self-therapy comprises three sections; (i) Opening, (ii) Content, and (iii) Closing, with their respective elements of therapy. The whole structure of the IBVR self-therapy tool must apply the second component which is **Guided Imagery Therapy** (GIT) that includes the principles and elements of GIT. The IBVR for self-therapy must also cater the third component which is the **Spatial Presence** that includes three main elements namely Interactivity, Perceptual Realism and Calmness. This reflects the objective of this study to replicate GIT technique and implement Spatial Presence as part of the IBVR self-therapy tool. As a result, it will create a feeling of physically presence in the IBVR environment and provide a sense of calm that can reduce stress.

In addition, the proposed model also includes a fourth component which is a VR system consisting of software and hardware for the development of IBVR self-therapy tools. It also highlights the user's participation in the system for a given task, i.e. exploring the virtual environment with instructions provided through input and output devices. As in the case of this study, the interaction between the user and the system occurs through visual and aural mediums.

4.3.3 Third Cycle



The second refined model in Figure 4.9 was further evaluated in the third cycle by the experts. As in previous cycles, the purpose of the evaluation was to identify weaknesses and opportunities for improvement in the proposed model. Communication with the experts was conducted through emails and online meetings. They were provided with the descriptions and illustrations of the proposed model, along with the instruments for assessment. During the online meeting, experts have asked relevant questions for further clarification. Apart from the evaluation instruments, they were also allowed to provide independent comments and suggestions based on their expertise.

On the whole, in the third evaluation cycle, experts have recommended that (1) the components in the model should be further detailed and described by showing the differences between compulsory and recommended components and (2) the model should demonstrate a clearer relationship between components by scrutinizing each connections and arrows, thus making better flows of the model.

As a response to the first recommendation, this study has conducted further analysis to identify the generic components and elements for the proposed model based on existing selected models. The selection of the components and elements were conducted according to the conditioning rules to classify whether the components are compulsory or recommended to be applied. Table 4.6 indicates the conditioning rules for categorization of components from existing models, while Table 4.7 shows the conditioning rules for the classification of components.

Table 4.6

Indicator for Categories of Component

Indicator	Description	Condition
A	All models apply	**All** models apply the component
M	Majority models apply	There are between **6 to 9** models that apply the component
F	Few models apply	There are between **1 to 5** models that apply the component
X	No model apply	**No** model applies the component

Table 4.7

Indicator for Classification of Components

Indicator	Description	Condition
©	Compulsory to be applied	The component is compulsory to be applied when **A** or **M** appears in the row
®	Recommended to be applied	The component is recommended to be applied when **F** or **X** appears in the row

Based on the conditioning rules in Table 4.5 and Table 4.6, the generic components and elements for the proposed model were identified through comparative analysis of existing models. Firstly for GIT, several articles has been selected for analysis (refer Table 4.8), based on the following justifications:

i) The article is related to GIT in stress issues

ii) The article covers the fundamental principles of GIT

iii) The article contains adequate description of GIT

Table 4.8

Selected Articles for Guided Imagery Therapy

No.	Author	Title
1.	Overholser (1991)	The Use of Guided Imagery in Psychotherapy: Modules for Use with Passive Relaxation Training
2.	Apóstolo (2009)	The Effects of Guided Imagery on Comfort, Depression, Anxiety, and Stress of Psychiatric Inpatients with Depressive Disorders
3.	Owen (2010)	Spontaneous and Guided Imagery in Counselling: Putting fantasy to work
4.	Jallo et al. (2014)	Guided Imagery for Stress and Symptom Management in Pregnant African American Women
5.	Prabu (2015)	Guided Imagery Therapy
6.	Bashir & Goswami (2020)	Stress and Guided Imagery Technique
7.	Garcia (2017)	Guided Imagery Relaxation Effects on South Texas Public School Teachers' Stress Levels
8.	Giacobbi et al. (2017)	Guided Imagery Targeting Exercise, Food Cravings, And Stress: A Multi-Modal Randomized Feasibility Trial
9.	Jerath et al. (2020)	The Therapeutic Role of Guided Mental Imagery in Treating Stress and Insomnia: A Neuropsychological Perspective
10.	Zaki et al. (2018)	Effect of Guided Imagery in Reduction of Stress among Elderly People in Geriatric Homes

From these articles, several characteristics or components of GIT have been identified, especially in the intervention of stress. These components were compared among the selected studies through a comparative analysis, as shown in Table 4.9. The analysis were conducted to see the similarities and differences of the models in terms of their generic components. Based on the comparative analysis, the generic components were then summarized and classified according to the conditioning rules in Table 4.6 and Table 4.7 in order to determine the compulsory and recommended components for the proposed model.

Table 4.9

Comparative Analysis of Generic Components for GIT in Selected Studies

Generic Components	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Total**
Therapist Guide	/	/	/	/	/		/	/			7
Deep breathing	/	/	/	/	/	/	/		/		8
Relaxation exercise	/	/	/	/				/			5
Multiple senses	/	/	/	/	/		/	/		/	8
Natural/Ambient sounds		/	/		/		/				4
Images of peaceful nature	/	/			/	/	/		/	/	7
Image variation	/			/		/	/				4
Specific details of images	/			/	/	/	/	/			6
Client-based	/		/							/	3
Coping strategies							/		/	/	3

Note: Number 1-10 is referring to the selected articles/studies

Table 4.10

Summary of Generic Components for GIT in Selected Studies

Generic Components	**Summary**
Therapist Guide	**M**
Deep breathing	**M**
Relaxation exercise	**F**
Multiple senses	**M**
Natural/Ambient sounds	**F**
Images of peaceful nature	**M**
Image variation	**F**
Specific details of images	**M**
Client-based	**F**
Coping strategies	**F**

Description:
M - Majority models apply
F – Few models apply

From Table 4.9, the generic components for GIT are summarized in Table 4.10 to indicate the occurrences of the components in the selected studies. Accordingly, Table 4.11 shows the classification of the generic components based on the conditioning rules that determine whether it is compulsory or recommended to be applied in the proposed model of this study.

Table 4.11

Classification of Generic Components for GIT

Generic Components	**Classification**
Therapist Guide	©
Deep breathing	©
Relaxation exercise	®
Multiple senses	©
Natural/Ambient sounds	®
Images of peaceful nature	©
Image variation	®
Specific details of images	©
Client-based	®
Coping strategies	®

Description of symbols:
© - Compulsory to apply
® - Recommended to apply

The classification results in Table 4.11 show that five of the generic components are mandatory, while the others are recommended for use in the proposed model. In addition, it also consists of components for Model Structures that represent the activities that occur in each part of IBVR self-therapy. Figure 4.10 shows the proposed GIT components to be applied to the model to be developed. It also contains structural components for the IBVR self-therapy tool.

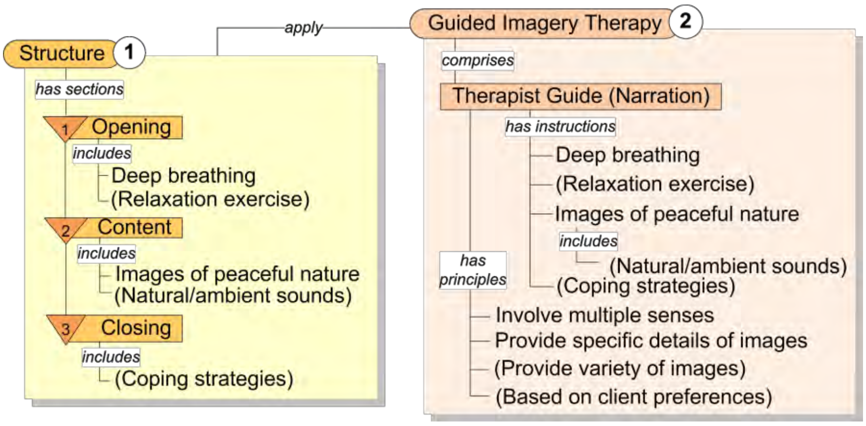


Figure 4.10. Proposed Components for Structure and GIT

Referring to Figure 4.10, the key components of GIT that should be included in IBVR for self-therapy is the **therapist guide**. It serves as a guidance to the patient in undergoing the therapy. For the purpose of this study, therapist guide is implemented in the form of a narration using the voice of a real therapist. The narration is recorded based on a script that is specifically created for self-therapy, adapted from existing GIT scripts. It comprises instructions on **deep breathing** and a description for **images of peaceful nature** that could include *natural or ambient sounds*. Referring to the proposed model, it is also recommended to add instructions on relaxation exercises and coping strategies for patients to cope with stress. In addition, IBVR for self-therapy should consider some principles of GIT that can increase the effectiveness of therapy. Among other things, it should engage and stimulate the user's **multiple senses** and provide **image-specific details** to aid the imagery process. In addition, it is recommended that IBVR should also provide a variety of images (variation of images) in order to give users the option to experience the environment based on their preferences (**client-based**).

As mentioned earlier, the overall structure of IBVR self-therapy in this study is based on the actual structure of a GIT session, showing the tasks and activities that take place throughout the IBVR application. According to Figure 4.10, it illustrates that the structure is divided into three sections which are (1) **opening**, (2) **content** and (3) **closing**. In the opening section, it includes the activity of deep breathing and relaxation exercise to help the patient to stay focus and relax. Then it continues with the guided imagery process in the content section. This includes the description for images of peaceful nature that could also include natural or ambient sounds to provide calmness to the patient. Finally in the closing section, it includes instructions on coping strategies for the patient to overcome the stress conditions.

Next for the spatial presence component, as previously highlighted, the elements proposed for the hybrid model of this study were adopted from SPM4IBVR (Nadia, 2017). This is due to the fact that SPM4IBVR was developed specifically to produce spatial presence in IBVR applications and is very suitable for this study. Components and elements in SPM4IBVR (Nadia, 2017) were generated based on user opinions and suggestions through the Repertory Grid technique. Through this technique, users were given the freedom to list the features of IBVR that are able to provide a sense of spatial presence according to their own view after using the IBVR application in the experiment conducted. The analysis of the experimental results has produced IBVR characteristics that can provide a sense of spatial presence which are categorized into three parts namely interactivity, perceptual realism and calmness.

These characteristics have been included in the second revised version of the initial model in this study as illustrated in Figure 4.9. In spite of that, experts have commented that the components are too general and ambiguous. They argue that the components need further detail and description to facilitate understanding and effectiveness of the proposed model. Therefore, this study has reviewed on the components for spatial presence by making a more in-depth reference to the document and descriptions of SPM4IBVR (Nadia, 2017) for further understanding and better adaptation. Table 4.12 shows the spatial presence components for IBVR as extracted from SPM4IBVR, with descriptions of the features and principles.

Table 4.12

Components of Spatial Presence from SPM4IBVR

Components	Features	Principles
Interactivity	Hotspot activity - A function in IBVR that allows user to shuttle from one environment to another.	Description or information of the action for each hotspot should be provided.
	Panning - A function in IBVR that allows user to view the environment in 360 degree	The visuals of the environment should be smooth without lagging.
	Auto panning	User should be able to adjust the speed of the auto panning, according to their preference.
	Standardized menu	The icons should be similar to other applications so user can easily understand.
	Comfort of navigation	Users should be given unlimited time to navigate through the virtual environment, according to their preference.
Perceptual Realism	Storyline - Sequence of the panoramic images in the virtual environment	1. Clear storyline - The IBVR should have a clear storyline and be easy to understand 2. Acceptable storyline - Sequence of images should be related to each other and similar to real environment.
	Panoramic view:	Panoramic views could be combined with other elements to make it more realistic.
	- (Include) Additional object	1. Should not include too many object in the panoramic view. 2. The object must be compatible with the panoramic view. 3. The object must be realistic. 4. Should avoid inappropriate object.
	- (Include) Natural sound	1. The natural sound should be compatible with the panoramic view. 2. The natural sound should match the additional object..
	- (Include) Animation	1. Should not include too many animation in the panoramic view. 2. The animation must be compatible with the panoramic view.
Calmness	Calm panoramic view	1. Should provide more than one option of the environment (location) so user can select according to their preference. 2. Should avoid distracting object in the panoramic view.
	Calm sound	Should use natural sound in the panoramic view.

These components are interconnected with each other in producing a sense of spatial presence. Referring to SPM4IBVR (Nadia, 2017), the main component to create a sense of spatial presence in IBVR is the calmness of the panoramic views and sounds incorporated into the virtual environment. However, it is supported by two other components namely perceptual realism and interactivity for the spatial presence to occur. Figure 4.11 illustrates this relationship, along with the characteristics and principles of each component. It shows that the sense of spatial presence is generated mainly by the calm panoramic view and sound included in the IBVR application, provided that it incorporates the established principles. However, it must be applied with two more critical components to create a sense of spatial presence in IBVR, namely interactivity and perceptual realism. Both components must be developed according to the characteristics and principles that have been established. Above all, calmness is considered as a prerequisite for the IBVR self-therapy application to produce a sense of spatial presence, once interactivity and perceptual realism have been successfully generated.

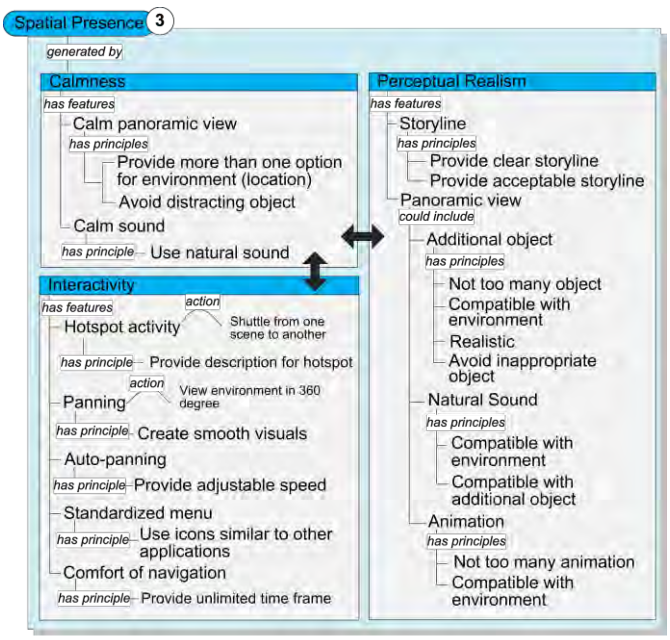


Figure 4.11. Proposed Components for Spatial Presence

Thirdly for VR system component, this study has selected several articles (as listed in Table 4.13) as the basis for determining the generic components to be considered for inclusion in the proposed hybridized model for IBVR self-therapy tool. The selection of the articles is based on the following justifications:

i) The article is related to VR in psychotherapy, especially for stress

ii) The article covers the fundamental principles of VR system

iii) The article contains adequate description of VR system

Table 4.13

Selected Articles for VR System

No.	Author	Title
1.	Burdea & Coiffet (2003)	Virtual Reality Technology
2.	Hanson & Shelton (2008)	Design and Development of Virtual Reality: Analysis of Challenges Faced by Educators
3.	Velling et al. (2016)	Childhood trauma, psychosis liability and social stress reactivity: a virtual reality study
4.	Gorski et al. (2017)	Effective Design of Educational Virtual Reality Applications for Medicine using Knowledge- Engineering Techniques
5.	Lindner et al. (2017)	Creating state of the art, next-generation Virtual Reality exposure therapies for anxiety disorders using consumer hardware platforms: design considerations and future directions
6.	Rizzo et al. (2017)	Virtual Reality Applications for the Assessment and Treatment of PTSD
7.	Zhang (2017)	Head-mounted display-based intuitive virtual reality training system for the mining industry
8.	Guillén et al. (2018)	Users' Opinion About a Virtual Reality System as an Adjunct to Psychological Treatment for Stress-Related Disorders: A Quantitative and Qualitative Mixed-Methods Study
9.	Menelas et al. (2018)	Use of Virtual Reality technologies as an Action-Cue Exposure Therapy for truck drivers suffering from Post-Traumatic Stress Disorder
10.	Zhang et al. (2019)	Fuzzy comprehensive evaluation of virtual reality mine safety training system

From the above articles, the generic components for a VR system especially in the application of psychotherapy have been identified through a comparative analysis. The aim of the analysis is to see the similarities and differences of components in the selected studies, as presented in Table 4.14. As mentioned previously, the generic components for a VR system include (1) VR engine, (2) software and database, (3) input and output devices, (4) user, and (5) task. For the purpose of comparative analysis in this study, the components were broken down into single components to make a clearer comparison.

Table 4.14

Comparative Analysis of Generic Components for VR System in Selected Studies

Generic Components	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Total**
VR engine	/	/		/	/	/	/	/	/	/	9
Software	/	/	/	/	/	/	/	/	/	/	10
Database	/						/			/	3
Input	/	/	/	/	/	/	/	/	/	/	10
Output	/	/	/	/	/	/	/	/	/	/	10
User	/		/	/	/	/	/	/	/	/	9
Task	/	/	/			/	/	/		/	7

Note: Number 1-10 is referring to the selected articles/studies

Then, the following Table 4.15 summarizes the result of the comparative analysis according to the conditioning rules as formulated in Table 4.6. Principally, Table 4.15 shows the categorization of components based on their application in the selected studies. Subsequently, the generic components for VR system were classified as either compulsory or recommended to be applied in the proposed model, based on the conditioning rules in Table 4.7. The VR system components classification result is as shown in Table 4.16.

Table 4.15

Summary of Generic Components for VR System in Selected Studies

Generic Components	Summary
VR engine	**M**
Software	**A**
Database	**F**
Input	**A**
Output	**A**
User	**M**
Task	**M**

Description:
A - All models apply
M - Majority models apply
F - Few models apply

Table 4.16

Classification of Generic Components for VR System

Generic Components	Classification
VR engine	©
Software	©
Database	®
Input	©
Output	©
User	©
Task	©

Description of symbols:
© - Compulsory to be applied
® - Recommended to be applied

Based on Table 4.16, all the essential components for a VR system that were identified from various studies are classified as compulsory to be included in the proposed model, except for one component - the database. While most studies mentioned or implemented the database, it is considered recommended rather than compulsory for the proposed hybridized model. In the case of IBVR self-therapy, user data is not recorded, making the database component relatively unnecessary. However, all other generic components for the VR system should be included in the proposed hybridized model. A brief description of each VR system component can be found in Table 4.17.

Table 4.17

Description for VR System Component

VR System Component	Description
VR engine	It refers to the computer architecture to run the virtual environment. This includes the processing power (CPU) of the computer and the graphical processing unit (GPU). It may also be in a form of a standalone virtual reality headset that is imbedded with its own CPU and GPU. The VR system component also refers the virtual reality engine, a platform that is used to design, build and run the VR application such as Unity, Unreal and etc. In the proposed model of this study, it falls under the software component, as mentioned below.
Software	It refers to the software or programs that is involved in modelling the object, developing and executing the virtual environment. In the case of this study, the virtual environment is made of real photos taken with specialized 360 camera. Hence, no modelling software is involved. The photos are put together in a dedicated software or VR engine (such as Unity) to form the virtual environment. It also includes the integration of hotspot function which enable the IBVR users to navigate from one scene to another. Once developed and published, it needs to be executed in the head-mounted display (HMD) through a dedicated platform like SteamVR to run the IBVR in the HMD.
Input	It refers to the devices used for capturing users' input in the IBVR self-therapy application and sending the data to the VR system. This includes users' navigation and interaction with the virtual environment. In this study, the interaction between users and the VR system involves head tracking device for updating the displays according to the users' viewpoint. It also involves the use of controller for users' direct selection of the menus or functions in the virtual environment.
Output	It refers to the devices for providing feedback, as a response to the input from the users. It could be in the form of visual, aural, olfactory and haptic. In this study, the output is mainly on the visual through the use of head mounted display that provide images to the users according to the input from the head tracking device. It also involve aural output that provide sounds to the users based on the objects and scenes in the virtual environment. The IBVR gives feedback to the selection made by the users through the controller, by providing the appropriate views in the IBVR.
User	It refers to the human or subject that interacts with the VR system. For this study, users of the IBVR self-therapy tool are those who may experience stress as a result of a variety of situations and circumstances. However, this study only focused on users who experienced mild and medium stress in which the IBVR only acts as a supportive intervention to reduce stress to prevent the occurrence of more serious conditions.

Table 4.17 continued.

Task	It refers to the activity performed by the users within the virtual environment, based on user's problem to be solved. In this study, the task of the users in the IBVR self-therapy consists of the exploration of the virtual environment based on the instructions given in the narration, for the purpose of relieving stress.

This is followed by Figure 4.12 that illustrates these VR system components to be incorporated in the proposed hybridized model. Referring to Figure 4.12, the main component for the VR system is the VR engine which includes the computer and software that involve in developing and executing the IBVR self-therapy application. Setting up the computer for the VR system must consider the processing (CPU), graphical (GPU) and memory (RAM) capacity for smooth development and execution. Despite that, as mentioned earlier, the virtual environment in the IBVR self-therapy application only involve real photos with 360^0 views, instead of a 3D graphic images. Thus, developing and running the IBVR self-therapy does not require computer with high capacity, compared to other VR application. Whereas, for the software, this study does not use any modelling software to build objects and textures for the virtual environment. Instead, it only involves software for development, integration and rendering, as well as software that is used as a platform to run the IBVR in the VR headset or HMD.

In the VR system component, the VR engine interacts with input and output devices to provide response to users accordingly. In this study, a head tracking device is used as an input to the VR system that tracks the head movement of the users and display the right views according to the users' head orientation. Other than that, a controller is also used as an input device that allows users to make selection and navigate within the virtual environment. As a result of the input from the head tracking device, the VR engine produces visual output through the HMD worn by the users by displaying the right views according to the head orientation, along with the animations provided in the virtual environment. It also shows the appropriate output according to the selection made by the users through the controller, which is displayed in the HMD. Other than that, the VR engine also produces aural output to the users through speakers or headphones, by playing the sounds that are embedded in the virtual environment.

Apart from that, other crucial elements in the VR system component are user and task. As proposed in this study, the target user for the application of IBVR self-therapy are those who experience mild or moderate level of stress. The goal is to provide an initial therapy or intervention for stress, as a prevention of worsening circumstances. In the IBVR self-therapy application, the users' task is to undergo the therapy themselves by exploring the virtual environment based on the instructions given in the narration.

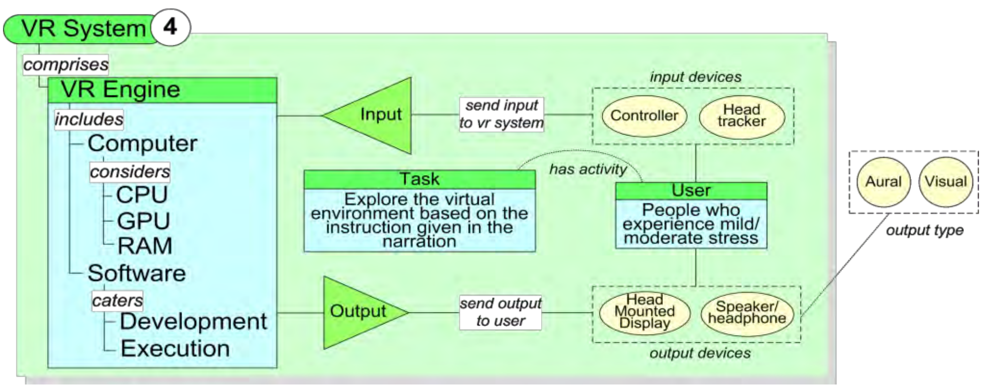


Figure 4.12. Proposed Components for VR System

Eventually, as a result of the third cycle of the expert review process, the proposed design model for IBVR self-therapy was revised and refined as illustrated in Figure 4.13. This third refined model is a combination of all the components and elements described above. The refinements also include rearrangement of connections and arrows in the model to make a clearer relationship between components, thus making better flows of the model. This is, in fact, a direct response to the second recommendation by the experts in this third cycle of expert review who suggested that the relationships between components in the model should be clear to ensure that the model is readable and easy to understand.

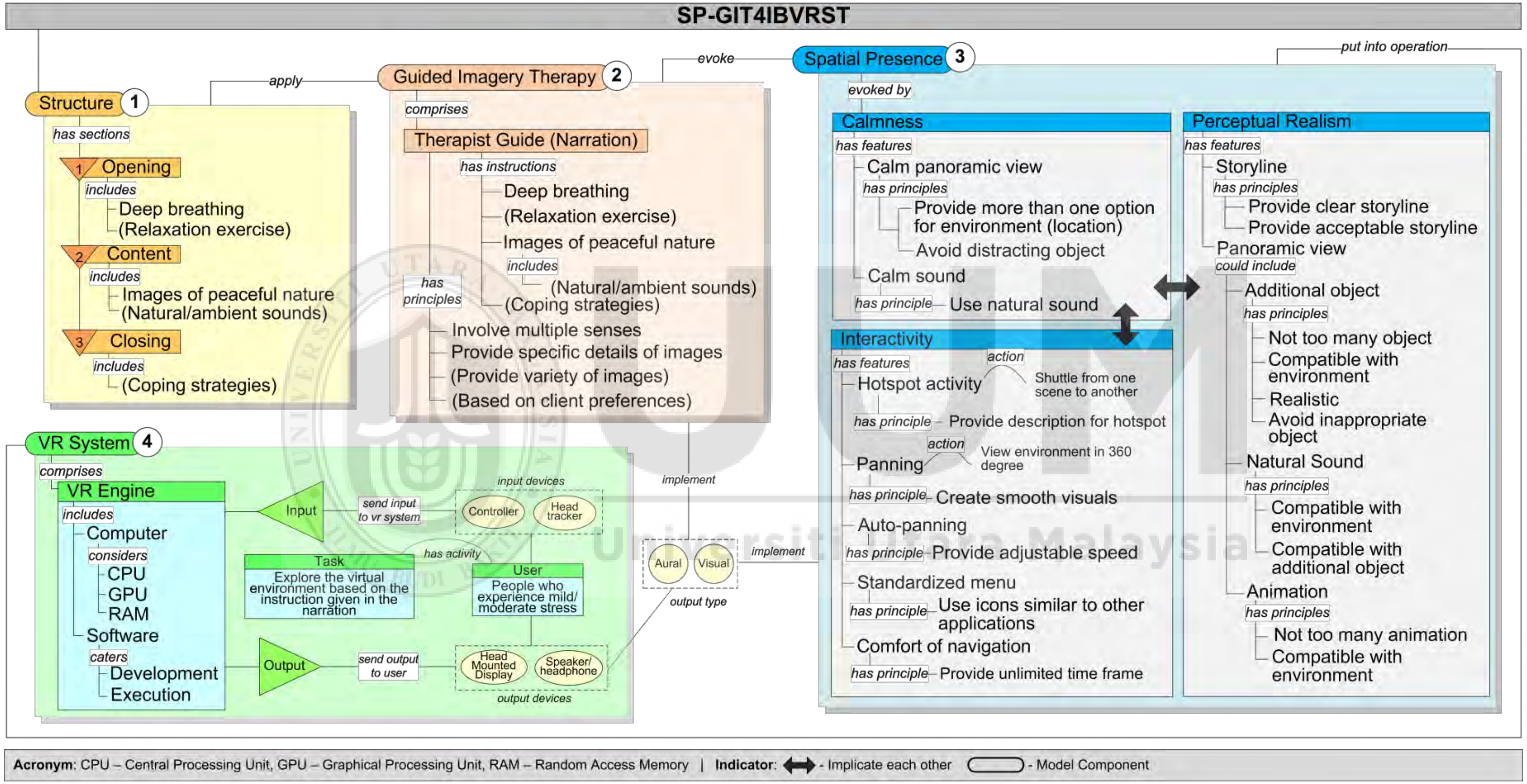
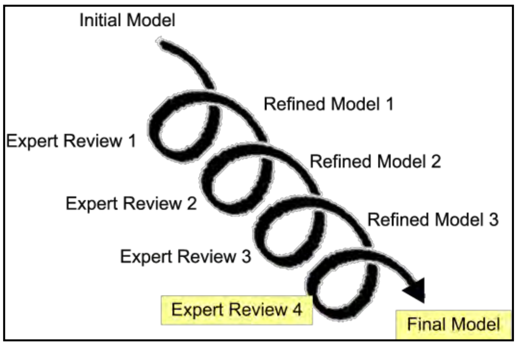


Figure 4.13. Third Refined Model

4.3.4 Fourth Cycle



Then, the third refined model was re-evaluated in the fourth cycle of expert review to evaluate the relevancies of the proposed components and elements, readability and understandability of SP-GIT4IBVRST. The experts were contacted via email containing a brief information about the study and was attached with a review instrument, as well as an illustration and description of the proposed design model (Appendix A).

As noted previously, a total of 6 experts participated as reviewers for the design model proposed in this study. The experts were given a formal letter of appointment from the faculty to formally appoint them as reviewers (Appendix B). Ample time was given to them to review the proposed design model and provide their comments in the accompanying review form, before returning it via email. In addition, virtual discussions with experts were also conducted through video conferencing to provide further clarification on the proposed design model, thus obtaining more comprehensive reviews from the experts. Content of the discussion was based on the review instrument provided earlier. Video of the virtual session was recorded for future reference. The video content was documented and then verified by the experts to ensure its validity. Based on the experts' comments and recommendations, refinement was made to the proposed design model. On average, the expert review process has taken about one to two months to complete.

The expert review instrument is in the form of a questionnaire (Appendix C), adapted from Nurulnadwan (2015) and Siti Zulaiha (2017). At the beginning of the questionnaire, a brief introduction and description of the study is provided, as well as the objective of the expert review. Experts are required to refer to the illustrations and descriptions of the proposed design model provided, before filling out the review questions. In part I of the questionnaire, it contains questions on demographic data which are Name, Age, Gender, Highest level of Education, Experience and Area of Expertise. Then in part II, the questions are related to (i) the relevancy of the components and elements, (ii) the understandability of the terms used and (iii) the readability of the proposed SP-GIT4IBVRST design model. These questions reflect the objectives of the expert review.

Questions in part II represent all four main components of the proposed SP-GIT4IBVRST design model. These components are listed as item 1, 2, 3 and 4 in the review form. The elements for each of the components are also included in the respective item numbers. Experts are required to determine the relevancy of each components and elements by choosing one of the options given either “some are definitely not relevant” or “some maybe not relevant” or “all are relevant”. Experts can also put their comments for each of the item in the spaces provided. Then, item 5, 6 and 7 represent three statements regarding the understandability of the terms used, the logic of the flows and the overall readability of the model. Experts are required to determine whether they agree or disagree with the statements by choosing “yes” or “no”. Finally, at the end of the questionnaire, the experts are requested to provide their overall perceptions of the proposed model as well as suggestions for improvement, based on their expertise and experience.

Table 4.18 shows the experts' feedback on review item number 1, 2, 3 and 4 regarding the relevancies of the components and elements in the proposed SP-GIT4IBVRST design model. While Table 4.19 shows the experts' feedback on the review item number 5, 6 and 7 that reflect the understandability and readability of the proposed design model.

Table 4.18

Experts' feedback on the relevancies of the components for SP-GIT4IBVRST

Item No.	Proposed Components and Sub-Components		Expert A	Expert B	Expert C	Expert D	Expert E	Expert F
1	**Structure**	**Opening** • Deep breathing • Relaxation exercise	All are relevant	All are relevant	All are relevant	All are relevant	All are relevant	All are relevant
		Content • Images of peaceful nature • Natural ambient sounds	All are relevant	All are relevant	All are relevant	All are relevant	All are relevant	All are relevant
		Closing • Coping strategies	All are relevant	All are relevant	All are relevant	All are relevant	All are relevant	All are relevant
2	**Guided Imagery Therapy**	**Therapist guide (narration)** • Deep breathing • Relaxation exercise • Images of peaceful nature • Natural ambient sounds • Coping strategies	All are relevant	All are relevant	All are relevant	All are relevant	-	All are relevant
3	**Spatial Presence**	**Calmness** • Calm panoramic view • Calm sound	-	All are relevant	All are relevant	All are relevant	All are relevant	All are relevant
		Perceptual realism • Storyline • Panoramic view - Additional object - Natural sound - Animation	-	Some are definitely NOT relevant	All are relevant	All are relevant	All are relevant	All are relevant
		Interactivity • Hotspot activity • Auto panning • Panning • Standardized menu • Comfort of navigation	-	All are relevant	All are relevant	All are relevant	All are relevant	All are relevant

Table 4.18 continued.

4	**VR System**	**VR Engine** • Computer • Software	All are relevant	-	All are relevant	All are relevant	-	All are relevant
		Output	All are relevant	-	All are relevant	All are relevant	-	All are relevant
		Input	All are relevant	-	All are relevant	All are relevant	-	All are relevant
		User	Some are definitely NOT relevant	-	All are relevant	All are relevant	-	All are relevant
		Task	Some are definitely NOT relevant	-	All are relevant	Some are definitely NOT relevant	-	All are relevant

Table 4.19

Experts' feedback on the understandability and readability of SP-GIT4IBVRST

Item No.	Statement	Expert A	Expert B	Expert C	Expert D	Expert E	Expert F
5	The terms used are easy to understand	-	Yes	Yes	Yes	Yes	Yes
6	The relationships and flows of all the main components and sub-components are logical	-	Yes	Yes	Yes	Yes	Yes
7	Overall, the design model is readable	-	Yes	Yes	Yes	Yes	Yes

Referring to Table 4.18, it can be observed that majority of the experts agree that the proposed components and elements for SP-GIT4IBVRST design model are all relevant. This is directly reflects the first objective of the expert review which is to evaluate the proposed design model in terms of relevancies of the proposed components and elements of SP-GIT4IBVR. Although several experts also responded that 'some are definitely not relevant' for some elements in Spatial Presence and VR System, they have supported their answers with appropriate comments and recommendations as discussed later in this sub topic.

While Table 4.19 shows that all experts have chosen a 'Yes' answer for all three statements provided, except for one expert who has not given any feedback on these statements. Thus, it can be concluded that the majority of experts agree that the terms used in the model are easy to understand, the relationship and flow of the model is logical and the design model as a whole is readable. This feedback give positive input and fulfilled the second objective of the expert review which is to evaluate the comprehensibility and readability of the proposed SP-GIT4IBVRST design model.

As mentioned earlier, the experts have also provided their comments and recommendations to improve the proposed design model. Table 4.20 shows the experts' comments and recommendations for item number 1 of the review instrument that represents the first component of the proposed model i.e. Structure.

Table 4.20

Expert Reviews on Item 1 of the Review Instrument - Structure

Expert	Comments and Recommendations
A	- Each of the component (opening, content and closing) on its own are relevant. However, my concern is on the overall structure (implementation wise). - Need to design the setup so that users will not be distracted with any visual cues, so they can focus on the instruction from the narration. - Perhaps user can select their preferred location (e.g. Island) even before the opening. Then the user is guided with deep breathing and relaxation exercise. Next the user will be guided for therapy in that location and not allowed to change to another location.
B	- Best done using only one environment throughout the session. Meaning, once patient selected environment 1 (e.g. beach), all activities should maintain by the beach. Don't allow patient any option to change.
C	- The explanation about STRUCTURE of the model was not sufficient for me to justify the relevant. However, my thought this is the outline or the frame for the design model therefore I think they are relevant. - I would imagine the content factor also has role in GIT and Spatial Presence. Perhaps the interconnection can be explained. - How the closing will be interrelated with the rest of the model?
D	- Reconsider the term STRUCTURE to denote content-related items. Perhaps Content Flow or Outline or Module?
E	- This model is refer to virtual reality, so all image/images world should be change into virtual environment
F	- None

Based on Table 4.20, experts' comments and recommendations for the Structure component of the proposed model are summarized and listed in the following numbered paragraph.

i) Expert A and B were concerned on the setup or implementation of the IBVR therapy. They have recommended that each therapy session should only be done in one selected location in which users are not able to change to another location during the session. This is to avoid distraction to the user should they are given the option to change location during the session. Hence, the user should be asked to select their preferred location or environment even before the session begins.
ii) Expert C was unsure of the explanation of the Structure component and its elements. Indirectly, this suggests that the representation of the Structure component was inadequate to be fully understood. Accordingly, Expert D recommended to reconsider the term 'Structure' to indicate the outline or content flow of the IBVR. In addition, Expert E recommended that the term 'images' should be changed to 'virtual environment' as the proposed design model is referring to virtual reality.
iii) Expert C highlighted that the content of the Structure component is related to GIT and Spatial presence. Therefore, the interconnection of these components should be visualized in the proposed model.

In response to the first recommendation, this study agrees that during the therapy session in the IBVR, users should be presented and guided for therapy in only one location per session. It aims to avoid the likelihood of users losing focus if they are given multiple choices during that session. Therefore, a new element has been included in the Structure component to indicate an activity where users are required to select their preferred location before proceeding with a therapy session.

For the second recommendation, it can be concluded that there are deficiencies in the representations and descriptions of the Structure component that has caused experts to be slightly confused with the actual context of this component. Accordingly, this study has made amendments by providing a clearer description of the activity or element within the Structure component. This includes renaming the component title from ‘Structure’ to ‘Content Structure’ to clearly indicate the actual context and function of the component.

While for the third recommendation on the interconnection between the first component and the other components in the model, this study identifies that emphasising such connection will increase the readability and understandability of the proposed design model. Hence, this study has placed appropriate arrows in the proposed model as additional connections, to show the relationship between Content Structure component with GIT and Spatial Presence components.

Next, the second item for the expert review instrument is related to the second component of the proposed SP-GIT4IBVRST design model which is the GIT. It includes all the elements and principles that are needed in the IBVR self-therapy to apply the GIT technique. The experts’ comments and recommendations for item number 2 are integrated in Table 4.21.

Table 4.21

Expert Reviews on Item 2 of the Review Instrument - Guided Imagery Therapy

Expert	Comments and Recommendations
A	- Should state "Recorded" Therapist Guide. - In GIT, user follow instruction from the therapist on what to visualise. In VR, users already being presented with the view, so how the narration can work in parallel to users? - If the narration must include/refer to images of peaceful nature - how do you make sure the narration tally with what the users is currently viewing, since from our discussion, users can jump between location, and between hotspots in each location as they wish? - My concern is that users will be busy navigating between location and hotspot that they will not hear/relate to the narration. - How you want to make sure that the narration can control the user? - Moreover, the user is forced to hear to the narration and has no option to stop it.
B	- None.
C	- Review of these factors should involve expert in the fields. Knowledge in HCI may not be sufficient.
D	- None.
E	- Do users need exercise before or while watching the IBVR application? - In this part, the model should explain the script for the therapist guide - How therapist's script can reflect the storyline in the virtual environment and the sound? - What are coping strategies? How do these strategies relate to GIT and self-therapy?
F	- None.

Referring to Table 4.21, three of the experts did not provide any comments for item 2 of the review instrument. While other experts have left some comments and suggestions for improvements for the GIT components of the proposed SP-GIT4IBVRST design model, as summarized in the following paragraph.

i) The expert comments on this item are mainly related to the implementation of the narration or the therapist guide. Expert A wondered about how to keep users 'attention to the narration while they could view the virtual environment independently. Furthermore, users are given the option to shuttle from one scene to another in the virtual environment, via the hotspot function. This would distract the users to focus on the narration. While Expert E concern on how the therapist guide can reflect the storyline and the sound in the virtual environment.

ii) Expert E questioned on the ordering of activities in GIT especially in the implementation of deep breathing and relaxation exercise. The expert also argued about the appropriateness of ‘coping strategies’ element as part of GIT or self-therapy. Indirectly, these comments indicates some limitations in the representation of the proposed model, particularly in terms of the description of the elements involved.

As far as this study is concerned, the first comment mentioned above is more towards the implementation of the narration or therapist guide in the IBVR for self-therapy as proposed in this study. This indicates that the descriptions of the components and elements for GIT in the proposed model are insufficient, leading to some degree of uncertainty. Thus, this study has made appropriate changes in the representation of the model, by providing more descriptions to the GIT component and its elements. This also consist of the changes in response to the second comment of the experts regarding the implementation of deep breathing, relaxation exercise and coping strategies as part of the GIT. More detailed descriptions have been added in the GIT component to clearly describe the activities involved in the IBVR self-therapy.

Then for item 3 of the review instrument, it includes elements of the third component in the proposed SP-GIT4IBVRST design model, namely the Spatial Presence component. Experts’ comments and recommendations on this component are as displayed in Table 4.22.

Table 4.22

Expert Reviews on Item 3 of the Review Instrument - Spatial Presence

Expert	Comments and Recommendations

A	- The categorization of components/elements in spatial presence could be expanded and not just limited to calmness, interactivity and perceptual realism.
	- What are the criteria for the images/sounds to be regarded as calm? How do you select image that represent calmness? Might want to have some guideline in doing so since the system is meant for therapy.
	- Should also include image technical aspects, e.g. sharp image, not pixelated, broken, over-exposure, under-exposure, clarity, brightness, etc.
	- Should provide options of images/sounds for individual preference.
	- The term storyline is a bit confusing
	- Need to take into account on visual consistency/motion consistency (locomotion) when users navigate from the main view to hotspot.
	- Auto panning, need to find the suitable speed – else user will experience motion sickness. Maybe not suitable for immersive VR since the rotation will be 360 degree. Probably not needed.
	- Standardized menu doesn't seem to be suitable to be grouped directly under interactivity
	- Comfort of navigation seems not to be appropriately described with having given unlimited time frame for users to go through the therapy session.
	  - If it is unlimited time frame, how about the narration? Would you repeat the same narration? Or change to different narration script?
	  - What if users decide to stop/quit in the middle of the therapy session? Would they be presented with the closing narration/view? Closing narration is part of the structure.
	  - Maybe the time frame should be limited according to the narration.
	  - The narration should not be too long.

B	- Not sure how you define a calm panoramic view. This must be well-defined and explained how selection of the 'calm panoramic view' been made. - Not sure a storyline is needed.
C	- Are these considered as effects? What is the selection criteria for calm? - How to measure the effectiveness of storyline? What is the effect? - How these factors can be measured?
D	- None

E	- In IBVR, there are three primary functions: hotspot, panning, and zoom in/out. I would suggest you list out criteria for that interaction function.
	- For example: Criteria for zoom in/out function:
	  - No lagging when the user zooms in/out the panoramic virtual environment
	  - Users can zoom in/out in any pixel in the panoramic virtual environment
	  - I hope that you involve in the development phase to upgrade your knowledge about the criteria of the interaction function in IBVR

F	- None

Looking through Table 4.22, the experts' comments and recommendations for item 3 i.e. Spatial Presence are mainly focused on the elements and its' details which are seen to be insufficient to fully represent the Spatial Presence component in the proposed design model. Besides that, the comments are also related to the implementation and representation of some elements of the component. These are summarized in the following paragraph.

i) Most experts were concerned on the selection of calm panoramic view as depicted in the proposed SP-GIT4IBVRST design model. They argued that the criteria for images to be regarded as calm was not adequately represented and suggested to include the selection criteria in the proposed design model.
ii) Most experts were in disagreement and confused with the Storyline element as part of the Spatial Presence component because they don't see the significance. This is also the case for auto-panning function which seems to be irrelevant, as in this study users can independently view the environment in 360 degrees through the head-mounted display (HMD).

These comments and recommendations imply that the Spatial Presence component may not be well understood by the application designers and developers who are the target users of the proposed design model. Thus, this study has taken steps to make amendments to the proposed model based on the comments received. For the first comment and recommendation, this study has made further research and analysis through existing literatures, on the characteristics of images that are considered as calm. Referring to table 4.10 that shows the generic components of the GIT, one of the characteristics of the therapy is the 'peaceful nature images'. It implies that during the actual GIT session, the therapist will guide the patient to visualize a peaceful nature scenery to provide a feeling of relaxation and thereby reduce stress. This is also in line with the opinion and findings in some previous studies which state that images of natural scenery are able to provide calmness and subsequently reduce stress levels (Nanda, Zhu & Jansen, 2012; Brown, Barton & Gladwell, 2013; Koon, 2015; Jo, Song & Miyazaki, 2019; Mochizuki-Kawai, Matsuda, Mochizuki, 2020). Therefore, this study decided to include the 'peaceful nature images' as part of the characteristics of the calm images in the Spatial Presence component of SP-GIT4IBVRST design model. It denotes that the selection of images to be included in the IBVR self-therapy tool should be based on peaceful natural scenery.

While for the second recommendation, this study agrees with the experts' concern on the relevance of Storyline and Auto-panning elements in the spatial presence component. The IBVR self-therapy in this study does not involve continuous scenes that make up a story, therefore the term storyline is not seen as very appropriate to use. This includes the elimination of Hotspot element as it is directly related to Storyline and they implicate each other. Also, the auto-panning function is seen as irrelevant in this study because the HMD is used to view the virtual environment in IBVR. It gives users the freedom to move their head in all directions or control the panning function themselves to see the displayed scene. For that reason, both Hotspot and Auto-panning elements are removed from the proposed SP-GIT4IBVRST design model, specifically from the spatial presence component.

Lastly, for item number 4 of the expert review instrument, it encompasses the elements of the fourth component in the proposed design model which is the VR system. This component consists of the generic elements needed to establish a VR system which include VR engine, Output, Input, User and Task. Table 4.23 shows the experts comments and recommendations on the significance and relevance of the VR system component of the design model proposed.

Table 4.23

Expert Reviews on Item 4 of the Review Instrument – VR System

Expert	Comments and Recommendations
A	- User and Task element can be removed
B	- None
C	- Consider accessibility, affordability - Consider issue of portability, comfort-ability, experience - Consider what are the form of input - What is the target - inclusive design? - Consider UCD -usability & ease of use
D	- Task should not be included in VR System as it is considered as the work to be done rather than component.
E	- none
F	- None

According to Table 4.23, it can be observed that there are not many comments or suggestions from experts regarding the elements in the VR System component. This indicates that the component and its' elements are acceptable in the proposed design model. Although some experts commented that the User and Task elements are not significant, this study decided that these two elements should be retain as they provide an overview to application designer and developer about the users and the activities involved in the IBVR development. In fact, these elements has been classified as 'compulsory to be applied', based on the comparative analysis done earlier. Overall, no changes or amendments was made for the VR system component in the SP-GIT4IBVRST design model, during this fourth cycle of expert review.

However, apart from the four main review items as mentioned above, experts were also requested to give additional comments and recommendation in the spaces provided at the end of the review instrument. In this section, the experts provided a comprehensive review of the entire proposed model, as well as other recommendations in addition to what they have provided previously.

Table 4.24

Experts' Additional Comment and Recommendations

Expert	Comments and Recommendations
A	- For the user experience testing, perhaps it should be done on adults (e.g. employees, patients in a hospital) rather than students in higher institutions because they tend to get easily bored with the VR environment as it is just a still image.
B	- Personally, I find the model is understandable and terms used are familiar as I am a VR developer myself. Might be a handful for those who are not from the similar background. Panning/auto-panning is one example used and understood by 3D developers. Perhaps, simplify some of the technical terms for general understanding of your model.
C	- Based on the brief of explanation and image of the design model, the connection between models requires more deliberation and justification. - A solid theoretical foundation can be provided to support the design model. - The design model may be situated at a context of use – what is the form of expected input & output from the design model (e.g. expression, emotion, etc.). I assume an expert such as psychologists are involved in designing and interconnecting the module or at least the model should be seen by such expert. - Combining spatial presence and image therapy is a huge but novel understanding. Some significant and justification could be further explained. One of the challenges to be considered is how to evaluate the integration. A reliable hybrid measurement could be developed to evaluate the combination/integration of the two major components. - Context or environment to test this complex model should be designed. Perhaps the model should be explained with scenario in order to understand actual use and practical application.
D	- Great framework.
E	- Please improvise the SPMIBVR, especially the interactivity part.
F	- Well-designed model. - However, in the model, some items are written within brackets. The legend does not spell the meaning of the brackets. Therefore it makes a little confuse. Perhaps the legend should clear that.

Referring to Table 4.24, Expert B, D and F agree that the proposed SP-GIT4IBVRST design model is a good model. Expert B who is also a VR developer stated that the model is understandable and may be useful even for those who are not familiar with VR. Despite this, there are also other comments and suggestions from the experts for improvement as summarized in the following paragraph.

i) Some experts were a little bit curious about the comprehensibility of some elements of the proposed model. Expert B suggested that some technical terms could be simplified for a better understanding of the model. While, Expert C mentioned that the relationship between components needs more justification.

Also, Expert F recommended that explanation should be added for elements that were not included in the inscription or legend of the design model illustration.

ii) Expert A and C were concerned on the evaluation of the proposed SP-GIT4IBVRST design model, particularly on the implementation of user experience testing.

In response to the first suggestion, this study has taken steps to simplify some of the terms used and modify the arrows to show a more coherent relationship between the components in the proposed model. This also includes improvements to indicators or legends that provide explanations to the model illustration. On the other hand, the second recommendation from the expert is more about the evaluation implementation of the proposed model, which is not the focus of this chapter. However, its justification can be found in the next chapter which provides details about the evaluation of the model, in particular the user experience test.

Ultimately, after all items in the expert review instrument were analysed and recommendations from the experts were considered for improvements, Figure 4.14 shows the refined proposed model as a result of the fourth cycle of the expert review process.

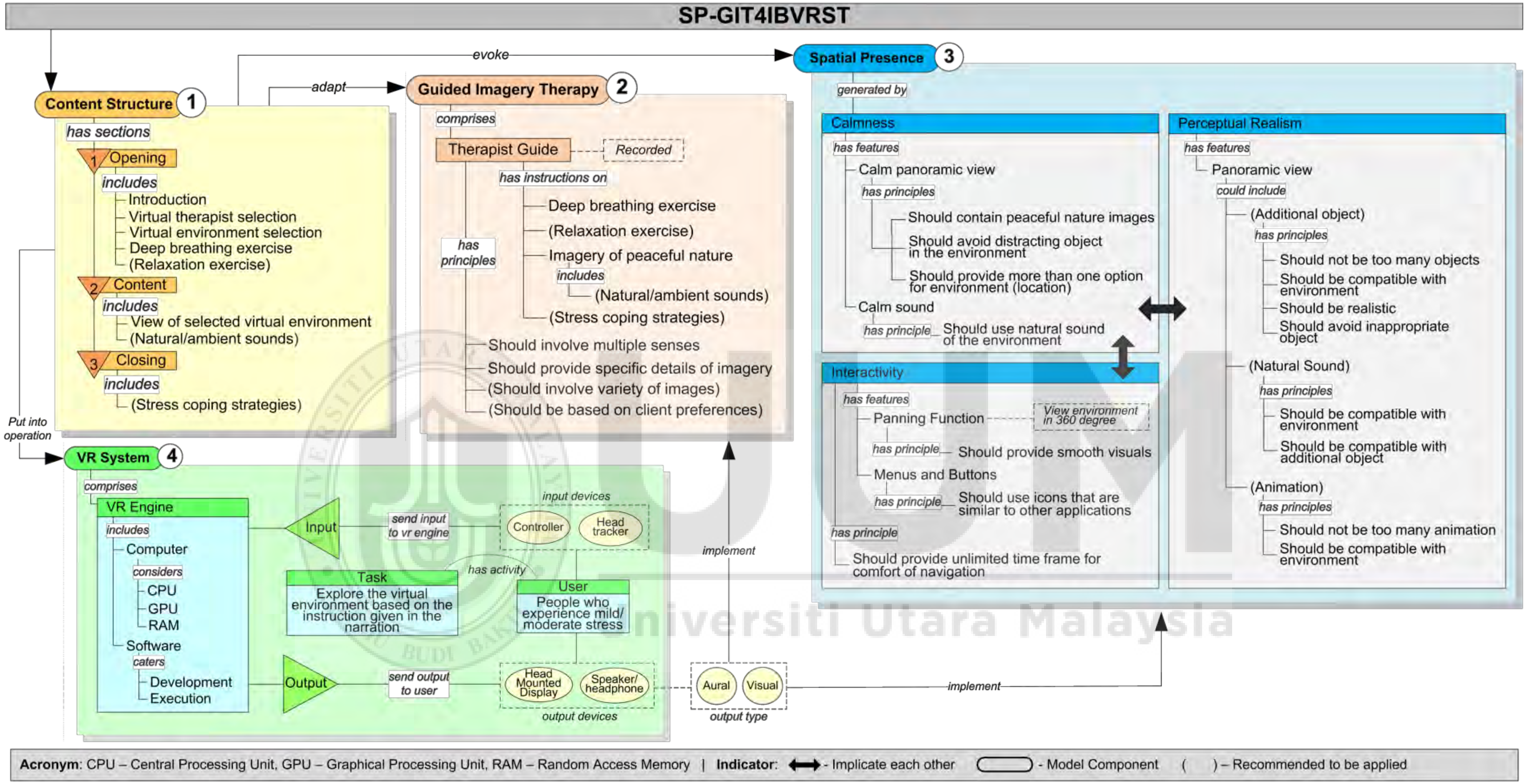


Figure 4.14. Fourth Refined Model

4.4 Summary

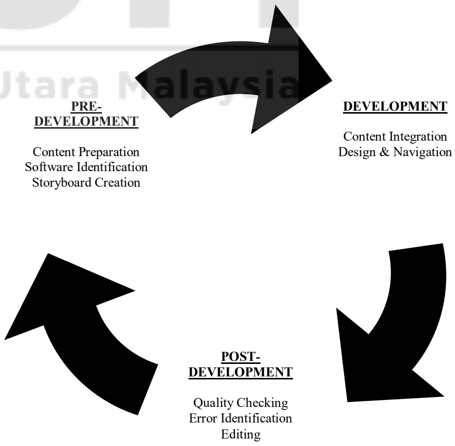
Basically, this chapter extensively explains the model development, in which every task has been scientifically and systematically carried out to ensure a rigorous process. It includes the steps in identifying the appropriate components to be integrated in the model development. As described previously, the components have been identified through content analysis of existing studies that are closely related to this study. It is followed by a comparative analysis of the models found in selected studies, to determine the most suitable components to be adapted in the proposed model. Based on these components, a design model for IBVR self-therapy was developed, integrating the features of GIT, spatial presence and VR systems. This model is named as SP-GIT4IBVRST. Then, a number of selected experts were assigned to review and validate the proposed model in terms of the relevance of components and elements, as well as readability and understandability of the model. Next, the model was further evaluated in terms of the user experience. Users were tested and observed while interacting with the prototype that was developed based on the proposed SP-GIT4IBVRST design model. Prior to explaining on the user experience testing, the following chapter describes the prototype development process.

CHAPTER 5

MODEL IMPLEMENTATION IN PROTOTYPE

5.1 Introduction

A partially functional prototype was created for this study's user experience evaluation in order to further evaluate the suggested design model. An IBVR application designed for self-therapy is the prototype. It tries to make people feel calm, therefore lowering or completely eliminating the risk of experiencing stress. This chapter describes the steps involved in developing the prototype. The IBVR self-therapy application was created by VR application developers using the elements and components included in the proposed SP-GIT4IBVRST design model. The development process is divided into three basic parts, namely (i) pre-development, (ii) development, and (iii) post-development, as described in Chapter 3. By relating the development processes to the suggested design model, these phases are discussed in the next subtopics. Some descriptions and screenshots of the prototype are also presented later in this chapter to give an overview of the IBVR application.



5.2 Pre-Development

Before developing the prototype, all content for the IBVR self-therapy application was prepared based on the components and elements in the proposed SP-GIT4IBVRST design model. Referring to the illustration of the model in chapter four (Figure 4.13), the elements involved in developing IBVR self-therapy are mainly visual and sound. The visuals consist of images of a peaceful natural environment with a 360-degree view. For the purpose of this study, the images were downloaded from existing online sources that met the requirement of this study.

As for the sound, it includes the recorded therapy script or narration, and the natural sounds of the environment. This is as outlined in the proposed model, which is the characteristics that has been defined in the GIT and Spatial Presence component. The script for the narration was composed with reference to existing scripts, audio and video for therapy, obtained from existing online sources. Some of the natural sounds were also downloaded from reliable online sources, according to the predetermined specifications as in the proposed model.

In addition, a storyboard was also created to illustrate the screen layout, flow and navigation of the self-therapy application based on the Content Structure component in the proposed model. It visualizes each screen displayed in the IBVR application, along with a description of the elements found in each screen (Appendix D). The storyboard integrates interaction functionality and all other features that have been specified for IBVR self-therapy. Storyboards are important in prototype development, especially to application designers and developers, as they provide guidance and reference in the process of designing and developing IBVR applications. Figure 5.1 shows a sample of the storyboard produced.

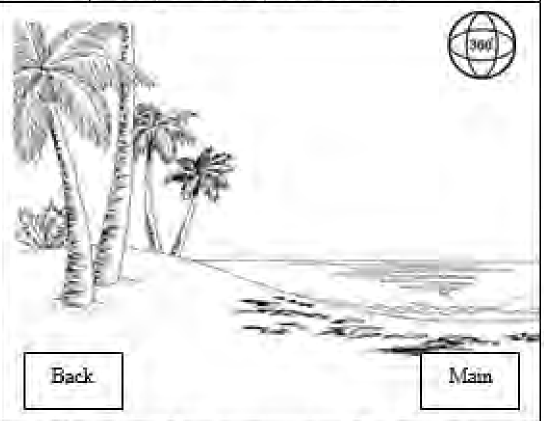
3	Selected Location (Location A)	4	Hotspot View (Location A)
			
- 360° view of the environment (head tracking) - Natural/ambient sounds - Therapist guide (recorded voice) - Main button: go to main menu - Hotspot button: go to another view of current location		- 360° view of the environment (head tracking) - Natural/ambient sounds - Therapist guide (recorded voice) - Back button: go to previous view - Main button: go to main menu	

Figure 5.1. Sample of the Storyboard

5.3 Development

Subsequently, based on the storyboard, prototype development was carried out by integrating all the elements that had been prepared. For this study, a head-mounted display (HMD) was used to deploy the IBVR application. The videos and sounds were directly installed in the HMD for viewing. As opposed to 3D graphics commonly used in GBVR development, the video used for IBVR self-therapy application in this study did not involve any specific software for image development. In addition to video and sound, the prototype also contains an animation of therapist giving instructions to the user through a virtual voice based on the script prepared earlier. A software called Powtoon was used to develop the animation and the virtual voice. It also includes the design of navigational features for the prototype, particularly buttons and links, as well as the screen layouts.

5.4 Post-Development

Having all the contents and elements installed, the prototype of IBVR self-therapy application were ready to be utilized for the next step. Nonetheless, prior to the utilization, the prototype was scrutinized to ensure that it met the requirements and specifications of the IBVR self-therapy based on the proposed model. Editing was carried out accordingly, as well as corrections to any errors identified.

5.5 The Prototype

As aforementioned, the prototype developed for this study is an IBVR application used for self-therapy purposes. It was developed based on the proposed SP-GIT4IBVRST design model that has been constructed in earlier phase. The model was composed of components and elements from VR, GIT and spatial presence. In terms of the content or navigational flows, the prototype was developed based on the Content Structure component included in the proposed model, as shown in Figure 5.2. This content structure was adapted from the actual practice of GIT.

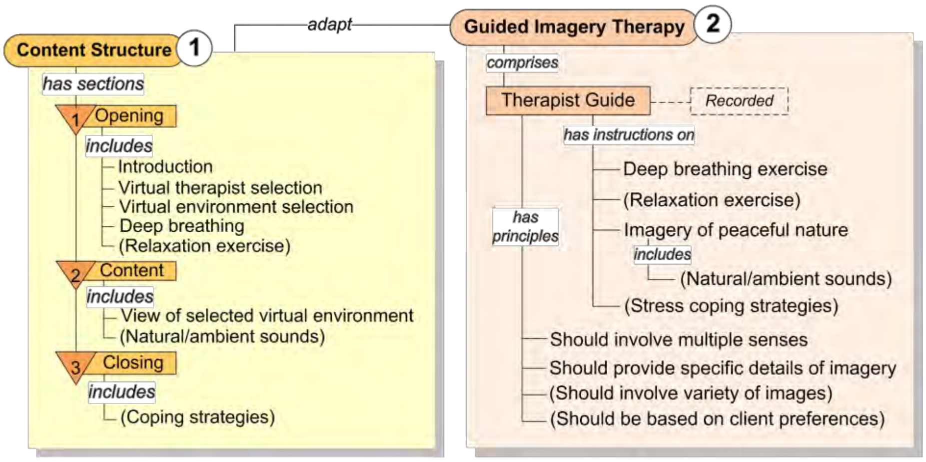


Figure 5.2. Content Structure and GIT Component of the Proposed SP-GIT4IBVRST Design Model

As seen in Figure 5.2, the structure of the IBVR prototype comprises three main sequential sections which are (i) opening, (ii) content and (iii) closing. In the opening section, an **introduction** screen is displayed to the user. It initially shows the title of the application, namely Image-based Virtual Reality Self-Therapy (IBVReST).

Figure 5.3. First Screen of the Prototype (Introduction)

After being introduced with the application, the user is presented with the second screen consisting of the **virtual therapist's selection** (Figure 5.4). It was explained earlier that the virtual therapist is in the form of animation. User can select one of the available virtual therapists, either male or female. Once selected, the voice of the virtual therapist is played for narration and instructions, for the rest of the prototype.

Figure 5.4. Second Screen of the Prototype (Virtual Therapist Selection)

The use of virtual therapists in IBVR self-therapy is based on the GIT features that involves the therapist guiding the patient in a real therapy session. In the beginning of the IBVR self-therapy prototype, the virtual therapist's voice delivers a welcoming note explaining what the app is about and what the user should expect to happen next. It also gives instructions and guidance to the user to make selection of their preferred location from the list of virtual environment provided. Figure 5.5 shows the sample of the therapist script.

Ini adalah program terapi minda melalui aplikasi realiti maya yang akan mambantu anda untuk merehatkan minda dan menjadi lebih tenang. Anda akan dapat melihat pemandangan indah yang menenangkan melalui imej-imej yang disediakan. Sebelum bermula, sila pilih satu lokasi yang menjadi kegemaran anda, daripada pilihan lokasi yang disediakan di sini.

Figure 5.5. Virtual Therapist's Welcoming Note

Immediately after that, a third screen is displayed to the user, which is the **virtual environment selection**. It contains a list and screenshots of natural environments options available for the user to choose from (Figure 5.6). This is in accordance with the characteristics of GIT and Spatial Presence in the proposed SP-GIT4IBVRST design model which states that IBVR self-therapy should contain peaceful nature images with several or variety image options for users to choose based on their preferences.

Figure 5.6. Third Screen of the Prototype (List of IBVR Environment)

For this study, four options of natural environments provided in the prototype which are (i) waterfall, (ii) field, (iii) mountain and (iv) beach. Users can choose the environment they like, which can give a sense of calm when they see it. However, before the user start to navigate through the selected environment, the virtual therapist voice is played to the user, giving instructions on **deep breathing and relaxation exercise**. These two exercises are part of the GIT component in the proposed model. It aims to help users feel at ease before experiencing the IBVR environment and get the most out of the experience, thereby feeling calm. Figure 5.7 shows the sample of the virtual therapist script on deep breathing and relaxation exercise.

Untuk beberapa minit yang akan datang, tiada perkara lain yang harus anda lakukan, dan tiada tempat lain harus anda berada. Ini adalah masa untuk anda berehat dan merasai ketenangan yang mendalam. Anda akan melihat imej-imej pemandangan indah dengan bunyi-bunyian yang menenangkan. Sekarang, berikan fokus kepada tubuh badan anda dan tarik nafas secara mendalam beberapa kali. Tarik nafas secara perlahan-lahan dan mendalam. Isikan paru-paru anda dengan oksigen dan lepaskan. Sekali lagi perlahan-lahan tarik nafas anda secara mendalam... dan lepaskan. Rasakan ketenangan dengan setiap udara yang masuk ke dalam tubuh badan anda... dan lepas segala kerisauan dan ketegangan dengan setiap nafas yang dilepaskan. Anda boleh membenarkan tubuh badan dan minda anda untuk berehat dan berasa tenang sekarang.

Figure 5.7. Virtual Therapist Instructions on Deep Breathing and Relaxation

Next, in the content section of the structure, after the deep breathing exercise, users can **view the selected virtual environment** in 360-degree dimensions through the provided HMD. This is made possible by the panning function available on the HMD through the head tracking technology that allows the user to see the environment in 360 degrees with head rotation. The panning function is one of the features for the interactivity element in the Spatial Presence component of the proposed SP-GIT4IBVRST design model, as visualized in Figure 5.8.

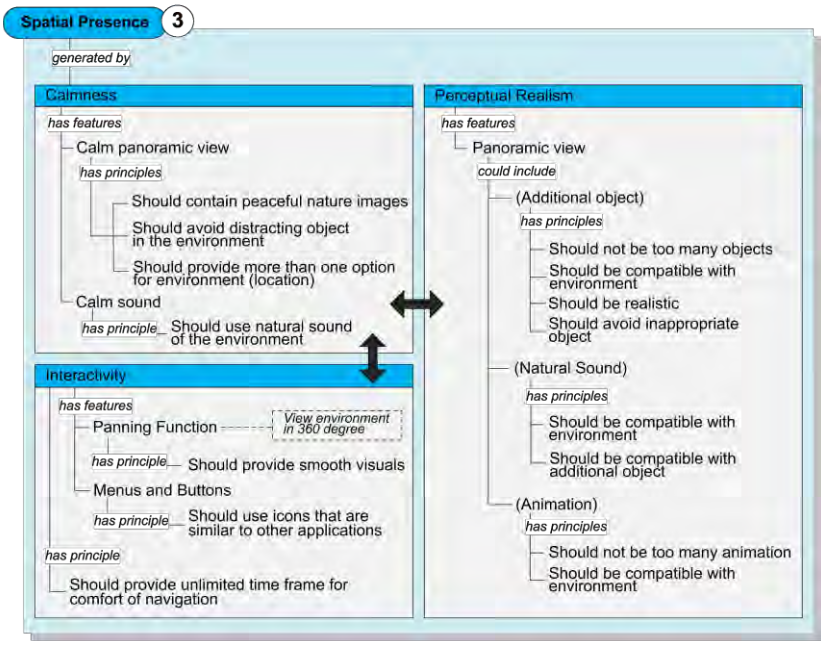


Figure 5.8. Spatial Presence Component of the Proposed SP-GIT4IBVRST Design Model

In the previous paragraph, it was explained that the images included in IBVR for self-therapy are **images of nature** that is in compliance with the characteristics or principles to provide a calm panoramic view to create the sense of spatial presence in the virtual environment. Also, according to the principles, the images should not contain any objects that can distract the users attention to the nature. Figure 5.9 shows the illustration of the 360-degress or panoramic view for the virtual environment.

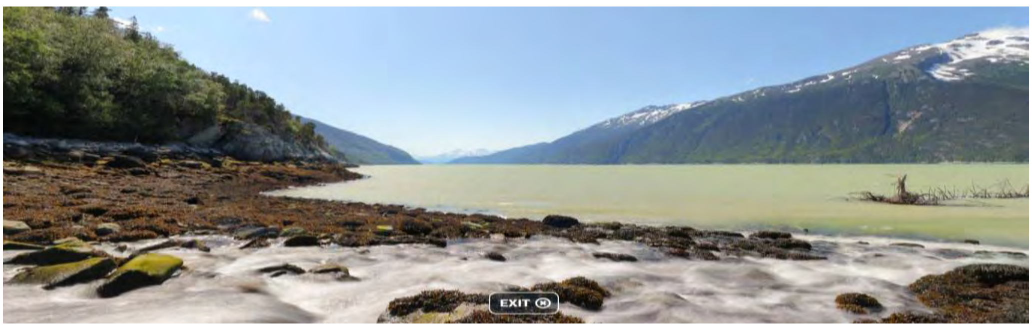


Figure 5.9. Illustration of the Panoramic View for the Virtual Environment

Along with the images, the user can also listen to the **natural sounds** of the environment through the headphones provided. The inclusion of natural environment sounds is part of the GIT elements. It is also in line with the principle of calm sound to generate a sense of spatial presence, as depicted in Figure 5.8. The included sound also conforms to the established principles to create perceptual realism i.e. it should be compatible with the virtual environment and any additional objects.

The additional objects are referring to other objects that are compatible with the virtual environment. This is also part of the characteristic of perceptual realism to create a sense of spatial presence, as outlined in the SP-GIT4IBVRST model. Among other things, it also stipulates that additional objects should not be too many and should be realistic. As can be seen in Figure 5.10, the 'boat' is regarded as additional object in the panoramic view of a beach which comes with the sound of a real boat.

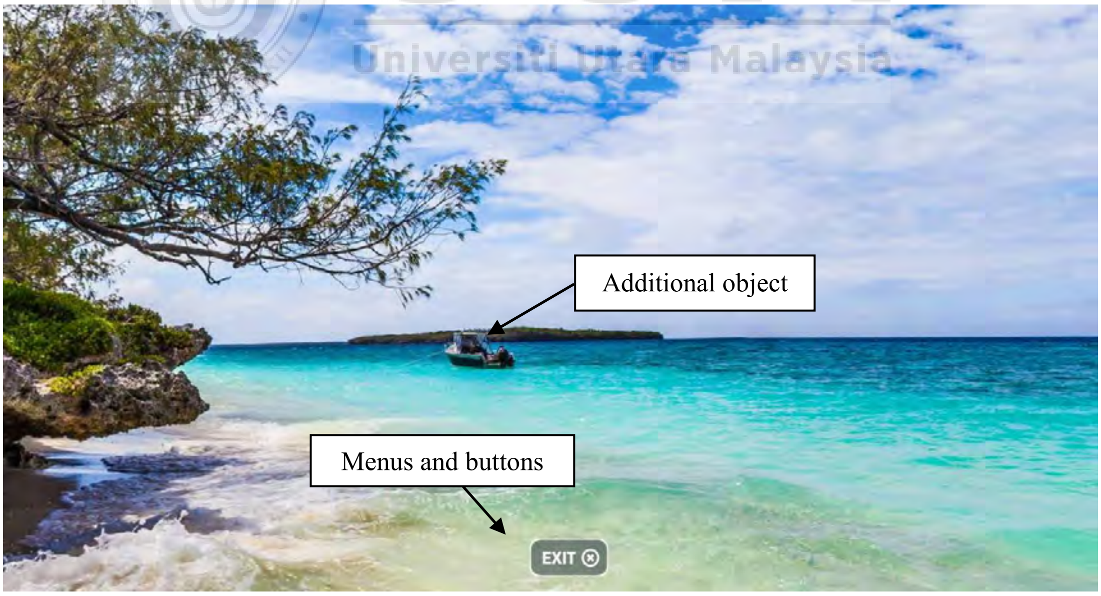


Figure 5.10. Additional Objects and Buttons in the Panoramic View of a Beach

Also, menus and buttons in the application are designed and developed based on the principle of interactivity which states that the icons used should be similar to other applications. This is to facilitate user navigation as they are familiar with the user interface provided. In addition, based to the interactivity principle of the Spatial Presence component, users of the IBVR self-therapy tool are given unlimited time to navigate through the application to provide comfort of navigation. Whenever they want, users can select the 'exit' button to go to the main menu.

Finally, in the closing section, after the user has finished navigating through the panorama in the virtual environment and select the 'exit' button, the end screen is displayed to the user (Figure 5.11). Based on the proposed SP-GIT4IBVRST design model, it is recommended to provide a guide on stress coping strategies to the user at the end of the therapy session. It aims to provide suggestions to users on ways to deal with stressful situations. Figure 5.12 shows a sample of the virtual therapist script on stress coping strategies included in the IBVR self-therapy prototype.

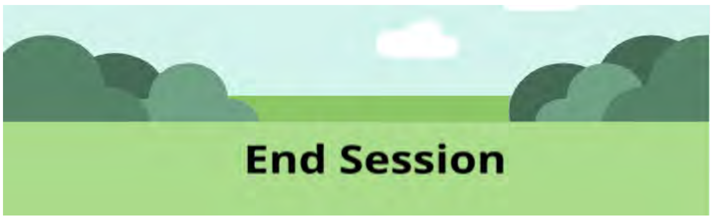


Figure 5.11. The End Screen

Baiklah. Anda telah pun melalui satu pengalaman terapi minda melalui aplikasi realiti maya IBVRest. Rasakan ketenangan dengan pemandangan indah dan bunyi-bunyian yang menenangkan menerusi gambar telah anda hayati sebentar tadi. Semoga anda akan dapat melalui hari-hari anda dengan lebih tenang.

Figure 5.12. Virtual Therapist Script of Stress Coping Strategies

5.6 Summary

In this study, the developed prototype is a semi-functional application of IBVR for therapeutic purposes, specifically for the condition of stress. It is developed based on the elements and components of the proposed SP-GIT4IBVRST hybrid model. This chapter describes on the development processes which can be classified into three phases namely (i) pre-development, (ii) development and (iii) post-development Output of these phases accomplished the third objective of this study which is to develop a prototype that applies the constructed model. Above all, the main focus of this chapter is to demonstrate the implementation of the proposed hybrid model for the IBVR self-therapy tool into a prototype. Then, the prototype was used for user experience evaluation and it is discussed thoroughly in the next chapter.

CHAPTER 6

USER EVALUATION

6.1 Introduction

As previously stated in Chapter 1, the fourth objective of this study is to evaluate the hybrid model from three dimensions, namely (i) spatial presence, (ii) user experience and (iv) effectiveness of the IBVR self-therapy. These dimensions are part of the user experience evaluation for the proposed hybrid model, which is based on previous studies as mentioned in Chapter 2. The first evaluation dimension is to measure the level of spatial presence sensed by the user while navigating through the virtual environment in the IBVR self-therapy. The second evaluation is to assess the quality of user experience (UX) while using the prototype. Then the third evaluation is to assess the effectiveness of the IBVR self-therapy in inducing calmness and relaxation to the user hence reduce stress. The results of these evaluation provide insights of the appropriateness of the components and elements applied in the hybrid model for the development of the IBVR self-therapy. For this study, the user evaluation was conducted quantitatively through questionnaire in which the selected participants provided their answers and were analysed. In this chapter, a description of the user evaluation conducted in this study is provided in the following sub-topics.

6.2 Evaluation Method

The study was conducted at Universiti Utara Malaysia on 100 students of undergraduate and postgraduate during the study week. As for postgraduate students, they were selected among those who will be having a viva session soon. The participants were selected on a voluntary basis. Only those who are interested are invited to be involved in this study and have the opportunity to experience the IBVR self-therapy tool. However, those with any physical disability or mental disorders were not considered as the subjects of this study.

6.2.1 Demographic Background

The demographics of the participants who took part in the user evaluation of this study are displayed in Table 6.1. The evaluation included 100 participants with equal representation of both genders; 50 male students and 50 female students. Out of these participants, 62 were undergraduates and 38 were post-graduate students. The age range of the participants was between 18 to 45 years.

Table 6.1

Demographics of the participants

Items	**Details**
Age	18 to 45
Number of Male Students	50
Number of Female Students	50
Number of Undergraduate Students	62
Number of Postgraduate Students	38

6.2.2 Experiment Design

The experimental session was conducted according to the diagram in Figure 6.1. The design of this experiment is based on several existing studies that adapted similar procedures for their experiments in VR therapy (Yu, Lee, & Luo, 2018; Camara & Hicks, 2019; Zaharuddin, Ibrahim, & Yusof, 2022). Initially, the participants received a brief explanation about the evaluation, particularly on the objectives and procedures of the evaluation session. The equipment involved were also introduced, with some instructions on how to use it. Then, the participants were asked to sign a consent form (Appendix E) and provide their demographic information.

Figure 6.1. User Evaluation Experiment Session Diagram

Before commencing the IBVR self-therapy, participants were requested to complete the DASS-21 questionnaire, a tool designed to evaluate their stress levels before going through the therapy session. The aim is to assess the level of stress experienced by the participants both before and after undergoing IBVR therapy. This will allow measurement of the effectiveness of the therapy in reducing stress levels. Following the completion of the questionnaire, participants were guided through a pre-recorded narration for a deep breathing and relaxation exercise, which aimed to induce a sense of calmness before entering the virtual environment.

Following the initial stage of the experiment, the participants proceeded to wear a Head-Mounted-Display (HMD) in order to be fully immersed in the IBVR environment. The participants were presented with a selection of four distinct environments to choose from, these include a serene waterfall, a vast field, a towering mountain, and a serene beach. As mentioned previously, these virtual environments were presented in high-quality 360-degree video format. Each participant have the freedom to choose any environment that suits their personal preference and enjoy the video in a comfortable position of their choosing. With the aid of the HMD, participants have the opportunity to fully explore the virtual environment by tilting their heads and looking around in any direction, while also being able to listen to the natural sounds that accompany each environment.

During the course of the session, the participants were given the freedom to halt their involvement if at any point they experienced any discomfort or unpleasant emotions. Subsequent to the session, they were politely requested to fill out a set of questionnaires that evaluated their level of spatial presence, user experience, and the efficacy of IBVR self-therapy. As previously mentioned, the effectiveness of the therapy was determined by comparing the DASS-21 questionnaire scores before and after the session. The purpose of these surveys was to gain a more extensive comprehension of the participants' individual perspectives and their overall engagement within the virtual environment.

6.3 Evaluation Analysis

6.3.1 Findings of the Spatial Presence Evaluation

The aim of the evaluation is to gauge the level of spatial presence experienced by participants. Four key components were identified for the purpose of evaluation; calmness, interactivity, perceptual realism, and spatial presence. These components were adopted from the Spatial Presence Metrics for IBVR application constructed by Nadia (2017) (Appendix G). To assess each items of the components, participants were asked to rate them on a five-point Likert scale, ranging from 'strongly disagree' to 'strongly agree'. The responses were analysed using descriptive analysis that calculate the mean and standard deviation for all four variables (calmness, interactivity, perceptual realism and spatial presence). The score was categorized into low, average, and high levels according to Cooper & Schindler's (2014) as shown in Table 6.2, for easy interpretation.

Table 6.2

The Tendency Level Based on Mean Score

Mean Score	Tendency Level
1.00 to 2.33	Low
2.34 to 3.67	Average
3.68 to 5.00	High

Based on the above classification, the mean score level for each variables of the spatial presence questionnaire are categorized accordingly. Table 6.3 indicates the descriptive analysis result from the respondents about the calmness variable. There are 4 questions used to evaluate the calmness variable and the mean is obtained after the analysis.

Table 6.3

Mean and Standard Deviation of Calmness Variable

Variables	Items		Mean	SD	Level
Calmness (4 items)	cal1	I feel calm when no negative object found when navigating the virtual environment.	4.10	.703	High
	cal2	The colour which is not too bright in panoramic views help me to feel calm.	3.55	.978	Average
	cal3	I feel calm while watching the panoramic virtual environments	3.75	.957	High
	cal4	I feel calm when listening to the natural sound	4.05	.672	High
		Total	**3.86**	**.791**	**High**

Referring to Table 6.3, the highest mean score (4.10) is from the item 'I feel calm when no negative object found when navigating the virtual environment'. Meanwhile, the lowest mean score (3.55) is from the item 'The colour which is not too bright in panoramic views help me to feel calm'. The table also revealed that all items were rated as high, as recommended by Cooper and Schindler (2014).

Table 6.4

Mean and Standard Deviation of Interactivity Variables

Variables	Items		Mean	SD	Level
Interactivity (5 items)	inter1	I could watch the virtual environment with my preferable speed.	3.40	1.21	Average
	inter2	I could interact very well with the application by using the panning.	3.90	.835	High
	inter3	I had no difficulties to use this application because this application's menu is similar to other standardized application menus I have used.	4.00	.636	High
	inter4	The navigation functions made it easier for me to navigate within this virtual environment.	4.00	.636	High
	inter5	I felt very comfortable in using the navigation buttons to navigate within this virtual environment.	4.00	.636	High
		Total	**3.86**	**.773**	**High**

Table 6.4 above indicates the descriptive analysis result from the respondents about the interactivity variable. There are 5 questions used to evaluate the interactivity variable and the mean is obtained after the analysis. Based on Table 6.4 above, the highest mean score (4.00) is from the item 3 'I had no difficulties to use this application because this application's menu is similar to other standardized application menus I have used', item 4 'The navigation functions made it easier for me to navigate within this virtual environment', and item 5 'I felt very comfortable in using the navigation buttons to navigate within this virtual environment'.

Meanwhile, the lowest mean score (3.40) is from the item 1 'I could watch the virtual environment with my preferable speed'. The table also revealed that all items were rated as high, except item 1 which was rated as average, as recommended by Cooper and Schindler (2014).

Table 6.5

Mean and Standard Deviation of Perceptual Realism Variables

Variables	Items		Mean	SD	Level
Perceptual Realism (11 items)	pr1	The visuals in the display were consistent made the virtual environment seems real.	4.02	.550	High
	pr2	The visuals in the display were clear (no blur and parallax) made the virtual environment seems real.	4.16	.368	High
	pr3	The visuals in the display were realistic made the virtual environment seems real.	4.30	.643	High
	pr4	The visuals in the display were beautiful made the virtual environment seems real.	4.60	.492	High
	pr5	The combination of recorded natural sound and additional objects, made the virtual environment seems real.	4.00	.899	High
	pr6	The combination of animation and beautiful scenery made the virtual environment seems real.	4.25	.770	High
	pr7	The combination of scenery and additional objects, made the virtual environment seems real.	3.90	.541	High
	pr8	The combination of scenery and sound, made the virtual environment seems real.	4.37	.485	High
		Total	**4.14**	**.516**	**High**

Table 6.5 above indicates the descriptive analysis result from the respondents about the perceptual realism variable. There are 8 questions used to evaluate the perceptual realism variable and the mean is obtained after the analysis. Based on table above, the highest mean score for perceptual realism variable is 4.60 from item 4 'the visuals in the display were beautiful made the virtual environment seems real'. Meanwhile, the lowest mean in this analysis is 3.90 from item 7 'The combination of

scenery and additional objects, made the virtual environment seems real'. However, all items were rated as high, as recommended by Cooper and Schindler (2014).

Table 6.6

Mean and Standard Deviation of Spatial Presence Variables

Variables	**Items**		**Mean**	**SD**	**Level**
Spatial Presence (6 items)	sp1	I felt like I was a part of the environment in the application.	3.82	.809	High
	sp2	I felt like I was actually there in the environment of the application.	3.79	.782	High
	sp3	I felt like the objects in the application.	3.77	.750	High
	sp4	I felt as though I was physically present in the environment of the application.	3.81	.787	High
	sp5	It was as though my true location had shifted into the environment in the application.	4.00	.636	High
	sp6	It seemed as though my self was present in the environment of the application.	3.98	.568	High
		Total	**3.86**	**.695**	**High**

Meanwhile, Table 6.6 above shows the descriptive analysis result for the spatial presence variable. There are 6 questions used to evaluate the spatial presence variable and the mean score is obtained after the analysis. Based on Table 6.6 above, the highest mean for perceptual realism variable is 4.00 from the question 'It was as though my true location had shifted into the environment in the application'. Meanwhile, the lowest mean in this analysis is 3.77 from the question 'I felt like the objects in the application'. All items were also rated as high, according to the classification by Cooper and Schindler (2014).

Above all, it can be summarized that the outcomes of the analysis show that respondents had a positive attitude towards all variables in the spatial presence questionnaire. Table 6.7 integrates the total mean score and standard deviation for all variables, with a mean score ranging from 3.86 to 4.14.

Table 6.7

Mean And Standard Deviation of Spatial Presence Variables

Variables	Mean	Std. Deviation	Level
Calmness	3.86	.791	Average
Interactivity	3.86	.773	Average
Perceptual Realism	4.14	.516	High
Spatial Presence	3.86	.695	Average

It is worth mentioning that perceptual realism received the highest mean score of 4.14, with a standard deviation of 0.516. In contrast, calmness, interactivity, and spatial presence had a mean score of 3.86, with standard deviations of 0.791, 0.773, and 0.695, respectively, indicating that they had the lowest mean scores. Overall, the findings suggest that the respondents viewed all variables positively, as evidenced by the relatively high mean score of 4.00. It is evident that calmness, interactivity, perceptual realism, and spatial presence are crucial factors in creating a positive user experience.

To sum up, the IBVR self-therapy has been created using the elements of spatial presence, and it can make the user feel as if they are truly present in the virtual environment. Although it is not as interactive as the GBVR, it still provides a high-quality virtual experience and generates a sense of spatial presence to the users, making them feel physically present in the virtual environment.

6.3.2 Findings of the User Experience Evaluation

In order to effectively measure user experience as part of this study, it was deliberately decided to use an abbreviated version of the User Experience Questionnaire (UEQ) (Appendix G). These results are based on the reputation of the UEQ-S as a reliable and easy-to-use tool for collecting user feedback about their experiences with interactive products (Schrepp et al., 2017; Chen et al., 2020).

UEQ-S comprises of eight items that are divided into two categories, namely pragmatic quality and hedonic quality, as illustrated in Table 6.8. This structured approach allows the researcher to gain a comprehensive understanding of the user's experience. Specifically, the pragmatic quality category focuses on the user's perception of the technical elements that are integral to achieving their goals within the product. On the other hand, the hedonic quality category is concerned with the user's emotional response to the non-technical aspects of the product.

Table 6.8

UEQ-S Evaluation item

Item	Evaluation		Scale
	Negative	Positive	
1	obstructive	supportive	Pragmatic Quality
2	complicated	easy	Pragmatic Quality
3	inefficient	efficient	Pragmatic Quality
4	confusing	clear	Pragmatic Quality
5	boring	exciting	Hedonic Quality
6	not interesting	interesting	Hedonic Quality
7	conventional	inventive	Hedonic Quality
8	usual	leading edge	Hedonic Quality

Item NO.	Evaluation								
	Negative	1	2	3	4	5	6	7	Positive
1	obstructive	○	○	○	○	○	○	○	supportive
2	complicated	○	○	○	○	○	○	○	easy
3	inefficient	○	○	○	○	○	○	○	efficient
4	confusing	○	○	○	○	○	○	○	clear
5	boring	○	○	○	○	○	○	○	exciting
6	Not interesting	○	○	○	○	○	○	○	interesting
7	conventional	○	○	○	○	○	○	○	inventive
8	usual	○	○	○	○	○	○	○	Leading-edge

Figure 6.2. Representation of the UEQ-S Evaluation Items

In order to gather responses for each item on the questionnaire, a scale ranging from 1 to 7 was utilized. The negative term is represented by the leftmost end of the scale, while the positive term is represented by the rightmost end. A visual representation of this can be found in Figure 6.2.

The data was analysed with the help of the UEQ-S analysis tool. This tool converts the score value of each statement answer from a 7-point Likert scale to a range from -3 (the most negative) to +3 (the most positive). The UEQ-S analysis provides insights into both pragmatic and hedonic quality, which are represented by the mean values for each scale.

The mean values obtained from this analysis allow a better understanding of the overall evaluation of the product or service. Values between -0.8 to 0.8 indicate a neutral evaluation, implying that the product or service did not elicit a strong reaction or opinion from the user. Values greater than 0.8 suggest a positive evaluation, indicating that the user was pleased with the product or service. On the other hand, values less than -0.8 indicate a negative evaluation, suggesting that the user was dissatisfied with the product or service.

Table 6.9 shows the mean values of each item in the UEQ-S for the IBVR self-therapy tool. While Table 6.10 shows the average scores for pragmatic quality, hedonic quality and overall user experience scale.

Table 6.9

Mean Values for UEQ-S Items

Item	Mean	Negative	Positive	Scale
1	1.4	Obstructive	Supportive	Pragmatic Quality
2	1.7	Complicated	Easy	Pragmatic Quality
3	0.7	Inefficient	Efficient	Pragmatic Quality
4	1.0	Confusing	Clear	Pragmatic Quality
5	1.1	Boring	Exciting	Hedonic Quality
6	1.2	Not interesting	Interesting	Hedonic Quality
7	1.1	Conventional	Inventive	Hedonic Quality
8	1.0	Usual	Leading edge	Hedonic Quality

Table 6.10

Mean Values for UEQ-S Scales

Scales	Mean
Pragmatic Quality	1.193
Hedonic Quality	1.095
Overall	1.148

Based on the data in Table 6.10, it is evident that the pragmatic quality mean score for the IBVR self-therapy tool was 1.193, while the hedonic quality mean score was 1.095. This indicates that the tool was effective in addressing practical needs while also providing a satisfying user experience. While the overall mean score of 1.148 shows that the IBVR self-therapy tool was successful in meeting the needs and expectations of its users. It is important to note that the overall score exceeded 0.8, which is a significant milestone, demonstrating that users had a positive experience while using the tool.

In addition, the mean score was compared with benchmark data obtained from a vast pool of 14,056 participants who had participated in 280 studies that covered a broad range of products, including enterprise software, websites, e-commerce platforms, and social media networks (Schrepp, 2019). This comparative analysis is particularly useful in assessing the product's quality in relation to other similar products and deriving meaningful insights from the data obtained.

Through to the analysis conducted using the UEQ Data Analysis Tool, Figure 6.3 indicates that the pragmatic quality score of the IBVR self-therapy tool surpasses the average. Furthermore, the hedonic quality score also exceeds the benchmark database, which further confirms the exceptional performance of the proposed IBVR self-therapy tool in this study. Consequently, the overall evaluation suggests that the IBVR self-therapy tool offers an exceptionally satisfying user experience, making it an effective tool for therapeutic purposes. This is also summarized in Table 6.11.

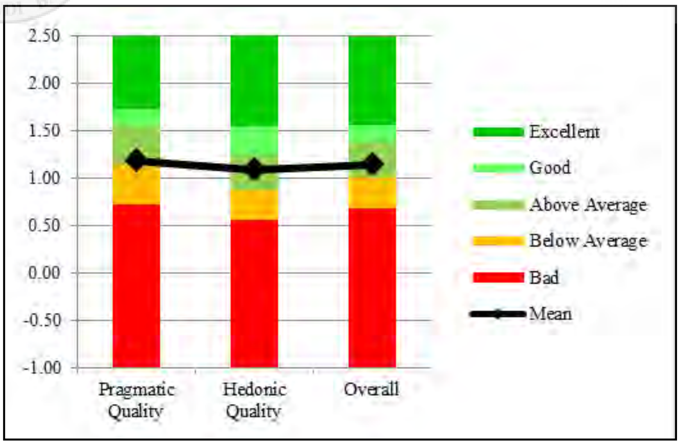


Figure 6.3. Comparison to Benchmark Data

Table 6.11

Comparison to Benchmark Data

Scale	Mean	Comparison to benchmark
Pragmatic Quality	1.1925	Above average
Hedonic Quality	1.095	Above Average
Overall	1.15	Above Average

Upon evaluation, the IBVR self-therapy tool developed for this study has been determined to be satisfactory in meeting the requirements and needs of its users to a certain extent. However, in comparison to GBVR, it has been found to have limitations in terms of its level of interactivity. Despite this, IBVR remains a more cost and time-effective alternative to the creation of virtual environments. It has the potential to facilitate a positive user experience that may prove helpful in managing stress effectively. The goal is to create a significant impact on emotions and psychology, thereby providing a comprehensive and effective self-therapy tool.

6.3.3 Findings of the Effectiveness Evaluation

This study aims to evaluate the effectiveness of the IBVR self-therapy tool in promoting a state of calmness and reducing stress levels among individuals. To achieve this goal, this study has adopted the DASS-21 questionnaire, a well-established self-reporting tool to assess participants' mental health status (Lovibond & Lovibond, 1995). It consists of 21 items that cover three emotional states namely (i) depression, (ii) anxiety and (iii) stress.

However, it is important to note that for this study, only the seven items linked to stress (as shown in Table 6.12) was included (Appendix F). The questionnaire was administered both before and after using the self-therapy tool to evaluate its efficacy in stress management. This in-depth analysis aims to identify whether IBVR self-therapy tool can serve as a beneficial resource for those seeking to manage their stress and enhance their overall well-being.

Table 6.12

Dass-21 Items on Stress

Variables	Items	
Stress (7 items)	dass1	I find myself inconsolable.
	dass2	I tend to overreact in certain situations.
	dass3	I think I use up a lot of energy being anxious.
	dass4	I found myself getting restless.
	dass5	I find it hard to relax.
	dass6	I can't stand things that stop me from doing what I'm doing.
	dass7	I think I'm touchy.

For each of the items in the variables, four-point Likert response scale from 0 (did not apply to me at all/never) to 3(applied to me very much/always) was used to measure the indicators for the variable. The responses of the participants were analysed using a descriptive analysis which was computed through means and standard deviation. Table 6.13 and Table 6.14 shows the results of the analysis. While Figure 6.4 illustrates these results.

Table 6.13

Mean Score for Each Item, Before and After Experiment

Items	Before		After	
	Mean	**Std. Dev**	**Mean**	**Std. Dev**
I find myself inconsolable.	1.00	.000	1.00	.000
I tend to overreact in certain situations.	1.37	.450	1.31	.432
I think I use up a lot of energy being anxious.	1.79	.555	1.57	.536
I found myself getting restless.	1.41	.608	1.29	.483
I find it hard to relax.	1.15	.320	1.13	.309
I can't stand things that stop me from doing what I'm doing.	1.08	.253	1.08	.253
I think I'm touchy.	1.84	.486	1.84	.486
Total	**1.38**	**.294**	**1.32**	**.257**

Table 6.14

Percentage of Changes in the Level of Stress Before and After Experiment

No.	Items	Before	After	Percent Change
1	I find myself inconsolable.	1.00	1.00	0
2	I tend to overreact in certain situations.	1.37	1.31	4.38
3	I think I use up a lot of energy being anxious.	1.79	1.57	12.29
4	I found myself getting restless.	1.41	1.29	8.51
5	I find it hard to relax.	1.15	1.13	1.74
6	I can't stand things that stop me from doing what I'm doing.	1.08	1.08	0
7	I think I'm touchy.	1.84	1.84	0
	Level of stress	**1.38**	**1.32**	**4.35**

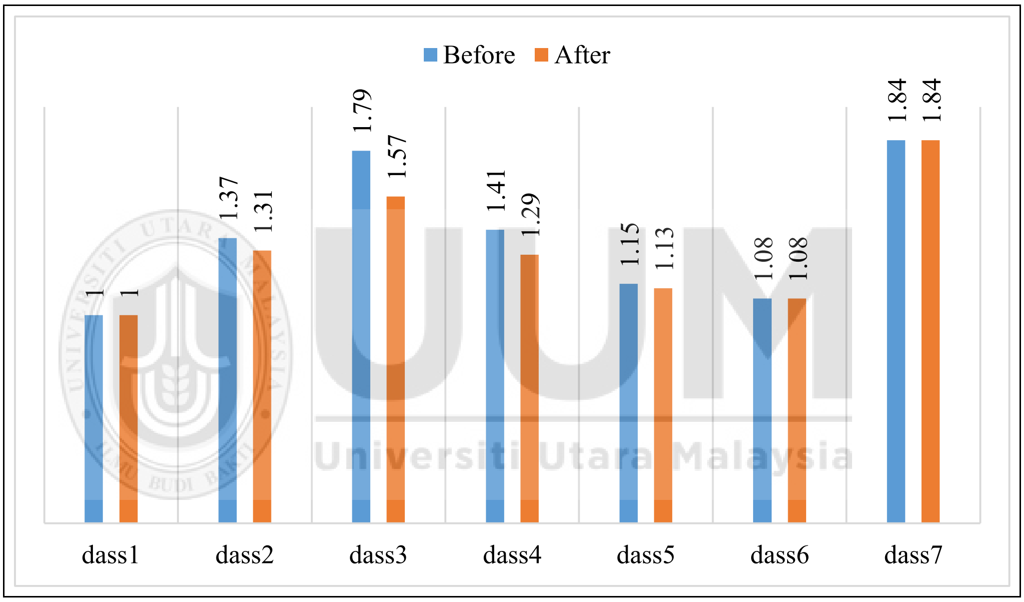


Figure 6.4. Mean Score of Each Item, Before and After Experiment

As shown in the Table 6.14 and Figure 6.4 above, no statistically significant differences were found in item 2 'I tend to overreact in certain situations' and item 5 'I find it hard to relax'. The mean score of item 2 was decrease from 1.37 to 1.31 with percent of change of 4.38, while item 5 was decrease from 1.15 to 1.13 with percent of change of 1.74. However, item 3 'I think I use up a lot of energy being anxious' showed a decrease from 1.79 to 1.57 with percent of change of 12.29.

While item 4 ‘I found myself getting restless’ also indicates a decrease from 1.41 to 1.29 with percent of change of 8.51. Meanwhile item 1 ‘I find myself inconsolable’, item 6 ‘I can't stand things that stop me from doing what I'm doing’ and item 7 ‘I think I'm touchy’ has showed no differences before and after.

Nevertheless, the total mean values of the stress variable are 1.38 with a standard deviation of 0.294 before and 1.32 with a standard deviation of 0.257 after it. In order to ensure easy interpretation of the result, the mean score was categorized into three namely: 1.00 to 2.33 as low; 2.34 to 3.67 as average, while 3.68 to 5.00 as high (Cooper & Schindler, 2014) as shown in Table 6.15. This also revealed that the level of stress is adjudged to be low, as suggested by Cooper and Schindler (2014).

Table 6.15

The Tendency Level Based on Mean Score

Mean Score	**Tendency Level**
1.00 to 2.33	Low
2.34 to 3.67	Average
3.68 to 5.00	High

Overall, the participants' level of stress has shown a decrease when comparing the result of the DASS questionnaire before and after the experiment, as illustrated in Figure 6.5. This means that the level of stress only experienced a slight decrease with a percentage change of 4.35% as shown in Table 6.14. Even though there was only a slight decrease in the stress level among the participants after experiencing the IBVR self-therapy tool, it is still showing a positive result.

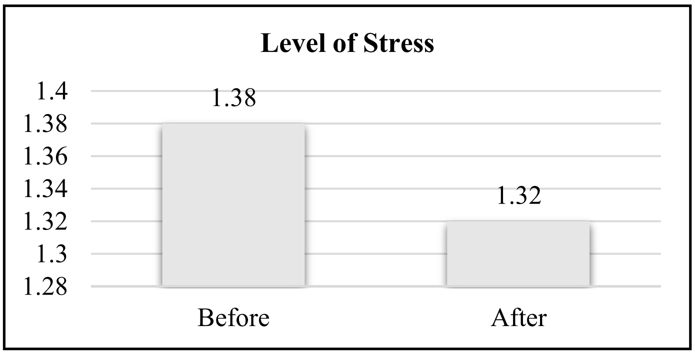


Figure 6.5. Level of Stress, Before and After the Experiment

This indicates that the IBVR self-therapy has the potential to provide calmness, thus helping users to reduce stress. This is also an indication that the components and elements applied in the IBVR are supporting the effectiveness of the self-therapy tool. The adaptation of the GIT concepts and techniques has ensured the appropriateness of the IBVR tool for therapeutic purposes. However, it is suggested that more study to be conducted to identify other elements to be included in the IBVR in ensuring more convincing results.

6.4 Summary

In conclusion, the user experience evaluation on the prototype of the IBVR self-therapy has garnered a promising outcomes that subsequently proven the successfulness of the proposed SP-GIT4IBVRST design model. The results has shown a positive results thus supporting the accomplishment of the fourth objective of this study which is evaluate the hybridized model of spatial presence and GIT technique for IBVR in self-therapy, in terms of spatial presence, user experience and its effectiveness through user testing. The next chapter provides some insights and summarization of this study based on the main objectives and implications to the theory and practical as well as recommendations for future works.

CHAPTER 7

CONCLUSION

7.1 Introduction

Practically, the implementation of this study is based on the goal of providing a therapeutic method to reduce stress through VR technology, in addition to existing psychotherapy methods. To achieve that, this study has set the aim of proposing a hybrid design model for an IBVR self-therapy tool that integrates the spatial presence model and the GIT technique. Accordingly, several research questions have been formulated to identify the objectives that need to be achieved in making this study a success, which are:

i) What are the appropriate components in the hybridized model of spatial presence and GIT technique for IBVR in self-therapy?

ii) How to construct the hybridized model of spatial presence and GIT technique for IBVR in self-therapy?

iii) How to validate the hybridized model of spatial presence and GIT technique for IBVR in self-therapy?

Based on these questions, four research objectives were outlined as the basis for conducting this study to find a solution for the questions, as follows:

i) To determine the appropriate components in the hybridized model of spatial presence and GIT technique for IBVR in self-therapy.

ii) To construct the hybridized model of spatial presence and GIT technique for IBVR in self-therapy.

iii) To develop a prototype that applies the constructed hybridized model of spatial presence and GIT technique for IBVR in self-therapy.
iv) To evaluate the hybridized model of spatial presence and GIT technique for IBVR in self-therapy, in terms of spatial presence, user experience and effectiveness.

In the following sub-topics, elaboration on the research questions and objectives is provided, explaining how the questions were answered and the objectives achieved through the research activities carried out in this study. It is followed by some discussion on the implications of the study to theory and practical. Other than that, limitations of the study are also explained, together with recommendations for future works, at the end of this chapter.

7.2 Research Question 1

What are the appropriate components in the hybridized model of spatial presence and GIT technique for IBVR in self-therapy?

The hybrid model proposed in this study comprises four main components which are (1) Structure, (2) GIT, (3) Spatial Presence, and (4) VR system. The structural component designate that the self-therapy IBVR tool is arranged into three parts, namely opening, content and closing. All GIT elements are applied in the IBVR self-therapy tool. Whereas the GIT component specifies that IBVR self-therapy tool must contain the therapist's guidance in the form of a recorded voice. This guide instructs users on deep breathing and peaceful imagery of nature. It must also engage the user's various senses and various images with particular details. As for the spatial presence component, it states that IBVR tool for self-therapy must be capable of invoking the sense of spatial presence through the tranquility of panoramic views and natural sounds. In terms of interactivity, it must provide panning function, standard menu and navigation comfort to the user. To create perceptual realism in IBVR, the panoramic display in the IBVR self-therapy tool can include additional objects, natural sounds, and animations that are compatible with the panoramic views in the IBVR. Finally, the VR system components describe the hardware and software that must be considered in the development of the IBVR. It includes computers, software, input and output mechanisms required for the development and implementation of the IBVR application.

7.3 Research Question 2

How to construct the hybridized model of spatial presence and GIT technique for IBVR in self-therapy?

It includes the steps in identifying the appropriate components to be integrated in the model development. As described previously, the components have been identified through content analysis of existing studies that are closely related to this study. It is followed by a comparative analysis of the models found in selected studies, to determine the most suitable components to be adapted in the proposed model. Based on these components, a design model for IBVR self-therapy was developed, integrating the characteristics of GIT, spatial presence and VR system, namely SP-GIT4IBVRST. Then, a number of selected experts were assigned to review and validate the proposed model in terms of the relevance of components and elements, as well as readability and understandability of the model. Then the proposed model was refined accordingly for the final version of the model before it is translated into a working prototype for user evaluation purposes.

7.4 Research Question 3

How to validate the hybridized model of spatial presence and GIT technique for IBVR in self-therapy?

The aim of model validation is to verify that the proposed model meets the requirements and is reliable for implementation. In this study, the model validation was conducted through expert review (Chapter 4), prototyping (Chapter 5) and user evaluation (Chapter 6).

The expert review aims to evaluate the proposed design model in terms of relevancies of the proposed components and elements, readability and understandability of proposed model. The experts review the initial model to identify any loopholes and areas for improvements to ensure that it is in line with the main objective of this study. The initial model has gone through four cycles of expert review process with several different experts whose expertise are relevant to this study. The comments and recommendations from the experts were taken into consideration in the refinement of the proposed model.

Subsequently, to further validate the proposed model, a semi-working prototype was developed for the purpose of user experience evaluation. The prototype is an IBVR tool for the purpose of self-therapy. The aim is to support the user to feel calm and reduce or avoid stress. Then this prototype was utilized in the user evaluation process from three dimensions, namely (i) spatial presence, (ii) user experience and (iv) effectiveness of the IBVR self-therapy. The first evaluation is to measure the level of spatial presence sensed by the user while navigating through the virtual environment in the IBVR self-therapy. The second evaluation is to assess the quality of user experience (UX) while using the prototype. Then the third evaluation is to assess the effectiveness of the IBVR self-therapy in inducing calmness and relaxation to the user hence reduce stress. The results of these evaluation provide insights of the appropriateness of the components and elements applied in the hybrid model for the development of the IBVR self-therapy.

7.5 Aim and Objectives: Revisit

This study aims at proposing a hybridized model of spatial presence and GIT for IBVR in self-therapy that hybrids the Spatial Presence Model with GIT technique. Having achieved all four main objectives of this study, the aim has been accomplished accordingly.

This first objective was accomplished through the discovery of the generic components and elements for the proposed model through analysis of existing literatures and models. Then the second objective was attained through the construction of the hybrid design model for IBVR self-therapy based on the identified components and elements. For validation purposes, four cycle of expert review process were conducted on the constructed model. Accordingly, a prototype was developed by referring to the design model to further validate the model. This marks the achievement of the third objective. Then the fourth objective was achieved through the user evaluation process that was conducted upon the developed prototype.

7.6 Contribution of the Study to Theory and Practical

In terms of the study's contribution to theory, this study has contributed to the body of knowledge through the development of a design model for IBVR in self-therapy. It is a model that hybridizes spatial presence theory and GIT technique, integrated in a VR system for therapeutic purposes. The design model enhances the spatial presence theory that implies the feeling of being physically present in the virtual environment, with the elements and principles of GIT technique to create a virtual environment that can provide calmness to users and subsequently relieve stress. With the integration of spatial presence and GIT in this study has made it possible for the IBVR to be applied for self-therapy, despite the limitation of its interactivity. The effectiveness of the IBVR self-therapy has also been assessed through the user evaluation which indicates that the IBVR gives positive impact to the user in terms of generating calmness and reducing stress. This also indicates that the components and elements included in the proposed hybrid model of spatial presence and GIT for IBVR self-therapy are appropriate in achieving the main objective of the study. The identification of the components and elements for model development has gone through a rigorous and systematic process through a scientific approach as described in detail in the fourth chapter.

Other than that, this study provides a significant practical contribution in the form of a comprehensive design model that can serve as a reliable and practical guide for both application designers and developers. Specifically, the model is designed to facilitate the development of an IBVR application for self-therapy. The model encompasses a range of essential components and elements that offer valuable insights and guidance to application developers for planning, designing, and developing IBVR-based self-therapy tools.

In addition, the prototype developed based on the design model has been proven to be a highly useful and effective tool for promoting peace of mind and reducing stress levels among users. This is a particularly significant finding, as stress-related issues are among the most common health problems people face today. The IBVR self-therapy application has the potential to offer an alternative solution to this problem, providing an engaging platform for individuals to manage their stress levels and improve their overall mental well-being. Overall, the study's findings suggest that IBVR-based self-therapy applications have the potential to make a positive impact on people's lives and well-being.

7.7 Limitations and Recommendations for Future Works

This study has identified some limitations that can be suggested for improvement and considered for future work. The limitations are mainly in terms of model development and evaluation, as described in the following paragraphs.

7.7.1 Model Development

In this study, the development of a design model for IBVR self-therapy was based on a broad perspective. The application of elements and components for the model takes into account the state of mental health or stressful situations that occurs in society in general. In addition, user evaluations have also been conducted on students at institutions of higher education taking into account the learning environment at the institutions. For future work, it is recommended that the development of the model also considers stressful situations in diverse environments, such as correctional facilities, medical centres, disaster shelters and etc. Additionally, the model development can also encompass a broader scope, such as comparing different cultural backgrounds and countries. The identification of the appropriate elements and components for these conditions may give slightly different results according to the specific situation.

7.7.2 Model Evaluation

In this study, a prototype was developed and tested for user evaluation. To gather user feedback on their experiences with the prototype, questionnaires were distributed and completed by the study's participants. The responses collected through the questionnaires were aimed at providing qualitative data on how users perceived the efficacy of the IBVR application. The questionnaires has gathered data on the users' self-perception and psychological changes upon completing the interaction with the IBVR. Moving forward, it is recommended that additional data be collected to comprehensively evaluate the model. This includes the collection of physiological data such as BP tests, heart rate pulses, electroencephalograms (EEGs), and electrocardiographs (ECGs). By collecting these additional data points, a more convincing evaluation of the model can be achieved. According to previous research, this evaluation method has demonstrated a noteworthy association between physiological information and various mental health conditions, including stress (Santaella et al., 2006; Kep, 2018; Yu et al., 2018; Vaquero-Blasco et al., 2021).

In terms of the participants for the evaluation, this study has involved students from higher institutions as the respondents in the user test. The selection of participants was carried out randomly from the general student population. However, in order to gain a more in-depth understanding of the impact of IBVR self-therapy on a broader segment of the population, it is recommended that future tests be conducted with diverse groups of respondents who possess varying characteristics. This would aid in the creation of a more comprehensive model.

7.8 Summary

This study has investigated and proposed a hybrid IBVR design model for self-therapy abbreviated as SP-GIT4IBVRST. The design model integrates two main components namely spatial presence and GIT, apart from the components of the VR system itself. Through review and analysis of existing literature and models, all appropriate components and elements in forming the design model were identified and verified by expert review and user evaluation process. The results and findings show that there are several advantages of the SP-GIT4IBVRST design model as follows:

- The proposed SP-GIT4IBVRST design model is usable and reliable to serve as a guide for developers to develop IBVR for self-therapy.
- The IBVR self-therapy tool is capable of creating a sense of spatial presence for its users.
- The IBVR self-therapy tool helps in providing calmness and stress relief to its users.

Above all, VR is now one of the technologies that is becoming more widely used and is able to provide benefits and positive effects to human life in general. In fact it can be one of the alternatives to the problems of human life in various angles. The IBVR self-therapy proposed in the study is expected to be an alternative intervention to the problem of stress faced by humans to prevent more serious situations from occurring, should the stress is allowed to continue to dominate humans negatively. Without meeting a therapist physically, users can do therapy by themselves through the IBVR. Users are expected to be able to calm themselves down and subsequently lower their stress levels to avoid more serious mental stress situations.

However, it should be emphasized that this IBVR self-therapy is not a substitute for existing standard intervention measures that a person suffering from mental stress needs to go through. But it is one of the alternative preventive measures to help maintain a positive and controlled mental state in general.

REFERENCES

Ahmadizadeh, M. J., & Taheri, M. (2019). Investigating the Efficacy of Brain Training by Using Virtual Reality and Real Shooting on the Shooting Skills of Students of a Military University. *Journal of Military Medicine*, *21*(2), 153–160.

Albayrak, T., Karasakal, S., Kocabulut, Ö… & Cengizci, A. D. (2019). Customer loyalty towards travel agency websites: The role of trust and hedonic value. *Journal of Quality Assurance in Hospitality & Tourism*, *21*(1), 50–77. https://doi.org/10.1080/1528008x.2019.1619497

Anthes, C., García-Hernández, R. J., Wiedemann, M., & Kranzlmüller, D. (2016). State of the art of virtual reality technology. In *IEEE Aerospace Conference Proceedings*. https://doi.org/10.1109/AERO.2016.7500674

Apóstolo, J. L. A., & Kolcaba, K. (2009). The Effects of Guided Imagery on Comfort, Depression, Anxiety, and Stress of Psychiatric Inpatients with Depressive Disorders. *Archives of Psychiatric Nursing*, 23(6), 403–411. https://doi.org/10.1016/j.apnu.2008.12.003

Arif, W. N. W. A., Ahmad, W. F. W., Nordin, S. M., Abdullah, A., & Sivapalan, S. (2009). Designing 3 dimensional virtual reality using panoramic image. In Lecture notes in computer science (pp. 404–414). https://doi.org/10.1007/978-3-642-05036-7_38

Ariffin, A. M. (2009). *Conceptual Design of Reality Learning Media (RLM) Model Based on Entertaining and Fun Constructs*. Universiti Utara Malaysia.

Arnold, P., Khot, R. A., & Mueller, F. F. (2018). “You Better Eat to Survive”: Exploring Cooperative Eating in Virtual Reality Games. In *Proceedings of the Twelfth International Conference on Tangible, Embedded, and Embodied Interactio* (pp. 398–408). Stockholm, Sweden: ACM. https://doi.org/https://doi.org/10.1145/3173225.3173238

Bamodu, O., & Ye, X. M. (2013). Virtual Reality and Virtual Reality System Components. *Advanced Materials Research*, 765–767, 1169–1172. https://doi.org/10.4028/www.scientific.net/amr.765-767.1169

Bargas-avila, J. A., & Hornbæk, K. (2011). Bargas-Avila (2011) - Old Wine in New Bottles or Novel Challenge_A Critical Analysis of Empirical Studies of UX. In *Proceedings of the International Conference on Human Factors in Computing Systems* (pp. 2689–2698). Vancouver, BC, Canada. https://doi.org/10.1145/1978942.1979336

Bashir, J., & Goswami, Y. P. (2020). Stress and guided imagery technique. *Galore International Journal of Health Sciences and Research*, 5(1), 147–149. Retrieved from https://www.gijhsr.com/GIJHSR_Vol.5_Issue.1_Jan2020/21.pdf

Baskerville, R., Baiyere, A., Gregor, S., Hevner, A., & Rossi, M. (2018). Design Science Research Contributions : Finding a Balance between Artifact and Theory. *Journal of the Association for Information Systems*, *19*(5), 358–376. https://doi.org/10.17705/1jais.00495

Basri, N. H., Adnan, W. A. A., & Baharin, H. (2019). E-Participation service in Malaysian e-government website: The user experience evaluation. *In Proceedings of the 10th International Conference on E-Education, E-Business, E-Management and E-Learning (IC4E '19)*. Association for Computing Machinery, New York: USA, 342–34

Beck, B. D., Hansen, Å. M., & Gold, C. (2015). Coping with Work-Related Stress through Guided Imagery and Music (GIM): Randomized Controlled Trial. *Journal of Music Therapy*, 52(3), 323–352. https://doi.org/10.1093/jmt/thv011

Bernhaupt, R. (2015). *User Experience Evaluation Methods in the Games Development Life Cycle*. (R. Bernhaupt, Ed.). Springer. https://doi.org/10.1007/978-3-319-15985-0

Bhagat, K. K., Liou, W., & Chang, C. (2016). A cost-effective interactive 3D virtual reality system applied to military live firing training. Virtual Reality, 20(2), 127–140. https://doi.org/10.1007/s10055-016-0284-x

Bilgihan, A. (2016). Computers in Human Behavior Gen Y customer loyalty in online shopping : An integrated model of trust, user experience and branding. *Computers in Human Behavior*, *61*, 103–113. https://doi.org/10.1016/j.chb.2016.03.014

Bilgihan, A., & Bujisic, M. (2015). The effect of website features in online relationship marketing: A case of online hotel booking. *Electronic Commerce Research and Applications*, *14*(4), 222–232. https://doi.org/10.1016/j.elerap.2014.09.001

Bilgihan, A., Okumus, F., & Nusair, K. (2013). Customer experience in e-commerce and managerial. https://doi.org/10.1007/s40558-013-0003-3

Biocca, F. (1997). The Cyborg's Dilemma: Progressive Embodiment in Virtual Environments. *Journal of Computer-Mediated Communication*, *3*(2). https://doi.org/10.1111/j.1083-6101.1997.tb00070.x

Biocca, F. (2003). From the two-pole to a three-pole model of shifts in presence. Venice, Italy.

Blackwell, S. E. (2021). Mental Imagery in the science and practice of Cognitive Behaviour therapy: Past, present, and Future Perspectives. *International Journal of Cognitive Therapy*, *14*(1), 160–181. https://doi.org/10.1007/s41811-021-00102-0

Bleumers, I., Broeck, W. Van den, Lievens, B., & Pierson, J. (2012). Seeing the Bigger Picture: A User Perspective on 360° TV. In *Proceedings of the 10th European Conference on Interactive TV and Video* (pp. 115–124). Berlin, Germany: ACM.

Bozgeyikli, L., Bozgeyikli, E., Katkoori, S., Raij, A., & Alqasemi, R. (2018). Effects of Virtual Reality Properties on User Experience of Individuals with Autism. ACM Transactions on Accessible Computing, 11(4), 1–27. https://doi.org/10.1145/3267340

Brade, J., Lorenz, M., Busch, M., Hammer, N., Tscheligi, M., & Klimant, P. (2017). Being there again – Presence in real and virtual environments and its relation to usability and user experience using a mobile navigation task. International Journal of Human-Computer Studies, 101, 76–87. https://doi.org/10.1016/j.ijhcs.2017.01.004

Bradley, D., Brunton, A., Fiala, M., & Roth, G. (2005). Image-based navigation in real environments using panoramas. In *IEEE International Workshop on Haptic Audio Visual Environments and their Applications* (pp. 57–59). Ottawa, Ontario, Canada. https://doi.org/10.1109/HAVE.2005.1545652

Brockmyer, J. F., Fox, C., Curtiss, K., McBroom, E., Burkhart, K., & Pidruzny, J. N. (2009). The development of the Game Engagement Questionnaire: A measure of engagement in video game-playing. *Journal of Experimental Social Psychology*, *45*(4), 624–634. https://doi.org/10.1016/j.jesp.2009.02.016

Brosz, J., & Samavati, F. (2010). Shape defined panoramas. In *2010 Shape Modeling International Conference* (pp. 57–67). Provence, France. https://doi.org/10.1109/SMI.2010.23

Burdea, G., & Coiffet, P. (2003). Virtual Reality Technology. *PRESENCE Virtual and Augmented Reality*, 12(6), 663–664. https://doi.org/10.1162/105474603322955950

Carlsson, M., & Sonesson, T. (2017). Using virtual reality in an automotive user experience development process. Retrieved from https://odr.chalmers.se/bitstream/20.500.12380/253134/1/253134.pdf

Casati, R., & Pasquinelli, E. (2005). Is the subjective feel of “presence” an uninteresting goal? *Journal of Visual Languages & Computing*, *16*(5), 428–441. https://doi.org/10.1016/j.jvlc.2004.12.003

Camara, D. R., & Hicks, R. E. (2019). Using virtual reality to reduce state anxiety and stress in university students: An experiment. GSTF Journal of Psychology, 4(2).

Chen, M., Tang, Q., Xu, S., Leng, P., & Pan, Z. (2020). Design and evaluation of an Augmented Reality-Based Exergame System to reduce fall risk in the elderly. *International Journal of Environmental Research and Public Health*, 17(19), 7208. https://doi.org/10.3390/ijerph17197208

Chen, S. E. (1995). QuickTime ® VR – An Image-Based Approach to Virtual Environment Navigation, 29–38.

Cheng, A., Yang, L., & Andersen, E. (2017). Teaching language and culture with a virtual reality game. In *Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems* (pp. 541–549). Denver, Colorado, USA: ACM. https://doi.org/10.1145/3025453.3025857

Chi, P. G., & Idris, M. Z. (2021). Employing Virtual Reality (VR) Technology with Experiential Learning Perspective to Enhance Students' Learning Experience. *International Journal of Academic Research in Business and Social Sciences*, 11(4), 650-655.

Chiang, C. C., Huang, A., Wang, T. S., Huang, M., Chen, Y. Y., Hsieh, J. W., … Cheng, T. (1997). PanoVR SDK - a software development kit for integrating photo-realistic panoramic images and 3-D graphical objects into virtual worlds. In *ACM Symposium on Virtual Reality Software and Technology* (pp. 147–154). Lausanne, Switzerland: ACM. https://doi.org/10.1145/261135.261162

Chilana, P. K., Ko, A. J., & Wobbrock, J. O. (2015). From User - Centered to Adoption - Centered Design : A Case Study of an HCI Research Innovation Becoming a Product. In *Annual ACM Conference on Human Factors in Computing Systems* (pp. 1749–1758). Seoul: ACM.

Chirico, A., Ferrise, F., Cordella, L., & Gaggioli, A. (2018). Designing awe in virtual reality: an experimental study. *Frontiers in Psychology*, 8. https://doi.org/10.3389/fpsyg.2017.02351

CompuPhase, I. (2000). *Panoramic Images*. Retrieved from www.compuphase.com

Cooper, A., Reimann, R., Cronin, D., & Noessel, C. (2014). *About Face: The Essentials of Interaction Design* (Fourth). Indiana: John Wiley & Sons Ltd.

Cooper, D.R. and Schindler, P.S. (2014). *Business Research Methods*. 12th Edition, McGraw Hill International Edition, New York

Cruz-Neira, C., Fernández, M., & Portalés, C. (2018). Virtual Reality and Games. *Multimodal Technologies and Interaction*, *2*(1), 8.

Cuijpers, P., Donker, T., Van Straten, A., Li, J., & Andersson, G. (2010). Is guided self-help as effective as face-to-face psychotherapy for depression and anxiety disorders? A systematic review and meta-analysis of comparative outcome studies. *Psychological Medicine*, *40*(12), 1943–1957.

Dan, A., Feldman, S. I., & Serpanos, D. N. (1998). Evolution and challenges in multimedia. *IBM Journal of Research and Development*, *42*(2), 177–183.

Davidavičienė, V., Raudeliūnienė, J., & Viršilaitė, R. (2020). Evaluation of user experience in augmented reality mobile applications. *Journal of Business Economics and Management (Online),* 22(2), 467–481. https://doi.org/10.3846/jbem.2020.13999

Davis, A. M. (1992). Operational Prototyping: A New Development Approach. *IEEE Software*, (September), 76–77.

Dayang, R., Awang, R., Suziah, S., Halabt, H., Abas, S., Peteras, B., & Mohd, Y. N. (2011). VReST: An image-based virtual reality stress therapy web application. In *ITME 2011 - Proceedings: 2011 IEEE International Symposium on IT in Medicine and Education* (Vol. 2, pp. 733–737).

Denisova, A., A. Imran, N., & Cairns, P. (2016). The Convergence of Player Experience Questionnaires. In *Annual Symposium on Computer-Human Interaction in Play* (pp. 33–37). https://doi.org/10.1007/BF00863294

Diemer, J., Alpers, G. W., Peperkorn, H. M., Shiban, Y., Mühlberger, A., & Oathes, D. J. (2015). The impact of perception and presence on emotional reactions : a review of research in virtual reality. *Frontiers in Psychology*, *6*(January), 1–9.

Dix, A., Finlay, J., Abowd, G. D., & Beale, R. (2004). *Human-Computer Interaction*. *Pearson* (Third). England: Pearson Education Limited.

Djamasbi, S., Jr, J. W., Valcour, V. J., Traietti, M., Li, W., Tran, L. C. T., & Yuan, F. (2015). Web Experience and Growth. In *Twenty First Americas Conference on Information Systems* (pp. 1–7). Puerto Rico.

Draper, J. V., Kaber, D. B., & Usher, J. M. (1998). Telepresence. *Human Factors*, *40*(3), 354–375.

Elbay, R. Y., Kurtulmuş, A., Arpacıoğlu, S., & Karadere, M. E. (2020). Depression, anxiety, stress levels of physicians and associated factors in Covid-19 pandemics. Psychiatry Research (Print), 290, 113130. https://doi.org/10.1016/j.psychres.2020.113130

Elias, A., Yaacob, L. H., Kadir, A. A., & Othman, A. (2015). Guided Imagery Relaxation Therapy in Malaysian Patients with Knee Osteoarthritis: A Randomized Controlled Trial. *International Journal of Collaborative*

Research on Internal Medicine & Public Health, 7(5). Retrieved from https://internalmedicine.imedpub.com/guided-imagery-relaxation-therapy-in-malaysian-patients-with-knee-osteoarthritis-a-randomized-controlled-trial.pdf

Elphinston, R. A., Vaezipour, A., Fowler, J. A., Russell, T., & Sterling, M. (2022). Psychological therapy using virtual reality for treatment of driving phobia: a systematic review. *Disability and Rehabilitation*, *45*(10), 1582–1594. https://doi.org/10.1080/09638288.2022.2069293

Eswaran, V. S. B., Veezhinathan, M., Balasubramanian, G., & Taneja, A. (2018). Virtual reality therapy for mental stress reduction. *Journal of Clinical and Diagnostic Research*, *12*(10), JC11–JC16.

Felix, M. M. D. S., Ferreira, M. B. G., Oliveira, L. F., Barichello, E., Pires, P. D. S., & Barbosa, M. H. (2018). Guided imagery relaxation therapy on preoperative anxiety: a randomized clinical trial. *Revista latino-americana de enfermagem*, 26, e3101. https://doi.org/10.1590/1518-8345.2850.3101

Felix, M. M. D. S., Ferreira, M. B. G., da Cruz, L. F., & Barbosa, M. H. (2019). Relaxation Therapy with Guided Imagery for Postoperative Pain Management: An Integrative Review. *Pain management nursing: Official journal of the American Society of Pain Management Nurses*, 20(1), 3–9. https://doi.org/10.1016/j.pmn.2017.10.014

Forlizzi, J., & Betterbee, K. (2004). Understanding Experience in Interactive Systems. In *Proceedings of the 5th Conference on Designing Interactive Systems* (pp. 261–268).

Freina, L., & Ott, M. (2015). A literature review on immersive virtual reality in education: State of the art and perspectives. In *Proceedings of eLearning and Software for Education* (p. 8). Bucharest, Romania.

Gamito, P., Oliveira, J., Coelho, C., Morais, D., Lopes, P., Pacheco, J., … Barata, A. F. (2015). Cognitive training on stroke patients via virtual reality-based serious games. *Disability and Rehabilitation*, *39*(4), 385–388.

Gao, J., Liu, S., Zhang, S., Wang, Y., Liang, Z., Feng, Q., . . . Zhang, Q. (2020). Pilot study of a virtual reality educational intervention for radiotherapy patients prior to initiating treatment. *Journal of Cancer Education*, *37*(3), 578–585. https://doi.org/10.1007/s13187-020-01848-5

Garcia, E. N. (2017). *Guided Imagery Relaxation Effects on South Texas Public School Teachers' Stress*. Retrieved from https://scholarworks.waldenu.edu/cgi/viewcontent.cgi?article=4872&context=dissertations

Garrett, J. J. (2010). Customer Loyalty and the Elements of User Experience. *Design Management Review*, *17*(1), 35–39.

Gasperin, D., Netuveli, G., Dias-da-Costa, J. S., & Pattussi, M. P. (2009). Effect of psychological stress on blood pressure increase: A meta-analysis of cohort studies. *Cadernos de Saude Publica*, *25*(4), 715–726.

Geng, W., Pan, Y., Li, M., & Yang, J. (2000). Picture-based virtual touring. *The International Journal of Virtual Reality*, *4*(3), 1–13.

Geraets, C., Van Der Stouwe, E. C. D., Pot-Kolder, R., & Veling, W. (2021). Advances in immersive virtual reality interventions for mental disorders: A new reality? *Current Opinion in Psychology*, *41*, 40–45. https://doi.org/10.1016/j.copsyc.2021.02.004

Gerling, K., Dickinson, P., Hicks, K., Mason, L., Simeone, A. L., & Spiel, K. (2020). Virtual Reality Games for People Using Wheelchairs. Proceedings of the 2020 CHI Conference on Human Factors in Computing System (pp.1-11). Honolulu, HI, USA. https://doi.org/10.1145/3313831.3376265

Ghanbarzadeh, R., Ghapanchi, A. H., Blumenstein, M., & Talaei-Khoei, A. (2014). A decade of research on the use of three-dimensional virtual worlds in health care: A systematic literature review. *Journal of Medical Internet Research*, *16*(2).

Giacobbi, P., Long, D., Nolan, R., Shawley, S., Johnson, K., & Misra, R. (2017). Guided imagery targeting exercise, food cravings, and stress: a multi-modal randomized feasibility trial. *Journal of Behavioral Medicine*, 41(1), 87–98. https://doi.org/10.1007/s10865-017-9876-5

Glenberg, A. M. (1997). What memory is for. *Behavioral and Brain Sciences*, 20(1), 1–19.

Górski, F., Buń, P., Wichniarek, R., Zawadzki, P., & Hamrol, A. (2016). Effective Design of Educational Virtual Reality Applications for Medicine using Knowledge-Engineering Techniques. *Eurasia Journal of Mathematics Science and Technology Education*, 13(2). https://doi.org/10.12973/eurasia.2017.00623a

Gougeh, R. A., & Falk, T. H. (2022). Head-Mounted Display-Based Virtual Reality and Physiological Computing for Stroke Rehabilitation: A Systematic Review. *Frontiers in Virtual Reality*, *3*. https://doi.org/10.3389/frvir.2022.889271

Gregor, S., & Jones, D. (2007). The Anatomy of a Design Theory. *Journal of the Association of Information Systems*, *8*(5), 312–335.

Guillén, V., Baños, R. M., & Botella, C. (2018). Users' opinion about a virtual reality system as an Adjunct to Psychological Treatment for Stress-Related Disorders: A Quantitative and Qualitative Mixed-Methods study. *Frontiers in Psychology*, 9. https://doi.org/10.3389/fpsyg.2018.01038

Gulec, U., Yilmaz, M., Isler, V., O'Connor, R. V., & Clarke, P. (2018). Adopting virtual reality as a medium for software development process education. In *Proceedings of the 2018 International Conference on Software and System Process* (pp. 71–75). Gothenburg, Sweden: ACM.

Gurwin, G. (2019). The Best Virtual Reality Games.

Hanson, K., & Shelton, B. E. (2008). Design and Development of Virtual Reality: Analysis of challenges faced by educators. *Educational Technology & Society*, 11(1), 118–131. Retrieved from https://u.cs.biu.ac.il/~ariel/download/mm664/resources/mediated_reality/virtual_reality/vr.pdf

Harris, D., Arthur, T., Kearse, J., Olonilua, M., Hassan, E. K., De Burgh, T. C., . . . Vine, S. J. (2023). Exploring the role of virtual reality in military decision training. *Frontiers in Virtual Reality*, 4. https://doi.org/10.3389/frvir.2023.1165030

Hartmann, T., & Fox, J. (2019). Entertainment in Virtual Reality and Beyond: The Influence of Embodiment, Co- Location, and Cognitive Distancing on Users' Entertainment Experience. In P. Vorderer & C. Klimmt (Eds.), *The Oxford Handbook of Entertainment Theory*. Oxford, UK: Oxford University Press.

Hartmann, T., Wirth, W., Schramm, H., Klimmt, C., Vorderer, P., Gysbers, A., … Sacau, A. M. (2016). The Spatial Presence Experience Scale (SPES): A short self-report measure for diverse media settings. *Journal of Media Psychology*, *28*(1), 1–15. https://doi.org/10.1027/1864-1105/a000137

Hashim, M. E. A. H. Bin, Idris, M. Z. Bin, & Othman, A. N. Bin. (2018). Developing Theoretical Framework on Augmented Reality (AR) Comic Using User Experience (UX) Approach. *International Journal of Academic Research in Business and Social Sciences*, 8(2), 827–834.

Hashim, M. E. A., Idris, M. Z., & Said, C. S. (2021). The Potential of Integrating User Experience (UX) and Aesthetic Experience (AX) in Augmented Reality Comic (AR Comic). *International Journal of E-Education, E-Business, E-Management and E-Learning*, 11(1), 34–41.

Hashim, M. E. A., Idris, M. Z., & Said, C. S. (2022). Defining the construct and elements of Aesthetic Experience (AX) and User Experience (UX) in Augmented Reality Comics (AR Comics). *International Journal of Creative Multimedia*, *3*(1), 17–34. https://doi.org/10.33093/ijcm.2022.3.1.2

Hassan, R. (2016). *Virtual Reality as a Tool for Reconstrucion and Documentaion of Cultural Heritage Sites and Historically Important Landscapes in Palestine*. NLA Hostkonferanse, Oslo.

Hassenzahl, M., Burmester, M., & Koller, F. (2003). AttrakDiff: A questionnaire to measure perceived hedonic and pragmatic quality. In *Szwillus G., Ziegler J. (eds) Mensch & Computer 2003. Reports of the German Chapter of the ACM* (pp. 187–196). https://doi.org/10.1007/978-3-322-80058-9_19

Hassenzahl, M., & Tractinsky, N. (2006). User experience - A research agenda. *Behaviour and Information Technology*, *25*(2), 91–97. https://doi.org/10.1080/01449290500330331

Hatta, M. H., Sidi, H., Koon, C. S., Roos, N. a. C., Sharip, S., Samad, F. D. A., . . . Saini, S. M. (2022). Virtual Reality (VR) Technology for Treatment of Mental Health Problems during COVID-19: A Systematic Review. *International Journal of Environmental Research and Public Health*, *19*(9), 5389. https://doi.org/10.3390/ijerph19095389

Hellianto, G. R., Suzianti, A., & Komarudin. (2019). User Experience Modeling on Consumer-to-Consumer (c2c) E-Commerce Website. *IOP Conference Series: Materials Science and Engineering*, *505*(1). https://doi.org/10.1088/1757-899X/505/1/012080

Hellweger, S., & Wang, X. (n.d.). What is User Experience Really : towards a UX Conceptual Framework.

Herdayatamma, K. L. (2022). Virtual Reality in Military Training to Maintain Indonesian Military Readiness in the Era of Covid-19 Pandemic. *International Journal of Human Capital Management*, *5*(2), 97–103. https://doi.org/10.21009/ijhcm.05.02.9

Hevner, A. R., Ram, S., March, S. T., & Park, J. (2004). Design Science in Information Systems Research. *MIS Quaterly*, *28*(1), 75–105.

Hinderks, A., Schrepp, M., & Thomaschewski, J. (2018). A Benchmark for the Short Version of the User Experience Questionnaire. Proceedings of the 14th International Conference on Web Information Systems and Technologies. https://doi.org/10.5220/0007188303730377

Hofer, M., Wirth, W., Kuehne, R., Schramm, H., & Sacau, A. (2012). Structural Equation Modeling of Spatial Presence: The Influence of Cognitive Processes and Traits. *Media Psychology*, *15*(4), 373–395. https://doi.org/10.1080/15213269.2012.723118

Hood, V., Knapp, M., & Grilliopoulos, D. (2019). Best VR Games 2019 : The top virtual eality games to play right now. Retrieved November 11, 2019, from https://www.techradar.com/sg/best/the-best-vr-games

Hosseini, M., Tirgari, B., Forouzi, M. A., & Jahani, Y. (2016). Guided imagery effects on chemotherapy induced nausea and vomiting in Iranian breast cancer patients. *Complementary Therapies in Clinical Practice*, 25, 8–12. https://doi.org/10.1016/j.ctcp.2016.07.002

Hussein, I., Mahmud, M., Tap, A. O., & Jack, L. (2013). Does User-Centered Design (UCD) Matter ? Perspectives of Malaysian IT organizations. *International Journal of Interactive Digital Media*, *1*(1), 71–78.

Ibrahim, A., Azizah, J., Mohd Fairuz, I., & Tarisa, M. (2015). Users' Experience in Role-playing Game: Measuring the player's gameplay experience. *Jurnal Teknologi*, *77*(19), 45–48. https://doi.org/10.11113/jt.v77.6512

IJsselsteijn, W., Ridder, H. de, Freeman, J., & Avons, S. (2000). Presence: Concept, determinants and measurement. In *Proceedings of SPIE--the International Society for Optical Engineering*.

IJsselsteijn, W., & Riva, G. (2003). Being there: the experience of presence in mediated environments.

Institute for Public Health. (2018). *National Health and Morbidity Survey (NHMS) 2017 : Key Findings from the Adolescent Health and Nutrition Surveys*.

International Society for Presence Research. (2000). *The Concept of Presence: Explication Statement*. Retrieved from https://ispr.info/

Islam, M. S., Sujan, M. S. H., Tasnim, R., Sikder, M. T., Potenza, M. N., & Van Os, J. (2020). Psychological responses during the COVID-19 outbreak among university students in Bangladesh. PloS One, 15(12), e0245083. https://doi.org/10.1371/journal.pone.0245083

Jain, F. A., & Fonagy, P. (2018). Mentalizing Imagery Therapy: theory and case series of imagery and mindfulness techniques to understand self and others. *Mindfulness*, *11*(1), 153–165. https://doi.org/10.1007/s12671-018-0969-1

Jallo, N., Ruiz, R. J., Jr, R. K. E., & French, E. (2014). Guided Imagery for Stress and Symptom Management in Pregnant African American Women. *Evidence-Based Complementary and Alternative Medicine*, *2004*(February). https://doi.org/10.1155/2014/840923

Jennett, C., Cox, A. L., Cairns, P., Dhoparee, S., Epps, A., Tijs, T., & Walton, A. (2008). Measuring and Defining the Experience of Immersion in Games. *International Journal of Human Computer Studies*, *66*(9), 641–661.

Jerald, J. (2016). *The VR Book: Human-Centered Design for Virtual Reality*. ACM.

Jerath, R., Beveridge, C., Jensen, M., & Paladiya, R. (2020). The therapeutic role of guided mental imagery in treating stress and insomnia: A Neuropsychological perspective. *Open Journal of Medical Psychology*, 09(01), 21–39. https://doi.org/10.4236/ojmp.2020.91003

Jones, A., Hah, E., & Shekhtman, A. (2017). 4 Reasons Why Fashion Brands Are Adopting Virtual Reality. Retrieved September 25, 2019, from https://www.huffingtonpost.ca/awane-jones/virtual-reality-fashion_b_10069340.html

Karapanos, E., Martens, J. B., & Hassenzahl, M. (2012). Reconstructing Experiences with iScale. *International Journal of Human Computer Studies*, *70*(11), 849–865. https://doi.org/10.1016/j.ijhcs.2012.06.004

Kauhanen, O., Väätäjä, H., Turunen, M., Keskinen, T., Sirkkunen, E., Uskali, T., . . . Karhu, J. (2017). Assisting immersive virtual reality development with user experience design approach. Proceedings of the 21st International Academic Mindtrek Conference. https://doi.org/10.1145/3131085.3131126

Kep, D. A. S. (2018). The Effect of Progressive Muscle Relaxation Techniques to Decrease Blood Pressure for Patients with Hypertension in Mataram. *Primary Health Care Open Access*, *8*(4), 1–4. https://doi.org/10.4172/2167-1079.1000309

Keskinen, T. (2015). *Evaluating the User Experience of Interactive Systems in Challenging Circumstances*. University of Tampere. Retrieved from http://tampub.uta.fi

Kim, B. H., Newton, R. A., Sachs, M. L., Glutting, J. J., & Glanz, K. (2012). Effect of Guided Relaxation and Imagery on Falls Self-Efficacy: a randomized controlled trial. Journal of the American Geriatrics Society, 60(6), 1109–1114. https://doi.org/10.1111/j.1532-5415.2012.03959.x

Kim, H. and Hyun, K. H. (2022). Understanding design experience in virtual reality for interior design process. *CAADRIA Proceedings* (pp. 59-68). https://doi.org/10.52842/conf.caadria.2022.1.059

King, R. J., Orr, J. A., Poulsen, B., Giacomantonio, S. G., & Haden, C. (2017). Understanding the Therapist Contribution to Psychotherapy Outcome: A Meta-Analytic Approach. *Administration and Policy in Mental Health and Mental Health Services Research*, *44*(5), 664–680. https://doi.org/10.1007/s10488-016-0783-9

Krekhov, A., Cmentowski, S., Emmerich, K., & Krüger, J. (2019). Beyond Human : Animals as an Escape from Stereotype Avatars in Virtual Reality Games. In *CHI PLAY '19 Proceedings of the Annual Symposium on Computer-Human Interaction in Play* (pp. 439–451). Barcelona, Spain: ACM. https://doi.org/10.1145/3311350.3347172

Krekhov, A., Cmentowski, S., & Kruger, J. (2018). VR Animals : Surreal Body Ownership in Virtual Reality Games. In *Proceedings of the 2018 Annual Symposium on Computer-Human Interaction in Play Companion Extended Abstracts* (pp. 503–511).

Kujala, S., Roto, V., Väänänen-Vainio-Mattila, K., Karapanos, E., & Sinnelä, A. (2011). UX Curve: A method for evaluating long-term user experience. *Interacting with Computers*, *23*(5), 473–483. https://doi.org/10.1016/j.intcom.2011.06.005

Kumar, V. V., Carberry, D., Beenfeldt, C., Andersson, M., Mansouri, S. S., & Gallucci, F. (2021). Virtual reality in chemical and biochemical engineering education and training. *Education for Chemical Engineers*, 36, 143–153. https://doi.org/10.1016/j.ece.2021.05.002

Kusumo, A. H., & Hartono, M. (2019). The evaluation of academic website using eye tracker and UEQ: a case study in a website of xyz. IOP Conference Series: Materials Science and Engineering, 703(1), 012049. https://doi.org/10.1088/1757-899x/703/1/012049

Latif, R. A., Ismail, R., & Zainudin, A. R. R. (2015). Using Sound for Stress Therapy in a Virtual-Reality Environment. In *Proceedings of the 5Th International Conference on Computing & Informatics* (pp. 152–158).

Laugwitz, B., Held, T., & Schrepp, M. (2008). Construction and Evaluation of a User Experience Questionnaire, 63–76.

LaValle, S. M. (2017). *Virtual Reality*. Cambridge University Press. https://doi.org/10.1049/cp:20061600

Law, E.-C., Roto, V., Hassenzahl, M., Vermeeren, A. P. O. ., & Kort, J. (2009). Understanding, Scoping and Defining User Experience: A Survey Approach. In *International Conference on Human Factors in Computing Systems* (Vol. 27, pp. 719–728). Boston, MA, USA: ACM.

Lebel, G. (2013). Self-help guide for stress management.

Lessiter, J., Freeman, J., Keogh, E., & Davidoff, J. (2001). A Cross-media Presence Questionnaire: The ITC-sense of presence inventory. *Presence: Teleoperators and Virtual Environments*, *10*(3), 282–297. https://doi.org/10.1162/105474601300343612

Lewis, C., Pearce, J., & Bisson, J. I. (2012). Efficacy, cost-effectiveness and acceptability of self-help interventions for anxiety disorders: Systematic review. *British Journal of Psychiatry*, *200*(1), 15–21. https://doi.org/10.1192/bjp.bp.110.084756

Lima, L. G. R. de, Salgado, A. de L., & Freira, A. P. (2015). Evaluation of the user experience and intrinsic motivation with educational and mainstream digital games. In *Latin American Conference on Human Computer Interaction*. https://doi.org/http://dx.doi.org/10.1145/2824893.2824904

Lin, A. C. H., Fernandez, W. D., & Gregor, S. (2012). Understanding Web Enjoyment Experiences and Informal Learning: A study in a museum context. *Decision Support Systems*, *53*(4), 846–858. https://doi.org/10.1016/j.dss.2012.05.020

Lindner, P., Miloff, A., Hamilton, W., Reuterskiöld, L., Andersson, G., Powers, M. B., & Carlbring, P. (2017). Creating state of the art, next-generation Virtual Reality exposure therapies for anxiety disorders using consumer hardware platforms: design considerations and future directions. *Cognitive Behaviour Therapy*, 46(5), 404–420. https://doi.org/10.1080/16506073.2017.1280843

Liszio, S., & Masuch, M. (2017). Virtual Reality MRI : Playful Reduction of Children's Anxiety in MRI Exams. In *Proceedings of the 2017 Conference on Interaction Design and Children* (pp. 127–136). Stanford, CA, USA: ACM. https://doi.org/https://doi.org/10.1145/3078072.3079713

Liu, X., Zhang, J., Hou, G., & Wang, Z. (2018). Virtual Reality and Its Application in Military. In *IOP Conference Series: Earth and Environmental Science* (Vol. 170). https://doi.org/10.1088/1755-1315/170/3/032155

Loachamín-Valencia, M., Mejía-Guerrero, J., Álvarez, V. E. V., Cárdenas-Delgado, S., & Calderón, D. M. P. (2023). A virtual shooting range, experimental study for military training. In *Communications in computer and information science* (pp. 412–425). https://doi.org/10.1007/978-3-031-24985-3_30

Lombard, M., & Ditton, T. (1997). At the Heart of It All: The Concept of Presence. *Journal of Computer-Mediated Communication*, *3*(2). https://doi.org/doi.org/10.1111/j.1083-6101.1997.tb00072.x

Lombard, M., Ditton, T. B., & Weinstein, L. (2009). *Measuring Presence : The Temple Presence Inventory*.

Lorenz, M., Brade, J., Diamond, L., Sjölie, D., Busch, M., Tscheligi, M., Klimant, P., Heyde, C., & Hammer, N. (2018). Presence and User Experience in a Virtual Environment under the Influence of Ethanol: An Explorative Study. Scientific Reports, 8(1). https://doi.org/10.1038/s41598-018-24453-5

Lovibond, S., & Lovibond, P. (1995). Manual for the Depression Anxiety Stress Scales. *Sydney Psychology Foundation*. http://www.scienceopen.com/document?vid=94df2470-a62a-44f5-aa35-f77e5794c225

Lucero-Urresta, E., Buele, J., Córdova, P., & Varela-Aldás, J. (2021). Precision shooting training system using augmented reality. In *Lecture Notes in Computer Science* (pp. 283–298). https://doi.org/10.1007/978-3-030-87013-3_22

Luciani, A., Urma, D., Marlière, S., & Chevrier, J. (2004). Presence: The sense of believability of inaccessible worlds. *Computers & Graphics*, *28*(4), 509–517. https://doi.org/10.1016/j.cag.2004.04.006

Lukowska, M. (2011). Influence of Shifting Attention and Absorption on Spatial Presence Formation. In *The International Society for Presence Research Annual Conference* (pp. 1–8). Edinburgh.

MacDonald, C. M. (2015). User experience librarians: user advocates, user researchers, usability evaluators, or all of the above? *Proceedings of the Association for Information Science and Technology*, *52*(1), 1–10. https://doi.org/10.1002/pra2.2015.145052010055.

March, S. T., & Smith, G. F. (1995). Design and Natural Science Research on Information Technology. *Decision Support Systems*, *15*, 251–266.

Martín-Gutiérrez, J., Mora, C. E., Añorbe-Díaz, B., & González-Marrero, A. (2017). Virtual Technologies Trends in Education. *Eurasia Journal of Mathematics, Science and Technology Education*, *13*(2), 469–486. https://doi.org/10.12973/eurasia.2017.00626a

Matin, H. Z., Razavi, H. R., & Campus, F. (2014). Is stress management related to workforce productivity ? *Iranian Journal of Management Studies*, *7*(1), 1–19.

Mawanza, W. (2017). The Effects of Stress on Employee Productivity : A Perspective of Zimbabwe's Socio-Economic Dynamics of 2016. *Journal of Economics and Behavioural Studies*, *9*(2), 22–32. https://doi.org/10.22610/jebs.v9i2.1647

Mayhew, D. J. (2008). User Experience Design: The Evolution of a Multi-Disciplinary Approach. *Journal of Usability Studies*, *3*(3), 99–102.

Mayo Clinic. (2022, December 10). Stress and high blood pressure: What's the connection? Retrieved from https://www.mayoclinic.org/diseases-conditions/high-blood-pressure/in-depth/stress-and-high-blood-pressure/art-20044190

Mazuryk, T., & Gervautz, M. (1999). *Virtual Reality: History, Applications, Technology and Future*. https://doi.org/10.1109/ISIE.2009.5221998

Menelas, B. J., Haidon, C., Ecrepont, A., & Girard, B. (2018). Use of virtual reality technologies as an Action-Cue Exposure Therapy for truck drivers suffering from Post-Traumatic Stress Disorder. *Entertainment Computing*, 24, 1–9. https://doi.org/10.1016/j.entcom.2017.10.001

Mental Health Foundation. (2016). *Fundamental Facts about Mental Health 2016*. Mental Health Foundation: London.

Merriam-Webster. (2019). Definition of Virtual Reality. Retrieved October 17, 2019, from https://www.merriam-webster.com/dictionary/virtual reality

Minister of Economic Affairs. (2018). *Mid-Term Review of the Eleventh Malaysia Plan*. Retrieved from https://www.ekonomi.gov.my/sites/default/files/2020-08/Mid-Term%20Review%20of%2011th%20Malaysia%20Plan.pdf

Ministry of Finance Malaysia. (2023, February). *Budget 2023 Speech*. Retrieved from https://belanjawan.mof.gov.my//pdf/belanjawan2023/ucapan/ub23-BI.pdf

Minsky, M. (1980). Telepresence. OMNI Magazine. https://philpapers.org/rec/MINT

Mitchell, C. (2016). Model Validation : Four Elements of Determining the Accuracy of Your Models. Retrieved September 4, 2019, from https://www.bba.org.uk/news/insight/model-validation-four-elements-of-determining-the-accuracy-of-your-models/#.XW9YyC4zbIU

Mucci, N., Giorgi, G., Ceratti, S. D. P., Fiz-Pérez, J., Mucci, F., & Arcangeli, G. (2016). Anxiety, stress-related factors, and blood pressure in young adults. *Frontiers in Psychology*, *7*, 1–10. https://doi.org/10.3389/fpsyg.2016.01682

Nadia, D. M. M. (2017). *Spatial Presence Model for Image-Based Virtual Reality*. Universiti Teknologi Petronas.

Nadia, D. M. M., & Dayang, R. A. R. (2018). An interactive image-based virtual reality application for guided imagery therapy. *Journal of Advanced Research in Dynamical and Control Systems*, *10*(4 Special Issue), 1–8.

Nagalingam, V., & Ibrahim, R. (2015). User Experience of Educational Games: A Review of the Elements. *Procedia Computer Science*, *72*, 423–433. https://doi.org/10.1016/j.procs.2015.12.123

Nagalingam, V., & Ibrahim, R. (2017). Finding the Right Elements, 90–93. https://doi.org/10.1145/3108421.3108436

Nasrah, H. B., Wan Adilah, W. A., & Hanif, B. (2019). E-participation Service in Malaysian E-government Website : The User Experience Evaluation. In *International Conference on E-Education, E-Business, E-Management and E-Learning* (pp. 342–346).

NHS, I. (2019). Self-help therapies. Retrieved December 5, 2019, from https://www.nhsinform.scot/healthy-living/mental-wellbeing/therapy-and-counselling/self-help-therapies

Nik Ahmad, N. A., & Hussaini, M. (2021). A Usability Testing of a Higher Education Mobile Application Among Postgraduate and Undergraduate

Students. *International Journal of Interactive Mobile Technologies* (IJIM), 15(09), 88. https://doi.org/10.3991/ijim.v15i09.19943.

Nicovich, S. G. (2005). The Effect of Involvement on Ad Judgment in a Video Game Environment. *Journal of Interactive Advertising*, *6*(1), 29–39. https://doi.org/10.1080/15252019.2005.10722105

Norman, D., & Nielsen, J. (2019). The Definition of User Experience (UX).

Nurulnadwan, A. (2015). *Conceptual Design and Development Model of Assistive Courseware for Young Low Vision Learners (AC4LV)*. Universiti Utara Malaysia.

Nurulnadwan, A., Ariffin, A. M., & Siti Mahfuzah, S. (2014). The design principles of assistive courseware for low vision (AC4LV) learners. In *Proceedings of the 2014 International Conference on Advances in Education Technology* (pp. 44–53). https://doi.org/https://doi.org/10.2991/icaet-14.2014.10

Okechukwu, M., & Udoka, F. (2011). Understanding Virtual Reality Technology: Advances and Applications. *Advances in Computer Science and Engineering*, (March 2011). https://doi.org/10.5772/15529

Othman, A., Buang, M. J., Taib, M. N. A., Mohamad, N., & Nasir, A. (2013). Guided Imagery and Relaxation Audio for Children with Cancer: Development and Evaluation. *Open Journal of Medical Psychology*, 02(03), 101–106. https://doi.org/10.4236/ojmp.2013.23016

Overholser, J. C. (1991). The Use of Guided Imagery in Psychotherapy : Modules for Use with Passive Relaxation Training. *Journal of Contemporary Psychotherapy*, *21*(3), 159–172. https://doi.org/10.1007/bf00973115

Owen, D. W. (2016). Spontaneous and guided imagery in counseling: Putting fantasy to work. Turkish Psychological Counseling and Guidance Journal, 4(33). http://turkpdrdergisi.com/index.php/pdr/article/download/228/159

Pallavicini, F., Argenton, L., Toniazzi, N., Aceti, L., & Mantovani, F. (2016). Virtual reality applications for stress management training in the military. Aerospace Medicine and Human Performance, 87(12), 1021–1030. https://doi.org/10.3357/amhp.4596.2016

Park, J., Han, S. H., Kim, H. K., Cho, Y., & Park, W. (2011). Developing Elements of User Experience for Mobile Phones and Services : Survey, Interview, and Observation Approaches, *00*(0), 1–15. https://doi.org/10.1002/hfm

Park, M., Im, H., & Kim, D. Y. (2018). Feasibility and user experience of virtual reality fashion stores. *Fashion and Textiles*, 1–17. https://doi.org/10.1186/s40691-018-0149-x

Peffers, K., Rothenberger, M., Tuunanen, T., & Vaezi, R. (2012). Design Science Research Evaluation. In *International Conference on Design Science Research in Information Systems and Technology* (pp. 398–410).

Peffers, K., Tuunanen, T., Rothenberger, M. A., & Chatterjee, S. (2007). A Design Science Research Methodology for Information Systems Research. *Journal of Management Information Systems*, *24*(3), 45–77. https://doi.org/10.2753/MIS0742-1222240302

Pereira, R. E., & Gheisari, M. (2019). 360-Degree Panoramas as a Reality Capturing Technique in Construction Domain : Applications and Limitations. In *ASC Annual International Conference Proceedings* (pp. 435–442).

Picard, R. W., & Klein, J. (2002). Computers that recognise and respond to user emotion: theoretical and practical implications. Interacting With Computers, 14(2), 141–169. https://doi.org/10.1016/s0953-5438(01)00055-8

Pinto, D., Peixoto, B., Krassmann, A. L., Melo, M., Cabral, L., & Bessa, M. (2019). Virtual reality in education: learning a foreign language. *Advances in Intelligent Systems and Computing*, 589-597. https://doi.org/10.1007/978-3-030-16187-3_57

Prabu, P. K., & Subhash, J. (2015). Guided Imagery Therapy. *IOSR Journal of Nursing and Health Science*, *4*(5), 56–58.

Preece, J., Sharp, H., & Rogers, Y. (2015). *Interaction Design: Beyond Human-computer interaction (4th Edition)* (Fourth). Chichester: John Wiley & Sons Ltd.

Pucillo, F., & Cascini, G. (2014). A Framework for User Experience, Needs and Affordances. *Design Studies*, *35*(2), 160–179. https://doi.org/10.1016/j.destud.2013.10.001

Rau, R. (2006). The association between blood pressure and work stress: The importance of measuring isolated systolic hypertension. *Work and Stress*, *20*(1), 84–97. https://doi.org/10.1080/02678370600679447

Ravaja, N., Saari, T., Turpeinen, M., Laarni, J., Salminen, M., & Kivikangas, M. (2005). Spatial presence and emotions during video game playing: Does it matter with whom you play? *Presence: Tele operators and Virtual Environments*, *15*(4), 381–392. https://doi.org/10.1162/pres.15.4.381

Riva, G., Waterworth, J. A., Waterworth, E. L., & Mantovani, F. (2011). From intention to action: The role of presence. *New Ideas in Psychology*, *29*(1), 24–37. https://doi.org/10.1016/j.newideapsych.2009.11.002

Rizzo, A., Roy, M. J., Hartholt, A., Costanzo, M., Highland, K. B., Jovanovic, T., . . . Difede, J. (2017). Virtual reality applications for the assessment and treatment of PTSD. In *Springer eBooks* (pp. 453–471). https://doi.org/10.1007/978-3-319-66192-6_27

Robert, J. M., & Lesage, A. (2011). *Designing and Evaluating User Experience*. *The Handbook of Human-Machine Interaction: A Human-Centered Design Approach*. https://doi.org/10.1201/9781315557380-16

Robinson, L., Segal, R., Segal, J., & Smith, M. (2019). Relaxation Techniques for Stress Relief. Retrieved October 15, 2019, from https://www.helpguide.org/articles/stress/relaxation-techniques-for-stress-relief.htm

Roscoe, J. T. (1975). *Fundamental research statistics for the behavioural sciences*. New York, NY: Holt, Rinehart and Winston.

Roth, R. (2017). User Interface and User Experience (UI/UX) Design. *Geographic Information Science & Technology Body of Knowledge*, *2017*(Q2). https://doi.org/10.22224/gistbok/2017.2.5

Sacau, A., Laarni, J., & Hartmann, T. (2008). Influence of individual factors on presence. *Computers in Human Behavior*, *24*(5), 2255–2273. https://doi.org/10.1016/j.chb.2007.11.001

Sag, A. (2019). Location-Based VR: The Next Phase of Immersive Entertainment. Retrieved November 10, 2019, from https://www.forbes.com

Saha, A., Pal, S. C., Santosh, M., Janizadeh, S., Chowdhuri, I., Norouzi, A., . . . Chakrabortty, R. (2021). Modelling multi-hazard threats to cultural heritage sites and environmental sustainability: The present and future scenarios. *Journal of Cleaner Production*, 320, 128713. https://doi.org/10.1016/j.jclepro.2021.128713

Santaella, D. F., Araújo, E. A., Ortega, K. C., Tinucci, T., Mion, D., Negrão, C. E., & de Moraes Forjaz, C. L. (2006). Aftereffects of exercise and relaxation on blood pressure. *Clinical Journal of Sport Medicine: Official Journal of the Canadian Academy of Sport Medicine*, 16(4), 341–347. https://doi.org/10.1097/00042752-200607000-00010

Santarcangelo, E. L., Scattina, E., Carli, G., Ghelarducci, B., Orsini, P., & Manzoni, D. (2010). Can imagery become reality? *Experimental Brain Research*, *206*(3), 329–335. https://doi.org/10.1007/s00221-010-2412-2

Schrepp, M. (2015). User Experience Questionnaire Handbook Extension of the User Experience Questionnaire View project No Project View project. *Www.Ueq-Online.Org*, (September). https://doi.org/10.13140/RG.2.1.2815.0245

Schrepp, M., Hinderks, A., & Thomaschewski, J. (2017). Design and evaluation of a short version of the User Experience Questionnaire (UEQ-S). *International*

Journal of Interactive Multimedia and Artificial Intelligence, *4*(6), 103. https://doi.org/10.9781/ijimai.2017.09.001

Schrepp, M. (2019). User Experience Questionnaire Handbook. Retrieved from https://www.ueq-online.org.

Schubert, T. W. (2009). A New Conception of Spatial Presence: Once again, with feeling. *Communication Theory*, *19*(2), 161–187. https://doi.org/10.1111/j.1468-2885.2009.01340.x

Schubert, T., Friedmann, F., & Regenbrecht, H. (1999). Visual Representations and Interpretations. In *Visual Representations and Interpretations*. https://doi.org/10.1007/978-1-4471-0563-3

Setyawati, E., Asyifa, A., Putro, H. T., & Ischak, M. (2019). Developing a Virtual Reality Application of Pathok Negoro Mosque for Digital Conservation. *Journal of Architectural Design and Urbanism*, *2*(1), 1. https://doi.org/10.14710/jadu.v2i1.5517

Sharma, L., Prabhakaran, B., Jin, R., & Gans, M. (2018). LearnDNA: An interactive VR application for learning DNA structure. In *Proceedings of the 3rd International Workshop on Interactive and Spatial Computing* (pp. 80–87). Richardson, Texas: ACM. https://doi.org/10.1145/3191801.3191810

Shelstad, W. J., Smith, D. C., & Chaparro, B. S. (2017). Gaming on the Rift: How Virtual Reality Affects Game User Satisfaction. Proceedings of the Human Factors and Ergonomics Society Annual Meeting, 61(1), 2072-2076. https://doi.org/10.1177/1541931213602001

Shneiderman, B., & Plaisant, C. (2005*). Designing the user Interface: Strategies for effective human-computer interaction* (4th ed.). Pearson Education.

Singh, G. (2017). Using Virtual Reality for Scaffolding Computer Programming Learning. In *Proceedings of the ACM Symposium on Virtual Reality Software and Technology, VRST*. https://doi.org/10.1145/3139131.3141225

Siti Mahfuzah, S. (2011). *Conceptual Design Model of Computerized Personal-Decision Aid (ComPDA)*. Universiti Utara Malaysia.

Siti Zulaiha, A. (2017). *A Conceptual Model of Interactive Computer Assisted Learning For Low Achieving Primary School Student*. Universiti Utara Malaysia.

Slater, M., Linakis, V., Usoh, M., & Kooper, R. (1996). Immersion, Presence and Performance in Virtual Environments, (June), 163–172. https://doi.org/10.1145/3304181.3304216

Slater, M., & Usoh, M. (1993). Presence in Immersive Virtual Environments. *IEEE Annual Virtual Reality International Symposium*, 90–96. https://doi.org/10.1109/vrais.1993.380793

Solano, A., López, G., Guerrero, L. A., & Quesada, L. (2019). User Experience Evaluation of Voice Interfaces: A Preliminary study of games for seniors and the elderly. *Proceedings*, *31*(1), 65. https://doi.org/10.3390/proceedings2019031065

Soliman, M., Pesyridis, A., Dalaymani-Zad, D., Gronfula, M., & Kourmpetis, M. (2021). The application of virtual reality in engineering education. *Applied Sciences*, *11*(6), 2879. https://doi.org/10.3390/app11062879

Sun, S., & Peng, L. (2020). Study of the virtual reality education and digitalization in China. *Journal of Physics*, *1456*(1), 012042. https://doi.org/10.1088/1742-6596/1456/1/012042

Stetz, M. C., Long, C. P., Schober, W. V., Jr., Cardillo, C. G., & Wildzunas, R. M. (2007). Stress assessment and management while medics take care of the VR wounded. *Annual Review of CyberTherapy and Telemedicine*, 5, 165–171

Steuer, J. (1992). Defining Virtual Reality: Dimensions Determining Telepresence. *Journal of Communication*, *42*(4), 73–93. https://doi.org/10.1111/j.1460-2466.1992.tb00812.x

Strijbos, J. W., Martens, R. L., & Jochems, W. M. G. (2004). Designing for interaction : Six steps to designing computer-supported group-based learning. *Computers & Education*, *42*, 403–424. https://doi.org/https://doi.org/10.1016/j.compedu.2003.10.004

Subha, I., & Shakil, A. (2009). Impact of Stress on Employee Productivity, Performance and Turnover; an Important Managerial Issue. *International Review of Business Research Papers*, *5*(4), 468–477. Retrieved from http://www.irbrp.com/static/documents/June/2009/38.Subha.pdf

Sulaiman, N. A. (2022, October 10). Masalah kesihatan mental membimbangkan - khairy. *BH Online*.

Sutcliffe, A. (2012). Multimedia User Interface Design. In *The Human-Computer Interaction Handbook* (pp. 387–404). https://doi.org/10.1201/b11963-21

Suter, P. M., Maire, R., Holtz, D., & Vetter, W. (1997). Relationship between self-perceived stress and blood pressure. *Journal of Human Hypertension*, *11*(3), 171–176. https://doi.org/10.1038/sj.jhh.1000409

Sutherland, I. E. (1965). The Ultimate Display. In *Proceedings of IFIP Congress*. Retrieved from http://arxiv.org/abs/1601.03459

Syamsul Bahrin, Z. (2011). *Mobile Game-Based Learning (mGBL) Engineering Model*. Universiti Utara Malaysia.

Tabuchi, H. (2015). Headsets for Shoppers. Retrieved September 25, 2019, from https://www.nytimes.com/2015/10/21/business/tommy-hilfiger-introduces-virtual-reality-headsets-for-shoppers.html

Takatalo, J., Häkkinen, J., Kaistinen, J., & Nyman, G. (2010). Presence, Involvement, and Flow in Digital Games. In R. Bernhaupt (Ed.), *Evaluating User Experience in Games: Concepts and Methods* (pp. 23–46). Springer. https://doi.org/10.1007/978-1-84882-963-3

Tcha-Tokey, K., Christmann, O., Loup-Escande, E., Loup, G., & Richir, S. (2018). Towards a Model of User Experience in Immersive Virtual Environments. *Advances in Human-Computer Interaction*, *2018*. https://doi.org/10.1155/2018/7827286

Tcha-Tokey, K., Loup-Escande, E., Christmann, O., & Richir, S. (2016). A Questionnaire to Measure The User Experience in Immersive Virtual Environments. In *ACM International Conference Proceeding Series*. https://doi.org/10.1145/2927929.2927955

The Star. (2018, August 5). 29% of Malaysians have mental problems due to stress, says Lam Thye. The Star. Retrieved from https://www.thestar.com.my.

Thompson, B. (2006). Panoramic photography. *The Journal of the Stomatological Society*, *37*(4). Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/3865419

Trindade, Y., Rebelo, F., & Noriega, P. (2018). Tourism and Virtual Reality: User Experience Evaluation of a Virtual Environment Prototype. In *Design, User Experience, and Usability: Users, Contexts and Case Studies. DUXU 2018. Lecture Notes in Computer Science* (Vol. 10920). Springer. https://doi.org/10.1007/978-3-319-91806-8

Tuch, A. N., Trusell, R. N., & Hornbaek, K. (2013). Analyzing Users' Narratives to Understand Experience with Interactive Products. In *SIGCHI Conference on Human Factors in Computing Systems* (pp. 2079–2088). ACM. https://doi.org/http://doi.org/10.1145/2470654.2481285

Tullis, T., & Albert, B. (2013). *Measuring the User Experience* (Second). Morgan Kaufmann.

Vaishnavi, V., Keuchler, B., & Petter, S. (2004). Design Science Research in Information Systems. Retrieved November 17, 2019, from http://www.desrist.org/design-research-in-information-systems/

Vaquero-Blasco, M. A., Perez-Valero, E., Morillas, C., & Lopez-Gordo, M. A. (2021). Virtual Reality Customized 360-Degree Experiences for Stress Relief. *Sensors*, 21(6), 2219. https://doi.org/10.3390/s21062219

Veling, W., Counotte, J., Pot-Kolder, R., Van Os, J., & Van Der Gaag, M. (2016). Childhood trauma, psychosis liability and social stress reactivity: a virtual reality study. *Psychological Medicine*, 46(16), 3339–3348. https://doi.org/10.1017/s0033291716002208

Vincent, B. (2019). The 25 Best VR Games.

Vivyan, C. (2009). Self-Help Course in Cognitive Behaviour Therapy. Retrieved from www.getselfhelp.co.uk/freedownloads.htm

Vorderer, P., Wirth, W., Gouveia, F. R., Biocca, F., Saari, T., Jäncke, L., … Jäncke, P. (2004). *MEC Spatial Presence Questionnaire (MEC-SPQ): Short documentation and instructions for application*. Retrieved from http://www.ijk.hmt-hannover.de/presence

Vorderer, P., Wirth, W., Gouveia, F. R., Biocca, F., Saari, T., Jäncke, L., … Jäncke, P. (2004). *MEC Spatial Presence Questionnaire (MEC- SPQ): Short Documentation and Instructions for Application*. Retrieved from http://www.ijk.hmt-hannover.de/presence

Walsh, T., Petrie, H., & Odutola, O. (2014). Developing Interactive Systems for Different Cultures: Issues of assessing user experience with visual materials. In *Proceedings of the 26th Australian Computer-Human Interaction Conference, OzCHI 2014* (pp. 470–479). https://doi.org/10.1145/2686612.2686687

Wan Nooraishya, W. A., & Nazlena, M. A. (2018). The Impact of Persuasive Technology on User Emotional Experience and User Experience over Time. *Journal of ICT*, *17*(4), 601–628.

Wedoff, R., Ball, L., Lieberman, L., Wang, A., & Rector, K. (2019). Virtual Showdown : An Accessible Virtual Reality Game with Scaffolds for Youth with Visual Impairments. In *CHI '19 Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems* (pp. 1–15).

Weichbroth, P. (2020). Usability of Mobile Applications: A Systematic Literature Study. *IEEE Access*, *8*, 55563–55577. https://doi.org/10.1109/access.2020.2981892.

Wiegers, K. E. (2002). Seven truths about peer reviews. *Cutter IT Journal*, 15(7), 31-37

Wirth, W., & Hartmann, T. (2001). *A Process Model of the Formation of Spatial Presence Experiences*.

Wirth, W., Hartmann, T., Böcking, S., Vorderer, P., Klimmt, C., Schramm, H., … Jäncke, P. (2007). A Process Model of the Formation of Spatial Presence Experiences. *Media Psychology*, *9*(3), 493–525. https://doi.org/10.1080/15213260701283079

Wirth, W., Vorderer, P., Hartmann, T., Klimmt, C., Schramm, H., Böcking, S. (2003). Constructing presence: a two-level model of the formation of spatial presence experiences. International Communication Association, San Diego, CA

Wirth, W., Hofer, M., & Schramm, H. (2012). The Role of Emotional Involvement and Trait Absorption in the Formation of Spatial Presence. *Media Psychology*, *15*(1), 19–43. https://doi.org/10.1080/15213269.2011.648536

Witmer, B. G., & Singer, M. J. (1998). Measuring Presence in Virtual Environments: A presence questionnaire. *Presence*, *7*(3), 225–240.

Wolf, K., Khalil, R., Knierim, P., & Funk, M. (2017). Using Virtual Reality for Prototyping Interactive Architecture. *ACM International Conference Proceeding Series*, 457–464. https://doi.org/10.1145/3152832.3156625

Won, A. S., Haans, A., Ijsselsteijn, W. A., & Bailenson, J. N. (2014). A framework for interactivity and presence in novel bodies. *Interacting with Presence: HCI and the Sense of Presence in Computer-Mediated Environments*, (October), 57–69. https://doi.org/10.2478/9783110409697.4

Wong, S. Y., & Ghavifekr, S. (2018). User Experience Design of History Game. *International Journal of Distance Education Technologies*, 16(3), 46–63. https://doi.org/10.4018/ijdet.2018070103

World Health Organisation. (2003). *Investing in Mental Health*.

Wu, M., & Skalski, P. (2011). *The role of personal experience in forming spatial presence in a video gaming context*. Human Communication and Technology Division of the National Communication Association, New Orleans, LA.

Xiao, D. (2000). Experiencing the library in a panorama virtual reality environment. *Library Hi Tech*, *18*(2), 177–184. https://doi.org/10.1108/07378830010333572.

Yang, W. B., Yen, Y. N., & Cheng, H. M. (2015). Digitalized Preservation and Presentation of Historical Building Taking Traditional Temples and Dougong as Examples. *ISPRS Annals of the Photogrammetry, Remote Sensing and Spatial Information Sciences*, *2*(5W3), 371–376. https://doi.org/10.5194/isprsannals-II-5-W3-371-2015

Yang, T., Lai, I. K. W., Fan, Z. B., & Mo, Q. M. (2021). The impact of a 360° virtual tour on the reduction of psychological stress caused by covid-19. *Technology in Society*, 64, 101514. https://doi.org/10.1016/j.techsoc.2020.101514

Yu, C.-P., Lee, H.-Y., & Luo, X.-Y. (2018). The effect of virtual reality forest and urban environments on physiological and psychological responses. *Urban Forestry & Urban Greening*, 35, 106–114. https://doi.org/10.1016/j.ufug.2018.08.013

Zaharuddin, F. A., Ibrahim, N., & Yusof, A. M. (2022). A conceptual framework for designing virtual environments for stress therapy. Applied Sciences (Basel), 12(19), 9973. https://doi.org/10.3390/app12199973

Zaki, M. M., Ahmed, F. M., & Sayed, F. S. (2018). Effect of Guided Imagery in Reduction of Stress among Elderly People in Geriatric Homes. *American Journal of Nursing Research*, 6(6), 380–387. https://doi.org/10.12691/ajnr-6-6-5

Zhang, H. (2017). Head-mounted display-based intuitive virtual reality training system for the mining industry. *International Journal of Mining Science and Technology*, 27(4), 717–722. https://doi.org/10.1016/j.ijmst.2017.05.005

Zhang, H., He, X., & Mitri, H. (2019). Fuzzy comprehensive evaluation of virtual reality mine safety training system. *Safety Science*, 120, 341–351. https://doi.org/10.1016/j.ssci.2019.07.009

Zhang, J., Wang, J., Chen, H., & Gao, M. (2018). Experience the Dougong Construction in Virtual Reality. In *VRST 2018: 24th ACM Symposium on Virtual Reality Software and Technology (VRST'18)*. Tokyo, Japan: ACM. https://doi.org/10.1016/j.plrev.2016.08.015

Zhang, M., Li, X., Yu, Z., Chen, Z., Sun, Y., & Li, Y. (2019). Virtual Range Training Based on Virtual Reality. In *Advances in Social Science, Education and Humanities Research* (Vol. 329, pp. 1556–1561). https://doi.org/10.2991/iccessh-19.2019.339

Zhao, R., Aqlan, F., Elliott, L. J., & Lum, H. C. (2019). Developing a Virtual Reality Game for Manufacturing Education. In *Proceedings of the 14th International Conference on the Foundations of Digital Games* (pp. 1–4). San Luis Obispo, CA, USA: ACM. https://doi.org/10.1145/3337722.3341831

Appendix A

Sample of Invitation Email for Expert Review

Dear Prof/Assoc.Prof/Dr/Sir/Madam,

EXPERT REVIEW FOR DESIGN MODEL

My name is Mohd Fairuz bin Zaiyadi. I am currently pursuing a PhD in Multimedia at Universiti Utara Malaysia under the supervision of Assoc. Prof. Dr. Ariffin bin Abdul Mutalib and Dr. Nadia Diyana binti Mohd Muhaiyuddin. I am writing to you to request for your views as an expert, for the model proposed in this study.

For your information, this study proposes a design model for Image-Based Virtual Reality (IBVR) for the purpose of stress therapy by applying Guided Image Therapy (GIT) and Spatial Presence Model (SPM). Therefore, based on your expertise, experience, knowledge and interests, I would like to humbly solicit your feedback on the proposed design model.

If you agree to be part of the expert review, please read and provide your response in the instruments attached. Illustration and description of the design model (Appendix A) are also attached for your reference.

Your cooperation and willingness to be involved in this study is greatly appreciated. Looking forward to hearing from you soon. Thank you for your time and help.

Sincerely,

MOHD FAIRUZ BIN ZAIYADI
Candidate for PhD in Multimedia
Universiti Utara Malaysia
Email: fairuzzaiyadi@gmail.com
Mobile.No: 012-4196961

2 attachments

Expert Review Instrument.docx
34K

Appendix A.docx
1001K

Appendix B

Sample of Appointment Letter for Expert Review

PUSAT PENGAJIAN TEKNOLOGI MULTIMEDIA DAN KOMUNIKASI
SCHOOL OF MULTIMEDIA TECHNOLOGY AND COMMUNICATION
Universiti Utara Malaysia
06010 UUM SINTOK
KEDAH DARUL AMAN
MALAYSIA

Tel: 604-928 5801
Faks (Fax): 604-928 5804
Laman Web (Web): http://www.smmtc.uum.edu.my

UUM/CAS/SMMTC/P-48
30 August 2021

Ts. Dr. Nazrita Bte Ibrahim
Senior Lecturer
Department of Informatics
College of Computing & Informatics
Universiti Tenaga Nasional (UNITEN)
Putrajaya Campus, Jalan IKRAM-UNITEN
43000 Kajang, Selangor

Madam

APPOINTMENT AS EXPERT REVIEWER FOR DESIGN MODEL

Thank you for your willingness to engage in a PhD study as an expert to study and evaluate a design model as detailed below:

Student Name	:	**Mohd Fairuz bin Zaiyadi**
Matric Number	:	**903652**
School	:	**School of Multimedia Technology and Communication, UUM**
Research Title	:	**Hybridized Model of Spatial Presence and Guided Imagery Therapy for Image-Based Virtual Reality in Self-Therapy (SP-GIT4IBVRST)**
Supervisor	:	**1. Assoc. Professor Ts. Dr. Ariffin bin Abdul Mutalib** **2. Dr. Nadia Diyana binti Mohd Muhaiyuddin**

For your information, the student will use the model for his research. Therefore, your expertise is needed to review the proposed model in a few dimensions as stated in the reviewing form.

Your cooperation, time and assistance are highly appreciated.

Thank you.

"PRIHATIN RAKYAT: DARURAT MEMERANGI COVID-19"
"WAWASAN KEMAKMURAN BERSAMA 2030"
"BERKHIDMAT UNTUK NEGARA"
"KEDAH SEJAHTERA - NIKMAT UNTUK SEMUA"
"ILMU BUDI BAKTI"

Sincerely yours

ASSOC. PROF. Ts. DR. SOBIHATUN NUR ABDUL SALAM
Dean
School of Multimedia Technology and Communication
Tel : 04-9285800 Fax : 04-9285804
HP : 019-5597417 Email : sobihatun@uum.edu.my

Universiti Pengurusan Terkemuka
The Eminent Management University

Appendix C

Sample of Expert Review Instrument

EXPERT REVIEW INSTRUMENT

HYBRIDIZED MODEL OF SPATIAL PRESENSE AND GUIDED-IMAGERY-THERAPY FOR IMAGE-BASED VIRTUAL REALITY IN SELF-THERAPY (SP-GIT4IBVRST)

Dear Prof/Assoc. Prof/Dr./Sir/Madam

EXPERT REVIEW OF SP-GIT4IBVRST DESIGN MODEL

I am Mohd Fairuz bin Zaiyadi and currently pursuing a PhD in Multimedia at Universiti Utara Malaysia. With great pleasure, I am pleased to inform that you have been selected as one of the experts to be involved in this study based on the following criteria:

i) Have academic qualification (Master/PhD) in related field, either in Multimedia or Human Computer Interaction (HCI) or Virtual Reality (VR) or Computer Science, and/or
ii) Have experience in studying/researching/practicing Multimedia or HCI or VR or Computer Science field for at least 5 years.

With that, I would like to humbly solicit your feedback on the proposed design model. I strongly believe that, with the capabilities you have, you will be able to complete this expert review **within 1 week**.

To your knowledge, this study proposes an approach to stress intervention using Image-based Virtual Reality (IBVR) in self-therapy that applies Guided Imagery Therapy (GIT) technique and Spatial Presence Model (SPM). It focuses on the issue of stress due to the current mental health condition of the community as well as the focus given by the government on the problem of stress among the Malaysian's population.

Thus, the main objective of this study is to propose a design model for IBVR in self-therapy that hybridizes SPM and GIT technique, which is able to induce the sense of being physically present in the virtual environment and provide calmness to the users.

This expert review aims to evaluate the proposed design model in terms of:

i) Relevancies of the proposed components and elements of SP-GIT4IBVRST
ii) Readability and understandability of the model.

The information supplied will be treated as confidential and will be used for the research purposes, which maybe reported anonymously in academic publications.

Your cooperation and consideration in completing the review question is highly appreciated.

Should you have any queries, please feel free to contact me via email (fairuzzaiyadi@gmail.com) or my supervisor Assoc. Prof. Ts. Dr. Ariffin Abdul Mutalib (am.ariffin@uum.edu.my).

Thank you for your time and assistance.

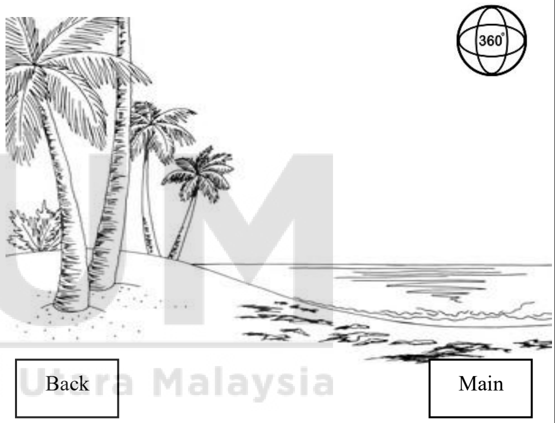
2.	**Guided Imagery Therapy**	**Therapist guide (narration)** • Deep breathing • Relaxation exercise • Images of peaceful nature • Natural ambient sounds • Coping strategies				
3.	**Spatial Presence**	**Calmness** • Calm panoramic view • Calm sound				
		Perceptual realism • Storyline • Panoramic view - Additional object - Natural sound - Animation				
		Interactivity • Hotspot activity • Auto panning • Panning • Standardized menu • Comfort of navigation				
4.	**VR System**	**VR Engine** • Computer • Software				
		Output				
		Input				
		User				
		Task				

5	The terms used are easy to understand		Yes		No
6	The relationships and flows of all the main components and sub-components are logical		Yes		No
7	Overall, the design model is readable		Yes		No

Please write your recommendations below:

Appendix D

Storyboard for Prototype Development

1	Opening	2	Main Menu
			Please select your preferred location:     Location A Location B Location C Location D
	- Blank screen - Therapist guide on deep breathing and relaxation exercise (recorded voice)		- Four selection of location - Instructions on selection of location (recorded voice) - User select preferred location
3	Selected Location (Location A)	4	Hotspot View (Location A)
			
	- 360° view of the environment (head tracking) - Natural/ambient sounds - Therapist guide (recorded voice) - Main button: go to main menu - Hotspot button: go to another view of current location		- 360° view of the environment (head tracking) - Natural/ambient sounds - Therapist guide (recorded voice) - Back button: go to previous view - Main button: go to main menu

Appendix E

Sample of Participant's Consent Form

Informed Consent

TITLE OF STUDY

A Hybridized Model of Spatial Presence and Guided Imagery Therapy for Image-Based Virtual Reality (IBVR) in Self-Therapy

PRINCIPAL INVESTIGATOR

Mohd Fairuz bin Zaiyadi
School of Multimedia Technology and Communication
College of Arts and Sciences
Universiti Utara Malaysia
Phone: 012-419 6961
Email: fairuzzaiyadi@gmail.com

PURPOSE OF STUDY

The purpose of this study is to gain the participants' individual perspectives and overall engagement within the virtual environment. Particularly, this study aims to evaluate the effectiveness of the IBVR self-therapy tool in providing calmness and reducing stress. In addition, this study also aims to evaluate the level of spatial presence and user experience while interacting with the IBVR self-therapy tool.

STUDY PROCEDURES

Initially, you are requested to complete the DASS-21 questionnaire to assess the level of stress before undergoing IBVR therapy. Then, you will be guided through a pre-recorded narration for a deep breathing and relaxation exercise, which aimed to induce a sense of calmness before entering the virtual environment.

Following the exercise, you will be asked to wear a Head-Mounted-Display (HMD). In the HMD, you will be prompted with a selection of four environments to choose from, i.e. a waterfall, a field, a mountain, and a beach. You have the freedom to choose any environment that suits your personal preference and enjoy the video in any comfortable position of your choosing. You can explore the virtual environment by tilting your heads and looking around in any direction, while also being able to listen to the natural sounds.

During the session, you have the freedom to end your involvement if at any point you experienced any discomfort or unpleasant emotions. Subsequent to the session, you are requested to fill out a set of questionnaires that evaluate the level of spatial presence, user experience, and the efficacy of IBVR self-therapy.

BENEFITS

There may or may not be any benefits to you. The information obtained from this study is expected to contribute to the body of knowledge in terms of the application and development of VR in mental health.

1

Informed Consent

CONFIDENTIALITY

Your responses to this study will be anonymous. Every effort will be made by the researcher to preserve your confidentiality including the following:

- Assigning code names/numbers for participants that will be used on all research notes and documents
- Keeping notes or any identifying participant information in a locked file cabinet in the personal possession of the researcher.

Participant data will be kept confidential except in cases where the researcher is legally obligated to report specific incidents.

CONTACT INFORMATION

If you have questions at any time about this study, or you experience adverse effects as the result of participating in this study, you may contact the researcher whose contact information is provided on the first page.

VOLUNTARY PARTICIPATION

Your participation in this study is voluntary. It is up to you to decide whether or not to take part in this study. If you decide to take part in this study, you will be asked to sign a consent form. After you sign the consent form, you are still free to withdraw at any time and without giving a reason. If you withdraw from the study before data collection is completed, your data will be returned to you or destroyed.

CONSENT

I have read and I understand the provided information and have had the opportunity to ask questions. I understand that my participation is voluntary and that I am free to withdraw at any time, without giving a reason and without cost. I understand that I will be given a copy of this consent form. I voluntarily agree to take part in this study.

Participant's signature: ______________________________ Date: __________

Investigator's signature: ______________________________ Date: __________

2

Appendix F

<u>Depression, Anxiety, Stress Scales (DASS)</u>

This is a self-report scale used to measure emotional states of depression, anxiety and stress. However, ***the questions in this instrument only focus on the emotion of stress***. Please read the statement carefully and circle the answer that fits you best for each statement. There are no right or wrong answers. Do not spend too much time on any statement.

The rating scale is as follows:

0 Did not apply to me at all
1 Applied to me to some degree, or some of the time
2 Applied to me to a considerable degree or a good part of time
3 Applied to me very much or most of the time

1.	I find myself inconsolable.	0	1	2	3
2.	I tend to overreact in certain situations.	0	1	2	3
3.	I think I use up a lot of energy being anxious.	0	1	2	3
4.	I found myself getting restless.	0	1	2	3
5.	I find it hard to relax.	0	1	2	3
6.	I can't stand things that stop me from doing what I'm doing.	0	1	2	3
7.	I think I'm touchy.	0	1	2	3

<u>Personal Details</u>

Please provide your answer and tick where appropriate.

Age : ______________________________

Gender : ☐ Male ☐ Female

Educational Level : ☐ Undergraduate ☐ Postgraduate

Appendix G

Spatial Presence Questionnaire

This instrument is divided into four segment i.e. calmness, interactivity, perceptual realism, and spatial presence. Please read the statement carefully and circle your answer according to your own opinion/perception.

Calmness

Strongly disagree *Strongly Agree*

1.	I feel calm when no negative object found when navigating the virtual environment	1	2	3	4	5
2.	I feel calm while watching the panoramic virtual environments	1	2	3	4	5
3.	I feel calm when listening to the natural sound	1	2	3	4	5
4.	The colour which is not too bright in panoramic views help me to feel calm					

Interactivity

Strongly disagree *Strongly Agree*

1.	I could watch the virtual environment with my preferable speed.	1	2	3	4	5
2.	I could interact very well with the application by using the panning.	1	2	3	4	5
3.	I had no difficulties to use this application because this application's menu is similar to other standardized application menus I have used.	1	2	3	4	5
4.	The navigation functions made it easier for me to navigate within this virtual environment.	1	2	3	4	5
5.	I felt very comfortable in using the navigation buttons to navigate within this virtual environment	1	2	3	4	5

Perceptual Realism

Strongly disagree *Strongly Agree*

1.	The visuals in the display were consistent made the virtual environment seems real.	1	2	3	4	5
2.	The visuals in the display were clear (no blur and parallax) made the virtual environment seems real.	1	2	3	4	5
3.	The visuals in the display were realistic made the	1	2	3	4	5

	virtual environment seems real.					
4.	The visuals in the display were beautiful made the virtual environment seems real.	1	2	3	4	5
5.	The combination of recorded natural sound and additional objects, made the virtual environment seems real.	1	2	3	4	5
6.	The combination of animation and beautiful scenery made the virtual environment seems real.	1	2	3	4	5
7.	The combination of scenery and additional objects, made the virtual environment seems real.	1	2	3	4	5
8.	The combination of scenery and sound, made the virtual environment seems real.	1	2	3	4	5

Spatial Presence

Strongly disagree *Strongly Agree*

1.	I felt like I was a part of the environment in the application.	1	2	3	4	5
2.	I felt like I was actually there in the environment of the application.	1	2	3	4	5
3.	I felt like the objects in the application.	1	2	3	4	5
4.	I felt as though I was physically present in the environment of the application.	1	2	3	4	5
5.	It was as though my true location had shifted into the environment in the application.	1	2	3	4	5
6.	It seemed as though my self was present in the environment of the application.	1	2	3	4	5

Appendix H

User Experience Questionnaire

This is the short version of the User Experience Questionnaire (UEQ-s). It contains 8 items to measure the pragmatic and hedonic quality of the IBVR self-therapy tool. Decide as spontaneously as possible which of the following opposing terms better describes the IBVR self-therapy tool. There is no "right" or "wrong" answer. Only your personal opinion counts.

Negative	1	2	3	4	5	6	7	Positive
obstructive								supportive
complicated								easy
inefficient								efficient
confusing								clear
boring								exciting
not interesting								interesting
conventional								inventive
usual								leading edge

https://www.ueq-online.org/