TAG CLOUDS ALGORITHM WITH THE INCLUSION OF PERSONALITY TRAITS

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Abstrak

Tag awan telah muncul sebagai teknik terkini dalam visualisasi maklumat yang menggunakan kaedah analisis teks dalam pelbagai situasi untuk mentafsir jenis data yang tidak berstruktur. Tinjauan literatur menekankan bahawa pembangunan teknik visualisasi maklumat harus merangkumi personaliti manusia untuk memberikan maklumat yang berkesan dan bermakna. Walau bagaimanapun, dalam bidang tag awan, tiada kajian yang dibuat untuk meneliti peranan personaliti dalam membangunkan reka bentuk visualisasi tag awan. Tambahan pula, algoritma untuk menjana tag awan visualisasi berdasarkan personaliti belum diterokai. Oleh itu, objektif utama kajian ini adalah untuk membangunkan satu algoritma yang boleh menyesuaikan ciri visual tag awan gaya susun atur berdasarkan personaliti pengguna. Kajian ini memberi tumpuan kepada dua ciri visual yang berkaitan dengan personaliti, iaitu warna dan bentuk. Untuk mencapai matlamat kajian ini, metodologi Sains Design digunakan melalui tiga fasa utama: pengenalan masalah, reka bentuk penyelesaian, dan penilaian. Algoritma ini dibangunkan berdasarkan kepada tiga teori personaliti, iaitu Myers-Briggs Type Indicator (MBTI), Bentuk, dan Kecerdasan Pelbagai (MI). Algoritma itu kemudiannya diuji melalui ujian kotak hitam. Di samping itu, prototaip telah dibangunkan untuk menilai algoritma yang dicadangkan. Kemudian, kepuasan pengguna telah dijalankan untuk menilai prototaip ini menggunakan instrumen Q-SAFI. Penemuan ketara mencadangkan bahawa pengguna amat berpuas hati dengan warna dan bentuk tag awan serta tag awan gaya susun atur keseluruhan. Sumbangan utama kajian ini adalah tag awan gaya susun atur algoritma, yang menggabungkan konsep personaliti dan ciri-ciri warna dan bentuk. Algoritma ini adalah bermanfaat dalam pembuatan keputusan dengan penggunaan visualisasi maklumat di mana ia mengambil kira personaliti pengguna. Selain itu, instrumen kepuasan pengguna tag awan, Q-SAFI, menyediakan ukuran untuk menilai visualisasi tag awan.

Kata kunci: Tag awan, Teknik visualisasi, Sifat personaliti

Abstract

Tag clouds have emerged as the latest technique in information visualization using text analysis methods in a variety of situations to interpret unstructured data types. Literature review emphasizes that information visualization development techniques should include the personality traits of humans to provide effective and meaningful information. However, in the field of tag clouds, no published studies have investigated the role of personality traits to guide the design of tag cloud visualization. Furthermore, the algorithm to generate tag cloud visualization based on personality traits has not been explored. Therefore, the main objective of this study is to develop an algorithm that can adapt visual features of tag cloud layout styles based on personality traits of the user. This study focuses on two visual features associated with personality traits, which are colors and shapes. To achieve the aim of this study, Design Science methodology was used through three main phases: problem identification, design of solution, and evaluation. The algorithm was developed based on three theories of personality traits, namely Myers-Briggs Type Indicator (MBTI), Shape, and Multiple Intelligence (MI). The algorithm was then tested through a black box testing. In addition, a prototype was developed to evaluate the proposed algorithm. Then, user satisfaction was conducted in order to evaluate this prototype using Q-SAFI instruments. Notable findings suggest that users are highly satisfied with colors and shapes of tag cloud as well as the overall tag cloud layout styles. The main contribution of this research is the tag cloud layout styles algorithm, which combines the concept of personality traits and characteristics of colors and shapes. This algorithm is beneficial for decision making using information visualization in which personality traits of the user are heavily inclined. Moreover, the tag cloud user's satisfaction instrument, Q-SAFI, provides measurements for evaluating tag cloud visualization.

Keywords: Tag cloud, Visualization technique, Personality traits

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CHAPTER ONE
INTRODUCTION

1.1 Background

In recent years, tag cloud has shown up as the most popular method of an emerging field known as "information visualization". Tag clouds portray the emergences of interest variables (such as popularity) in the visual appearance of the keywords themselves using text properties such as font size, weight, or color. Tag clouds are essentially used to represent the frequency of tags, which can be words within the content or descriptions of the content, created by users from social bookmarking websites (Hassan-Montero & Herrero-Solana, 2006) and social software (Rivadeneira, Gruen, Muller, & Millen, 2007). Tag clouds are visual representations that illustrate the word usage frequency within textual content, which typically consist of articles, websites, speeches or databases. The frequency of each word or "tag" is displayed in the tag cloud by escalating the color saturation and font size of that word.

Tag clouds have existed together with the growth of collaborative tagging, which is nowadays used in social software sites for photo sharing (e.g., Flickr), as bookmark sharing (e.g., del.icio.us), and as blog searching (e.g., Technorati). For these kind of websites, the keywords called tags are displayed to classify the information on the site (such as bookmarks or photos). Mostly, tags are hyperlinks, and by clicking on a tag will guide users to the source of the social website that has been signed to the tag. These clouds have been represented to help people in order to get a high-level understanding of the data, and to help people in exploration (Rivadeneira et al., 2007).

Tag clouds have given an enormous functionality for many purposes. Rivadeneira et al. (2007) announce four specific tasks that can be accomplished using tag clouds:

- Search: finding (or settling the absence of) a specific target or alternative target. This is purposely provided as a facility to get more information about the specific target.

  For example, Deeperweb.com (Figure 1.1) helps users to expand their searching results of Google by showing relevant keywords in tag cloud form.

- Browsing: casually examining the cloud without a specific purpose or target, often clicking down on multiple discovered targets as they displeasure the user's interest.

  For example in botanicus.org website that uses tag clouds visualization in order to provide users browsing facilities about literatures which are related to botanical subject (see Figure 1.2).

- Impression Formation and Presentation: the cloud can be shown in order to get a general idea about a subject (such as: in speech or recommendation system). This is due to visually outstanding items could carry more weight as initial impression, but the other less outstanding items also display to enhance the impression. Figure 1.3 portrays the speech of Barach Obama's campaign.

- Recognition or Matching: acknowledging the whole cloud as the data which depicts a subject. For instance, tagcrowd.com (Figure 1.4) is one of the websites that displays tag clouds visualization in order to describe the content of particular website at a glance. By putting the address of website URL in the textfield provided and clicking on the "visual it" button, tag clouds will be shown towards users.

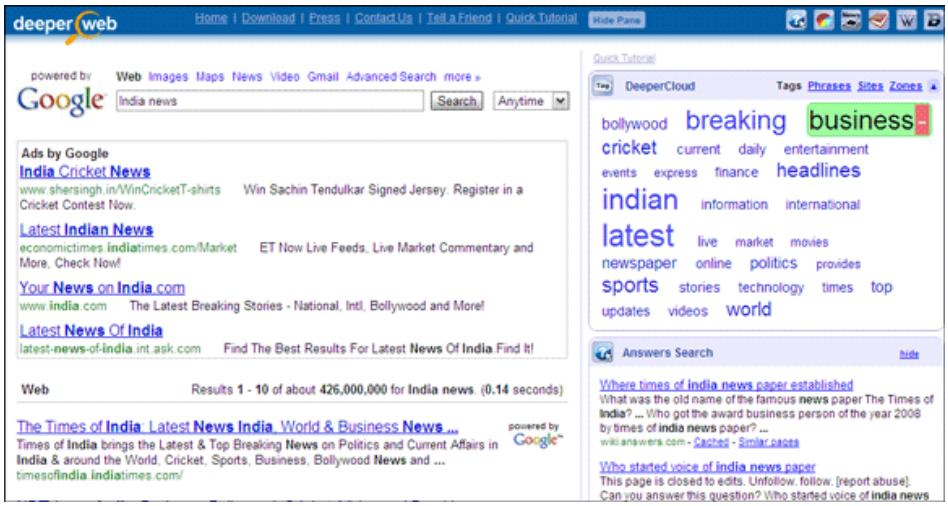


Figure 1.1. The use of tag clouds in Deeperweb.com to extend the searching result

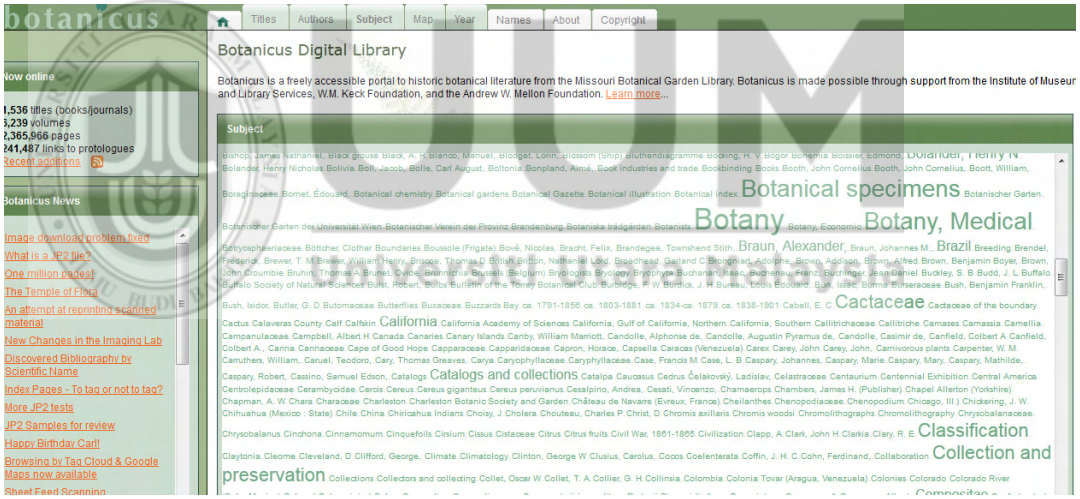


Figure 1.2. The use of tag cloud for browsing in botanicus website

Figure 1.3. The use of tag cloud to exhibit the speech of Barach Obama

Figure 1.4. The use of tag cloud to describe the content of particular website

There are many free applications for creating tag clouds on the internet such as Tagcrowd, ManyEyes, Wordle, MakeCloud, Tag Cloud Builder and so forth. It can be visible that the visual representation differs greatly across applications. These kinds of application have different styles and effects to be shown to users.

However, Ziemkiewicz, Ottley, Crouser, Yauilla, et al. (2012) stated that not only to consider visual perspective effects, but also to produce a well-designed visualization,

it must account for both the complex pre-attentive and cognitive processes triggered when a user views it. The balance of visual element can dramatically affect the user's comprehension of the information presented. Understanding the relations among pre-attentive processes, cognitive processes, and visual interfaces are longstanding goal of the visual analytics group. As a result, so many researchers have been trying to investigate these issues in order to get a better insight of what kind of factors that impact information visualization presentation in the tag clouds.

1.2 Problem Statement

Tag clouds have emerged as the new visualization technique and the most popular style that could be used to represent comparison among categories. They are visualizations technique that are usually used for navigation in the website and also purposely for visualizing unstructured data types since this technique could emphasize the most important variables of concepts (Daviduck, 2009). Different with other information visualization styles, tag clouds do not apply supplementary artifacts (for example the bars in the bar graph) in order to exhibit variables of interest, they represent the comparison by encoding word frequency information through font size (Viegas, Wattenberg, & Feinberg, 2009).

The use of tag clouds aids in many situations by using text analysis (Rivadeneira et al., 2007). In addition, recently many people start to consider tag cloud as visualization in recommendation systems, due to the advantages of tag clouds that are greatly able to show at a glance to users what the terms that are most prominently shown (Hinkle, 2009). However, in order to visualize information effectively and meaningfully, the development of information visualization techniques is not enough without following or understanding design guidelines that are acquired by

comprehending of human perspective (Few, 2013; Nass & Lee, 2000). It is crucial to display visualization more convincingly to users.

A published study suggested using customization of visualization by providing multiple appearances for particular users (Saati, Salem, & Brinkman, 2005). The role of personality traits of users is one factor that has influenced what kind of visualization to be displayed in meaningful ways in order to convince the viewers (Green & Fisher, 2010; Peffers, Tuunanen, Rothenberger, & Chatterjee, 2007; Ziemkiewicz, Ottley, Crouser, Yauilla, et al., 2012). This is because the diversity of users in terms of personality has affected them to prefer one style over others. The manipulation of visualization properties such as structure, layout, shape and color are recommended to be visually customized for some of group users. For instance, Karsvall (2002) focused on interface design for interactive television prototypes in website, he found that extrovert personality group is associated with brighter color, while the introvert prefers the darker color. Understanding on how people view or use visualizations and how to adapt visual designs to an individual user's need are really important matter. Naturally, someone with particular personality types will be more willing to view one visualization layout style than others (Green & Fisher, 2010; Ziemkiewicz, Ottley, Crouser, Yauilla, et al., 2012). Customization of visualization must be taken into account, due to it will increase the usability and usage experiences of users (Saati et al., 2005).

However, in tag cloud studies, none of the published studies has investigated the role of individual differences in terms of personality types of users as a guideline to be taken into account in visualizing tag clouds visualization. Most of the previous studies of tag cloud emphasize on the environmental differences facet perspective as a guidelines, such as differences in the interface design (Halvey & Keane, 2007;

Kuo, Hentrich, Good, & Wilkinson, 2007; Sinclair & Cardew-Hall, 2008) and visual features facet of tag clouds (size, positions, densities, and so on) (Bateman, Gutwin, & Nacenta, 2008). In addition, in a recent study the researchers focus on the impact of different kind of layout of tag clouds towards user's performance for different tasks (Lohmann, Ziegler, & Tetzlaff, 2009). Another study focuses on prefix tag cloud tree visual features (Burch, Lohmann, Pompe, & Weiskopf, 2013).

Moreover, even though a tag cloud has its own algorithm to show its color and shape for its layout that are assorted in the internet, there is no algorithm yet that uses personality traits factor for visualization. Therefore, in particular, the study describes in this thesis is on developing the algorithm that could generate varying tag cloud visualization layout style based on personality types of users.

1.3 Research Question

The research questions are as follows:

1. What is the appropriate combination of color and shape for algorithm used to develop tag cloud layout styles based on the personality traits of users?
2. How satisfied is the produced tag cloud layout styles that is generated from the proposed algorithm to the users?

In this study, two prominent visual features that are mostly related to personality traits are proposed, namely color (Cigic & Bugarski, 2010) and shape (Dellinger, 1989). This study is conducted by incorporating these two visual features in order to produce varying tagcloud layout styles. To fulfil this purpose, it is imperative to learn what kind of color and shape that must be displayed for particular group of

personality types. In doing so, according to Yi (2012), in understanding the individual differences especially personality traits must be derived from literature of study especially in psychology perspective.

To produce this generated result, a suitable approached must be utilized. This is due to the combination of personality traits that could have different results of color or shape that they prefer. This approach could help to decide in terms of solution of tag clouds that will be displayed to users based on the knowledge of personality traits that are saved in a database.

1.4 Research Objective

Based on research questions discussed above, this study aims to achieve two research objectives as put forth below.

1. To develop the algorithm that incorporates color and shape as tag cloud layout styles based on personality traits.
2. To measure users' satisfaction towards tag clouds layout styles based on the proposed algorithm.

These two visual properties (shape and color) are related to personality traits of users (refer to chapter 2). What kind of shape and color that must be shown for certain personality traits group will improve their preferences as well as their satisfaction towards interface style that are being displayed (Karsvall, 2002; Nass & Lee, 2000).

1.5 Scope of the Study

The following scopes are outlined to clarify the focus of this study:

1. This research focuses only on visual features of tag clouds layout styles, which are colors and shapes.
2. The tag cloud layout styles in this study will be developed by using Netbeans IDE desktop application, and java programming as fulfillment of prototype of case study.
3. The case study in this research is applied in a youth career recommendation system in order to test the tag cloud layout styles algorithm.

1.6 Significance of Studies

The significances of this study are as follows:

1. The main finding of this study is an algorithm of tag cloud layout styles, which combines the concept of personality traits, and visual properties adjusted of tag clouds, which are colors and shapes.
2. The findings could assist interface designers in selecting the appropriate tag cloud layout styles to be displayed for varying users which have personality differences.
3. The rules formed in this study as knowledge base can be useful in related studies that link between visual properties (color and shape) and personality traits.

1.7 Theoretical and Research Framework

This study is conducted based on theories and concept related to information visualization of tag clouds, visual properties (colors and shapes) and related to personality traits. The theoretical framework, which is depicted in Figure 1.5, describes three phases that are performed in this study: the problem identification, solution design and evaluation phases.

In problem identification phase, the collection of theories related in this study, such as visualizations, tag clouds, personality traits, color and shape preferences related to personality traits and artificial intelligence method in development are analyzed by using content analysis. Whereas, in the solution design phase, the selected components which have been reviewed from the first phase, which are visual properties (colors and shapes) based on personality traits are determined in order to construct an algorithm. The last phase (evaluation phase), the proposed algorithm is tested in order to measure the users' perspective of satisfaction regarding the appropriate styles of tag cloud layout styles through prototyping which is prepared as case study.

Multiple intelligence theory is deployed in case study to depict the appropriate career towards users. In other words, this theory can extract users' characteristic in terms of intelligences, so that the system could come out with the suggested careers that are mostly suitable for them which are depicted into tag cloud layout styles in this study.

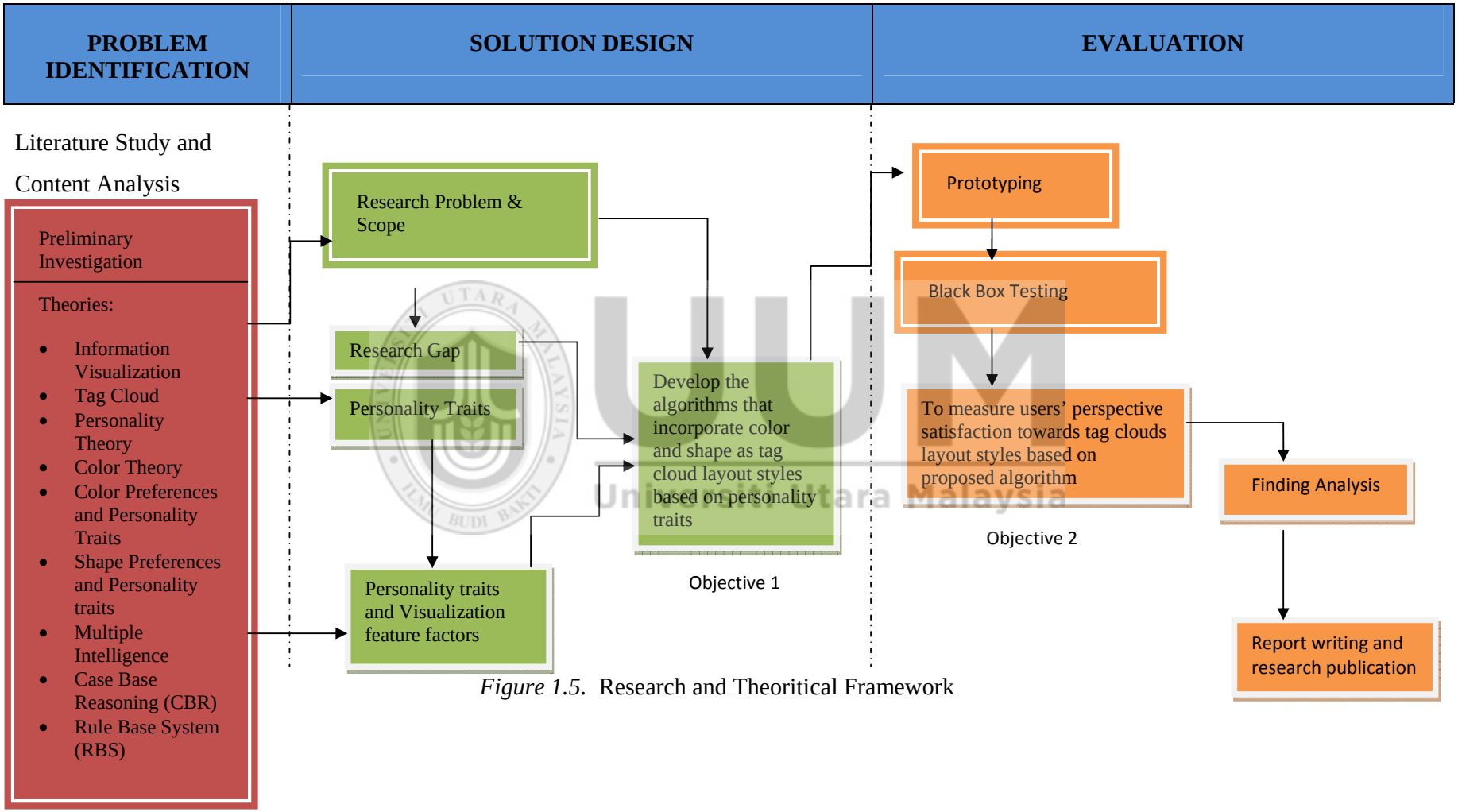


Figure 1.5. Research and Theoritical Framework

1.8 Operational Definition and Terminologies

This section explains the terminologies related to this study that is commonly used throughout this thesis.

Information visualization

Information visualization refers to the study that amplifies human cognition through interpretation of abstract data to become visual representations. In other words, the transformation of abstract data into some displays or visualization forms could allow users to get more insight and faster.

Tag clouds

Tag clouds can be defined as one of visualization methods that utilize various words in different size which are floating in space. Tag clouds are usually found in systems, website, blogs, social bookmarking to display the prominent terms; in other words, to display the important or most popular terms within the particular website.

Personality traits

Personality traits refers to different characteristics of people that affect the way they think, behave, react towards some certain conditions or situations. Personality traits are divided into many terms in which they describe that people are different with one another.

Multiple Intelligence (MI)

MI refers to the famous theory from Howard Gardner, Ph.D., Professor of Education at Harvard that classifies human intelligences into eight domains (Verbal-linguistic, Logical-mathematical, Spatial-visual, Bodily-kinesthetic,

Musical, Interpersonal, Intrapersonal and Naturalist). Each of them describes that human is different one another in terms of intelligence.

Case Base Reasoning (CBR)

CBR refers to an approach or method that stresses the role of previous experience during solving the future problem (i.e., by reusing from the previous cases the problems are solved and also could be from the similarity of the problem that is solved previously).

Rule Base System (RBS)

RBS refers to an approach or method that employs the "if-then" statement as rules of patterns during solving the future problem. The knowledge based in this approach based of gathering facts of domain knowledge as provided solutions.

Algorithm

Algorithm could be defined as systematic steps that need to be followed in order to solve certain goals or objectives. In computing, algorithm can be in the form of pseudocode or flow chart.

1.9 Overview of the Thesis Structure

This thesis proposal comprises six chapters. The contents of each chapter are described as follows:

Chapter 1: Introduction – This is as introductory part of this thesis. In this chapter, background of study, the discussion of problem statement, the objective, the research questions are included. The scope of study as well as the significance of study is also clarified. Lastly, the theoretical and research framework is depicted in order to conduct this research.

Chapter 2: Literature Review – In this chapter, the theories and concepts that underlie in this study are elaborated further. The discussion of underground theories and history of related theory are also discussed. The related works in this study, as a result to extract the gap in this study, which are from the previous work as well as the current study are included in this chapter. In brief, the discussion of substantial theories and concept are described in order to achieve the aims of this study.

Chapter 3: Research Methodology – This chapter contains the systematic processes that are conducted the research. Design research methodology is chosen; due to the main goal of this study, which is an algorithm. In summary, there are three main phases included: problem identification, solution design, and evaluation. Each of the phases has its own activities and outcomes.

Chapter 4: Development of Algorithm and Prototype – Related to objective 1 of this study, this chapter discusses the process involved in constructing an algorithm. The process involves four main activities, identifying color, determining shape, examining Artificial Intelligent (AI) techniques: forward chaining and backward chaining, and lastly the creation of rules. The development of prototyping is also discussed in this study in order to test the algorithm.

Chapter 5: Black Box Testing and Result of Users' Satisfaction – Related to objective 2 of this study, this chapter discusses the process involved in measuring the satisfaction of users upon the tag cloud layout styles. Before that, the black box testing is conducted in order to test the accuracy of system to produce the desired or expected tag cloud layout styles based on users'

personality traits. The analysis of satisfaction is clarified systematically in this chapter before concluding the achievement of finding results.

Chapter 6: Discussion and Conclusion – This chapter as last chapter in this thesis deliberates the depth discussion that leads to conclusion of accomplishment for each research objective as well as the limitation and future work.

1.10 Summary

This chapter shows the background of the study, introduces the research problem, research question, and objectives. Briefly, the purpose of this study to develop an algorithm that combines two visual features, which are color and shape, based on personality traits for tag cloud layout style.

CHAPTER TWO
LITERATURE REVIEW

2.1 Introduction

This chapter includes literatures related to this study. There are reviews of information visualization, tag clouds, personality theory, color, and shape theory related to personality traits, multiple intelligent as well as two artificial intelligence techniques (Case Base Reasoning (CBR) and Rule Base System (RBS)). All of these are discussed in order to get the concept and understanding of the issue at hand.

2.2 Information Visualization

Before discussing about tag cloud as one of the way of information visualizations, it is imperative in this study to have better understanding about the definition of information visualization as well as the purpose of information visualization. In addition, the substances in this section also show on how individuals interact to visualization whether in perspective of Pre-attentive theory (in sub-section 2.2.3) as well as Personality factors in visualization (in sub-section 2.2.5).

There are various definitions of information visualization across the literature. In order to know the definition of information visualization, beforehand is to know the definition of visualization itself. Ware (2000) describes visualization as a cognitive activity in which an individual is being engaged in. In other words, it affects a person's mind. According to Spence and Press (2000) the value of visualization is that to gain understanding and insight that influence internal of

human mind. Meanwhile, Card, Mackinlay, and Schneiderman (1999) explained that visualization is the use of computer-support, an interactive visual depiction of the data to strengthen the observation. The terms of visualization is a case point in which computer must facilitate the information to be presented visually by using visualization tools, so that a person who views it can understand about what kind of information are being displayed (Spence & Press, 2000).

In brief, the visualization term in the simple statement is to create or visualize somethings (data) to be more visible, so that it could be analyzed since it has visual form (Manovich, 2011). The emergence of information visualization field is from research in computer science, human-computer interaction, visual design, graphics, business methods, and psychology. It is gradually implemented as an important component in digital libraries, scientific research, financial data analysis, data mining, manufacturing production control, market studies, and drug discovery (Bederson & Shneiderman, 2003). According to Keim, Mansmann, Schneidewind, and Ziegler (2006) information visualization depicts the relationships of abstract data by using user interface interactively. The use of computer in order to encourage the creation of abstract data to be visual representations to amplify cognition (Card et al., 1999). Information visualization exploits computer graphics to guide humans in discovering the solutions towards problems (Kerren, 2008). It is the technology that utilizes visual computing to strengthen cognition of human towards abstract information (Sears & Jacko, 2007) and seeks to efficiently map the data variable in form of visual dimension (Gee, Yu, & Grinstein, 2005; Green & Fisher, 2010).

As a conclusion, according to many definitions, in brief, information visualization is the study that amplifies human cognition through interpretation of abstract data to become visual representations. The abstract data consist of both non-numerical and numerical data, for example geographic and text information. Information visualization assumes that interaction techniques and visual representations use the capability of the broad bandwidth of human eye lane across the mind to permit users to explore, see and comprehend the amounts of information at a time. The focus on information visualization is on the creation of approaches for transferring abstract information in perspective ways (Thomas & Cook, 2006).

2.2.1 The use of Information Visualization in the history

There are many situations in which data is available, sometimes in very large quantities, and where some human insight into that data is required. The use of computer to support visual representations of data is that to amplify cognition and solving problem. Thus, it creates the purpose of visualization is insight, not pictures; the goals of insight are: discovery (problem solving), decision making, and explanation (Card et al., 1999). This section elaborates the use of information visualization that has been used in the history:

- **Information Visualization for problem solving**

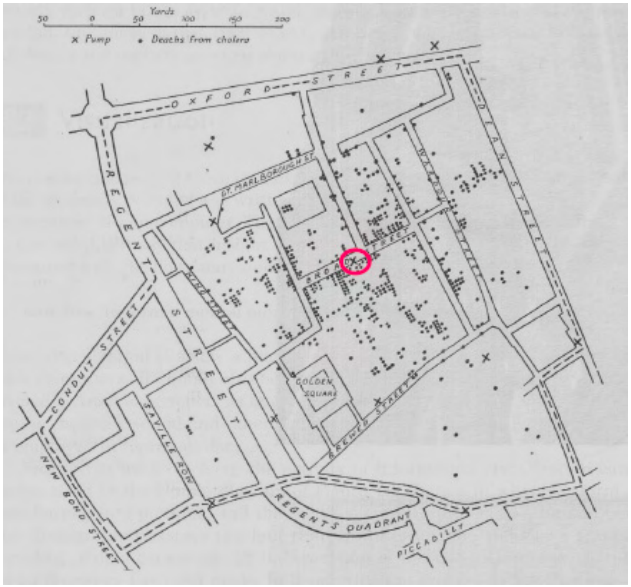


Figure 2.1. Visualization of London cholera epidemic by snow (Andrews, 2006)

In 1854, Snow claimed that a dangerous outbreak of cholera happened in a several block area of London. "About two hundred and fifty yards of the place where Cambridge Street joins Broad Street, there were above five hundred terrible attacks of cholera within ten days", Andrews (2006). Using data from the Office of the Registrar General of England and Wales, Snow arranged in the tables the number of deaths because of cholera within 1853-1854 based on the two water companies supplying the various sub-districts of London and tried to visualize it into the map. Eventually, John Snow deducted that the cholera epidemic was caused by a bad water pump which is visualized in the picture (see Figure 2.1). In that figure, the dots indicate the number of people who were infected by cholera and sign "x" in the middle were the point in which John concluded as the source of a bad water pump. As a result, closing that pump quickly solved the problem.

- **Information Visualization for Making Decision**

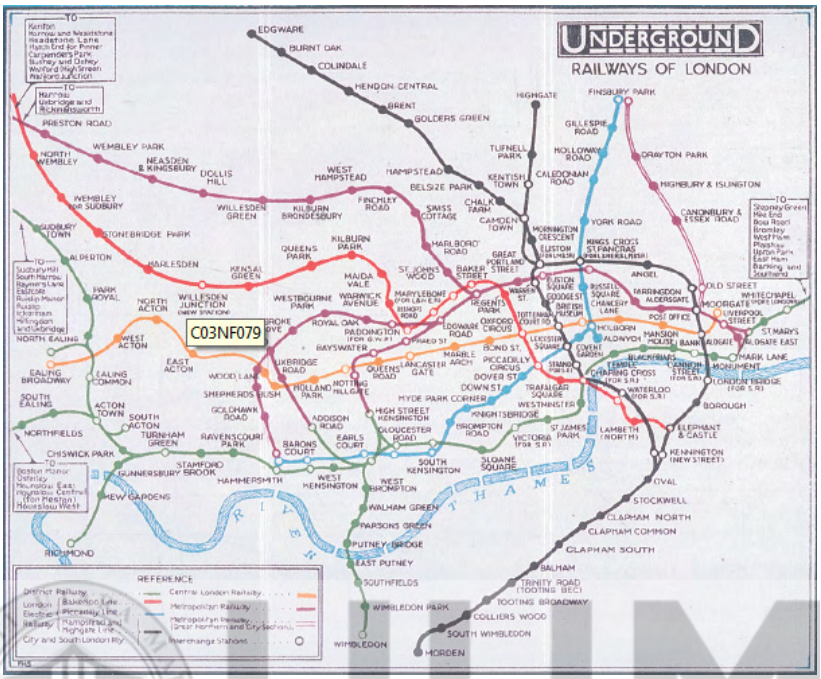


Figure 2.2. Map of London Underground Transportation System (Spence & Press, 2000)

Figure 2.2 represents London Underground railway map in 1927. The map describes towards the viewers to get some understanding in terms of finding the underground railway route and their regular interchange stations. It clearly can be noted that the map of underground system was visualized in relevant portion by displaying the colors which indicate the direction of the lines and interchange station (Spence & Press, 2000). As a result, it can be used during the traveling to assure arrival at the right destination.

- **Information Visualization for Explanation**

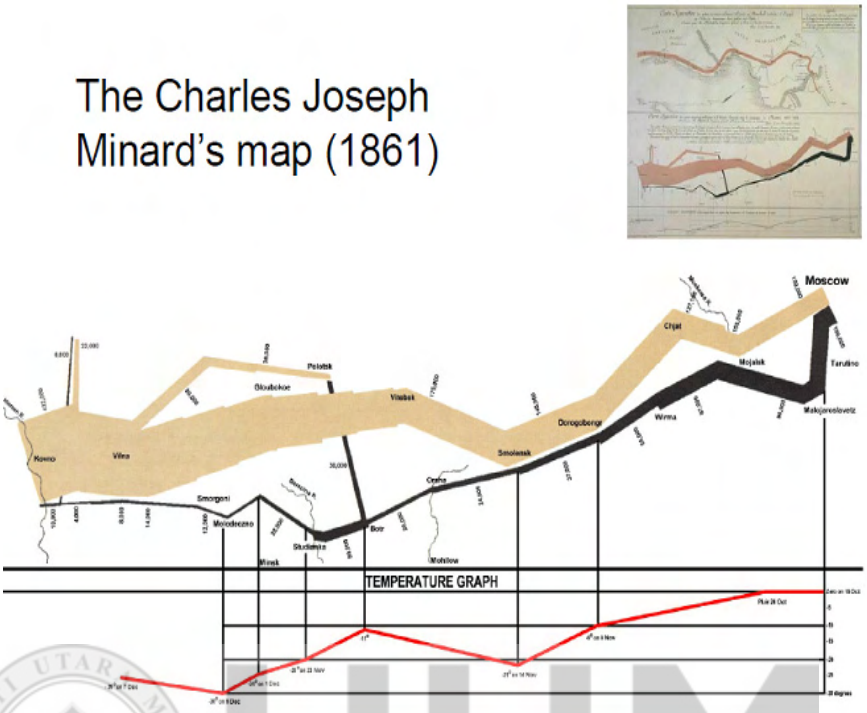


Figure 2.3. Minard's map of Napoleon's march to, and retreat from, Moscow (Spence & Press, 2000)

The figure above (see Figure 2.3) is an example for historical explanation which was produced by mapmaker, Minard, Napoleon's. The map illustrates the famous (Napoleon's army) March to, and retreat from, Moscow. The soldiers' number is depicted as the thickness of the brown line at one spot during the advance, while the retreat is depicted as black lines. The map describes that firstly there were 422.000 soldiers commenced, and just 10.000 people who came back (Spence & Press, 2000). The figure also depicts the death of army that happened while retreating throughout Berezina River (soldiers fell down to the ice) is very conspicuous. Moreover, a contributing facet also was coming from the conditions of weather which is illustrated at the bottom of the picture in red temperature plot.

2.2.2 Visualization and Cognition

As in the previous discussion**,** information visualization increases an ability to perform such cognitive activities. In this section, some explanations are elaborated in order to clarify the use of visualization in terms of amplifying human cognition. The first, a classic study by Larkin and Simon (1987) demonstrated some factors about the effectiveness of visualization. They compared task results of solving physic problems using non-diagrammatic versus diagram representations. Particularly, they tried to compare the effort that to be expended to do a search, recognition, and inference with or without the diagram. Based on the results, they deduced that diagrams helped in three basic ways:

1. By grouping together information that is used together, this means to avoid the big amount of searching information.
2. By utilizing the location method for grouping the information, this leading to reduce in terms of searching and also working memory.
3. In addition, the representation of visual could automatically assist human to easily having a huge amount of perceptual inferences. For instance, the element interior angles as geometric element in diagram are able to be recognized obviously and immediately.

According to Card et al. (1999) there are six major ways in which visualizations are able to amplify cognition:

1. By processing the available resources the visualization could increase the memory of the users. For instance, the visualization could be

implemented as a storage for huge number of information by showing quick accessible form (e.g. maps)

2. Visualization can reduce the searching process of information. In other words, visualizations group information used together which can reduce the process of searching.
3. Visualization represents to extend the detection of patterns. Recognition of information generated by a visualization is easier that recalling that information by the user.
4. Visualization enables perceptual inference operations. Visualization can support a large number of perceptual inferences that are extremely easy for humans (Larkin & Simon, 1987).
5. Visualization uses perceptual attention mechanisms for monitoring. Visualization could be used as monitoring for the big amount of potential event with the condition of display that should be organized, and then this leads to understanding from the overall appearance or also the motion.
6. Visualization generates information in a manipulable form. Different from static diagrams, visualizations could enable an exploration in changing value of space parameter and could strengthen the operations of users.

2.2.3 Pre-attentive Processing Theory

In conveying the information through visualization, there is important theory which is really crucial to be considered for human vision. It is called pre-attentive processing theory. This theory suggests the adjusting of visual features

such as shape or color could make “pop-out” effect of objects to be displayed display quickly to viewers (Healey, 1992). This processing of “pop-out” comes out so fast, without even using any attention to be focused on the display (Treisman, 1986). According to Healey and Enns (2012), this process of pre-attentive happens towards views in less than 200 to 250 milliseconds (msec).

For these reasons, pre-attentive theory becomes really effective consideration for visualization because it utilizes the highest bandwidths (eyes) as channel to bring information to our brain (Kosara, Miksch, & Hauser, 2002). In order to better understand about this theory, the following example could be seen on figures 2.4 and 2.5.

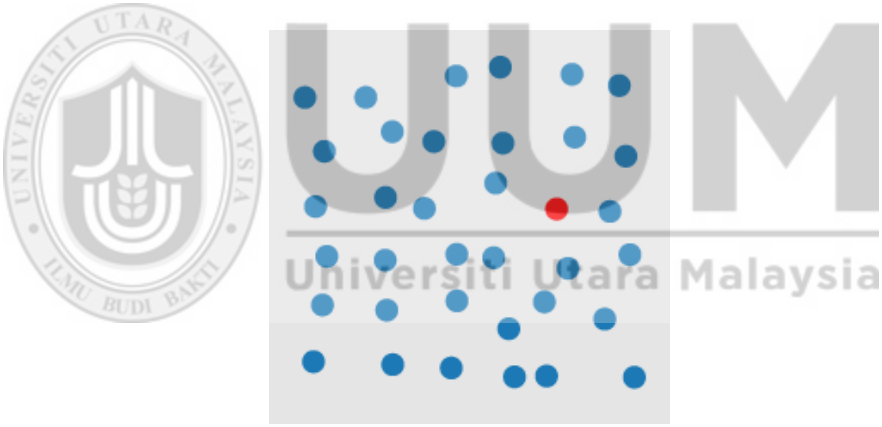


Figure 2.4. Preattentive visual properties: red dot among blue dots.

Figure 2.4 exemplifies about scenario of single glimpse towards one red dot with using very little attempts to have attention. This is due to our eyes just only needs 200 milliseconds or less to initiate an object. This “pop-out” effect is very useful and crucial in order to designing effective information visualization techniques.

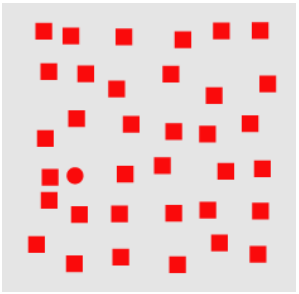


Figure 2.5. Preattentive visual properties: red circle among red squares.

Figure 2.5 is another example of pre-attentive processing which shows different shape or curvature that can be detected pre-attentively. However, for considering the effective pre-attentive processing, not all pre-attentive visual features are successfully working. Figure 2.6 illustrates the example of visual feature that is not detected pre-attentively. In this figure the presence of red circle is more difficult to be detected because of the distractions (blue circles and red squares). This phenomenon is known as conjunction search. The visual features are distracted between two distractors: blue circles and red squares.

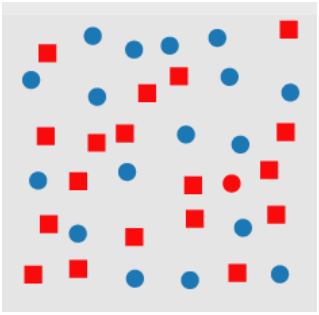


Figure 2.6. A red circle among distractors (blue circles and red squares)

This has shown that in designing effective information visualization techniques, avoiding such search conjunction is needed. Otherwise, it will have bad consequences to fulfill information visualization's aim. In conjunction to this study, pre-attentive theory should be taken into account in designing tag cloud,

even though tag clouds already have pre-attentive in terms of size of texts; it is crucial to consider the color distinction as well, so the pre-attentive processing works well.

2.2.4 Individual Differences and Visualization

Initially, in the history of Human Computer Interaction, Egan (1988) had taken the first step to investigate the human differences in information visualization field. Since then, there were so many researchers considering human differences as another factor in visualization influences (Yi, 2012). Velez, Silver, and Tremaine (2005) examined the influences of five different cognitive abilities of subjects (spatial orientation, visual memory, spatial visualization, dis-embedding, and perceptual speed) by developing a 3D model out of three orthogonal projects as on a basic visualization test. The findings demonstrated that high spatial ability has correlation with the accuracy based on the result of their visualization test. Similarly, Chen (2000) also investigated four facets (associative memory, spatial ability, online experiences, and visual memory) to identify these facets' influences on searching tasks through a spatial-semantic virtual setting.

Meanwhile, Conati and Maclaren (2008) tested six factors (i.e., spatial visualization, visual memory, perceptual speed, need for cognition, disembodiment, and learning style (sensing/Intuition, active/reflective, sequential/global, and visual/verbal). They found perceptual speed factor had a huge significant impact towards the accuracy of compelling the tasks given using a visualization tool, while the other factors did not show the influences statistically.

2.2.5 Personality factors in visualization

In recent studies, some researchers suggested that personality factors of user explain affect display. Some studies in visualization advocated that user personality has big impact toward visualization (Ziemkiewicz, Ottley, Crouser, Chauncey, et al., 2012).

In human computer interaction study, some researchers proved that personality factors are significantly associated with the way user prefers towards visual design of interface. For instance, Saati et al. (2005) conducted a study about skinning interface of music player based on visual themes which has variety of color choices to be changed. The results have shown that the correlation the groups of people who are introvert type prefer to choose blue themes, while conscientious types prefer to choose yellow theme. Another study by Karsvall (2002) investigated the correlation between color, shape (frame border) modification and interface design, and he focused on website interface design. The result of his study divided individuals into three categories of interface design, which are extrovert, introvert and neutral. He found that the contrast color design is highly associated with extroversion. Whereas, de-saturated colors design are correlated with introversion. Neutral design (original design) is provided for people who are neither extrovert nor introvert. He also found that sharp-edges of frame border are related to extroversion, while a round shape is related to introvert. The neutral type can use both of design.

Another study by Green and Fisher (2010) investigated and found that in terms of designing complex visualization design form, the locus of control personality traits type has significant effects towards user's performance. While,

Ziemkiewicz, Ottley, Crouser, Yauilla, et al. (2012) investigated the correlation between three personality traits, (such as extroversion level, locus of control, neuroticism and visualization methapor), and they concluded that all these traits could affect the performance of users while doing task.

Successful customization of visual features could have possibility to escalate the usability as well as the usage experience (Saati et al., 2005). Therefore, designers need to be aware of individual differences in terms of personality relating to users preferences by changing visual properties: layout, shape, structure, color (Karsvall, 2002; Saati et al., 2005; Ziemkiewicz, Ottley, Crouser, Chauncey, et al., 2012). To conclude, in this section, the justification of influences of personality traits towards visualization is discussed, rather than just only consider about human similarity. It is therefore imperative in this study to learn human personality traits deeply in order to get better insight in this study. Then, this understanding is deployed in order to customizing visual properties in tag cloud visualization. Therefore, in the next section, the discussion of tag cloud visualization is elaborated further.

2.3 Tag Clouds Visualization

This section discusses specifically all the things about tag clouds, including definition of tag clouds, the used of tag clouds, innovative ways to use tag clouds on the internet, tag cloud application, comparative analysis of tag clouds application and also the disscussion of the existing tag clouds study are reviewed. Each topic helps to gain a deep understanding about the study.

2.3.1 Definition of Tag Clouds

Tag clouds are depicted as information visual representations that demonstrate the words' frequency among textual content, such as, websites, articles, speeches or databases (Hassan-Montero & Herrero-Solana, 2006). The number of frequencies for each word or "tag" is displayed in the tag cloud by strengthening the color saturation as well increasing the words' font size. Tag cloud is one of the examples that represent method that is known as media visualization (Manovich, 2010). This is because tag cloud creates new visual representations without changing to others actualization such as point, retangle, image, etc. The visualization is still the same (as text), but having new visualization display which is different from original data (by changing data size).

2.3.2 Usage of Tag Clouds

The used of tag clouds is to display the number of frequency from the tags in words among description content, developed by using available social sofware (Rivadeneira et al., 2007) and websites of social bookmarking (Al-Khalifa, Davis, & Gilbert, 2007; Hassan-Montero & Herrero-Solana, 2006).

Tag clouds were firstly used in the novel entitled "Microserf", written by Douglas Coupland in 1995 (Coupland, 1996). Jim Flanagan created the tag clouds sofware application for blogs in 1997, and this software gave inspiration to produce tag cloud in flickr.com (photo sharing website). The widespread used of tag clouds was firstly popularized by Flickr website (Brusilovsky, Schwarz, & Weber, 1996).

In the website, tag clouds usually found in text form which is dynamically changed over the time in terms of tag size in order to represent the popularity of particular tag (indicating the frequency of tag usage). Nevertheless, there are also different way of mapping variable in text format across website in the internet, such as, Amazon website encodes the recent tag by using intensity of color (the vivid color indicates the recency of the tag), and del.icio.us website also uses red color to show shared tags, instead of using blue color. Swivel website provides the exploration of bunch of data set information (news, economic, politic, sport, whether, etc) using tag clouds, which is usually called data cloud in order to visualize it. The chain of thought website (chainofthoughts.com) uses image clouds, in which the images will be bigger as they get more clicks from the viewers.

To sum up, Rivadeneira et al. (2007) explain four distinct tasks that can be attained by applying tag clouds:

- Searching: Locating (or determining the existance of) a particular target or alternative target. This is purposely used to get further detailed information from the target.
- Browsing: This means to explore the used of the cloud casually without any intention to dicover specific purpose or target.
- Impression Presentation: The clouds are able to display the general idea of what subject is being shown through scanning. Visually, the item will be having more weight as a result for prominent items that represent the importance, and while the other which are less prominent also support to get more impression.

- Recognition or Matching: Recognizing the entire cloud as the data which describes a subject.

The next sub-section shows the implementation of tag clouds visualization in innovative ways to get more understanding.

2.3.2.1 Innovative Ways to Use Tag Clouds on the Internet

There are application generators that are available to produce a tag cloud in order to visualize the information to analyze discourse texts or responses. The use of a tag cloud is indeed useful to see at a glance the overall core patterns of certain content, since tag cloud is really eye-catching visualization type (Hearst, 2008). The examples provided below show the innovative ways of using tag clouds:

- **Used in a survey as an open-ended question.** Figure 2.7 displays an example of a tag cloud in a survey as an open-ended question concerning about an exhibition of a tiger in a zoo. This visualization of tag cloud shows that respondent's concern about the safety of livestock and people near the exhibit.

Figure 2.7. The survey's answer from the participant towards open-ended question type.

- **Used for card sorting exercise to determine the group names**. Even though, traditionally counting the number of frequency is usually used to

discover result of card sorting, the method that is provided by tag cloud could give faster or simpler insight through looking at the tag cloud. This means the bigger word represents the higher number of frequency. This helps people to determine which terms or group names, are the most generally suggested by participants. Figure 2.8 illustrates an example of suggested group names which is described in a list of cell phone terms that were part of the card sorting exercise.

Figure 2.8. Cell phone functions group names suggested by participants

Another in Figure 2.9 displays the produced tag cloud for the questions: "What word that is appropriate to represent ‘hold my services while I am on vacation.’"

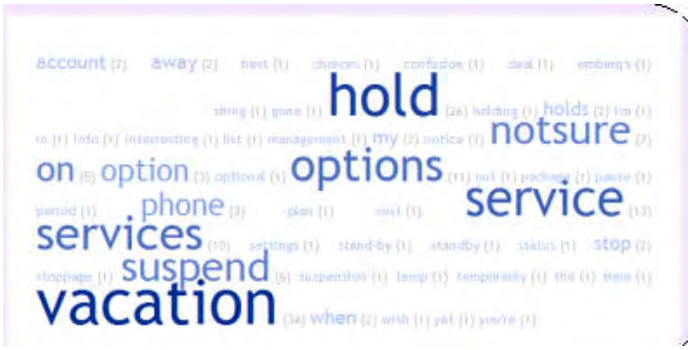


Figure 2.9. The user-suggested terms from the participants

- **Used as showing the themes from a bunch of text collection**. Cooke (2008) utilized a tag cloud in an article entitled "over the past 50 years", derived from journal "Human Factors and Ergonomics Society (HFES)". Figure 2.10 portrays the themes which are highlighted by using tag could visualization.

Figure 2.10. Tag clouds of frequently used terms in articles' titles for the HFES journal

2.3.3 Tag Cloud Application

Several tools can be used to generate tag clouds. The usability of these tools in generating effective and efficient tag clouds can be compromised by different factors, such as how the tags are organized and how the most frequent tags are represented. The following is a list of applications for creating tag clouds and a sample tag cloud from each. A list of suggested group names generated from a card sort study of cell phone information architecture was used to create the tag clouds in each of the applications listed. It can be seen that the visual representation varies greatly across applications. Applications that were for web purposes only were not included. Some of those that are popular to be used could be seen in the following figures:

- Tagcrowd

Figure 2.11. Tag clouds from Tagcrowd application

- ManyEyes

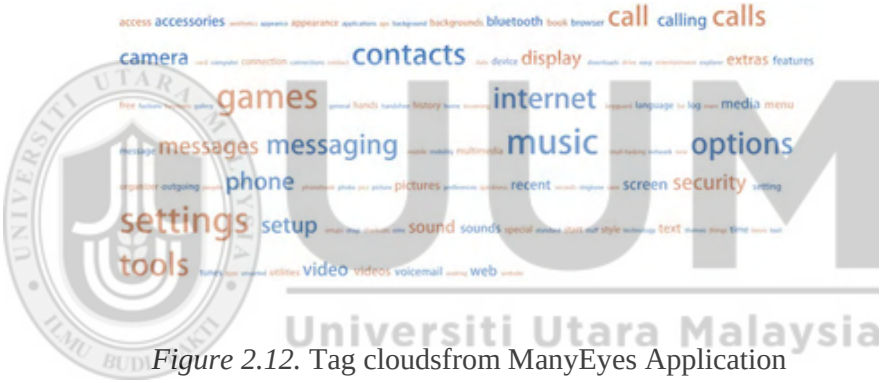


Figure 2.12. Tag cloudsfrom ManyEyes Application

- Wordle

Figure 2.13. Tag Cloud in Wordle Website

- MakeCloud

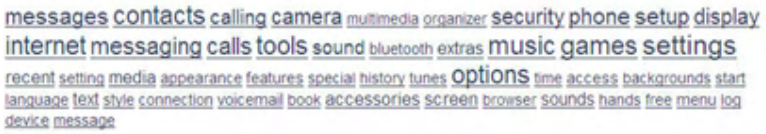


Figure 2.14. Tag Cloud in MakeCloud Website

- Tag Cloud Builder

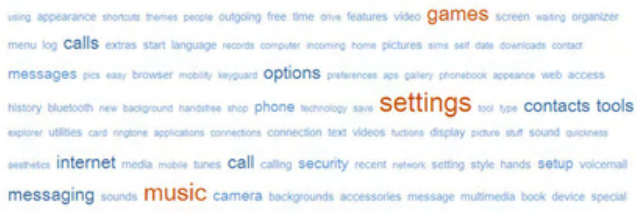


Figure 2.15. Tag Cloud in Tag Cloud Builder Web Site

2.3.3.1 Analysis of tag cloud applications

This section elaborates the each of style of the tag clouds application that has been provided earlier. The table 2.1 summarizes the analysis of those tag clouds applications.

Table 2.1

Overview of analysis of tag cloud application

No	Name	Summary
1	Tag crowd (Figure 2.11)	This application focuses on the differences of intensity of tag words color, besides using the differences of size. Instead of using different color, the tag crowd visualize data by using different intensity and size. The representation uses alphabetical order to visualize data.
2	ManyEyes (Figure 2.12)	This application focuses on different size and color in order to categorize the differences of subjects. The representation uses alphabetical order to visualize data.
3	Wordle (Figure 2.13)	Wordle uses both of different color and intensity of words. Different font is also integrated in this representation. In addition, the display layout is made in many forms. The representation does not use alphabetical order to visualize data.
4	MakeCloud (Figure 2.14)	This application just uses different size of words to visualize data. The representation does not use alphabetical order to visualize data.
5	TagCloud Builder (Figure 2.15)	This application uses the differences of color to interpret data. The different color and size are used for ordering the sequence from the most prominent data to the least prominent data.

2.3.3.2 The Implication of Analysis of Tag Cloud Application

Based on the review above, there are many available tag cloud applications in the internet. This review has shown that none of those existing applications of tag clouds has considered the role of human differences for developing tag clouds visualization. All are more prominently focus in using font-size and colors, but none of them are dynamically customized to be adapt to personality of users. Accordingly, there is a need to construct the algorithm that could adapt tag cloud visualization based on human perspective in terms of personality traits. In the next section, the existing studies of tag cloud are reviewed in order to gain more insights in tag cloud visualization research.

2.3.4 Examples of Tag clouds Visualization Research

There were many works of tag cloud visualization in the last decades. Tag clouds visualization has attracted many researchers to investigate as the new methods in information visualization. Initially in tag clouds studies, many researchers tried to evaluate tag clouds by attempting to compare the other user interface styles and tag clouds style. Halvey and Keane (2007) tried to compare tag clouds in terms of searching tasks with horizontal and vertical lists. They asked participants involved to search particular tags in both different styles of interface. The results show that people can solve the task given with un-weighted lists better than tag clouds. Moreover, they also found that the font sizes of tags gave big effect on speed of searching and tags, which are in the position of upper left corner in the tag clouds were found more quickly. They also concluded according to the result of the time used by participants that people scan the cloud instead of reading it.

Another researcher, Kuo et al. (2007) applied the tag clouds visualization in biomedical domain, and compared tag clouds interface and lists interface forms. They asked participants to perform descriptive tasks with both of these interfaces. The result also indicated the similar result with the previous researcher that lists interface give better performance on a searching task for the user than tag clouds. However, the participants suggested that tag cloud give higher level of satisfaction in terms of visualization view. Sinclair and Cardew-Hall (2008) carried out an experiment by involving participant to answer questions. The participants have two types of interface to answer questions, which were traditional search interface and tag cloud interface. The findings indicated that the people prefer tag cloud as open-ended questions, while for specific information retrieval was better with the traditional search interface.

Different with the other works, Bateman et al. (2008) investigated on the effects of nine tag clouds visual features: font size, font weight, color, intensity, number of pixels, tag width, number of characters, tag area and position and identify the relation to participants choices from the particular tasks given. The results showed that the stronger effects were coming from visual features: font weight and font size than the other features, like the intensity of a tag color and number of characters. Moreover, the authors considered that people tend to select tags, which are positioned in the center of the clouds more than the other positions like top or bottom areas. Rivadeneira et al. (2007) investigated tag clouds features by conducting experiments in order to inspect the font size effect, location of tags in the tag cloud, and proximity-to-the-largest-tag. By presenting the tag clouds, the participants were asked to recall the terms that they have read on tag clouds. In line with the result of Halvey and Keane (2007) and Bateman et

al. (2008), the observation of the font size effect was significant, whereas the another side, which was proximity-to-the-largest-tag did not give significant influence.

2.3.4.1 The Implication of examples of Tag Clouds Research

The implication of related works in this study is to see the gap that appears, according to observation in tag clouds literature review. This has led to the conclusion that in tag clouds study the role of personality traits has not been taken into accounts as a component in visualization. Meanwhile, some studies have explored and investigated the role of personality traits in other visualization designs style. The researchers agreed that personality traits have significant influences toward people viewing display. Therefore, in the next section, the discussion about personality traits is discussed further.

2.4 Personality Theory

As mentioned earlier, it is important to discuss about what makes people different in terms of personality. What makes people behave or interact with something differently is based on their characteristic or personality they have. The way people view some certain display also could affect their feeling, emotion, usability, experiences and so on (Brinkman & Fine, 2005; Saati et al., 2005).

Personality could be defined as the sum total of manners in which an individual interacts with and reacts to others (Robbins & Langton, 2007). According to Allport (1961), personality could be described as mechanism and psychological systems that are dynamically organized within human over the time that develop

their pattern of characteristic or behavior, the way of interaction, the way of thinking and feeling.

Mostly, the personality study concerned with the measurable traits on an individual displays. The previous study on personality structure pertaining about identifying and signing the long-term characteristic that explain a behavior of human (Robbins & Langton, 2007). The known characteristic includes aggressive, shy, lazy, submissive, loyal, ambitious, and timid. These characteristic occurred as a result an individual reacts against many situations, are known as personality traits. In the last 20 years, two famous approaches of framework for classifying and identifying traits have been used, which are the Big Five Model and the Myers-Briggs Type Indicator (MBTI). By answering the questions, which are from these two types of questionnaires, the people could know in which group they are included. The explanations of both questionnaires are described in the following sub-sections.

2.4.1 The Myers-Briggs Type Indicator (MBTI)

MBTI is a personality-assessment instrument most widely used around the world. This model was developed originally by Katharine Cook Briggs and her daughter, Isabel Briggs Myers (Coe, 1992). Based on this questionnaires, the people are divided into four categorizations, which are Extrovert or Introvert (E or I), Thinking or Felling (T or F), Sensing or Intuition (S or N), and last Judging or Perceiving (J or P). The following are the detailed explanation for those terms:

- *Extrovert versus Introvert:* The individual who is more tend to outgoing, sociable person, and assertive is known as Extrovert. On contrary, introverted person tend to be shy and quite.
- *Thinking versus Feeling:* The individual, who is in thinking types, solves his or her problem by using logical mind. Whereas, the feeling types of person solves his or her problem by using their feeling or emotion.
- *Sensing versus Intuition:* This kind of individual likes to have order and routine to be performed; this types also see the thing in details. Meanwhile, the Intuition types depend on their subconscious to process and tend to see the things in big picture.
- *Judging versus Perceiving*: The person who prefers to manage things or situations to be always in structured and organized is known as Judging types. Meanwhile, the perceiving type is more flexible and spontaneous in their life.

These four terms make into 16 types of personality combination specifically which means each of the combinations has its own characteristic differences. Figure 2.16 depicts the combinations.

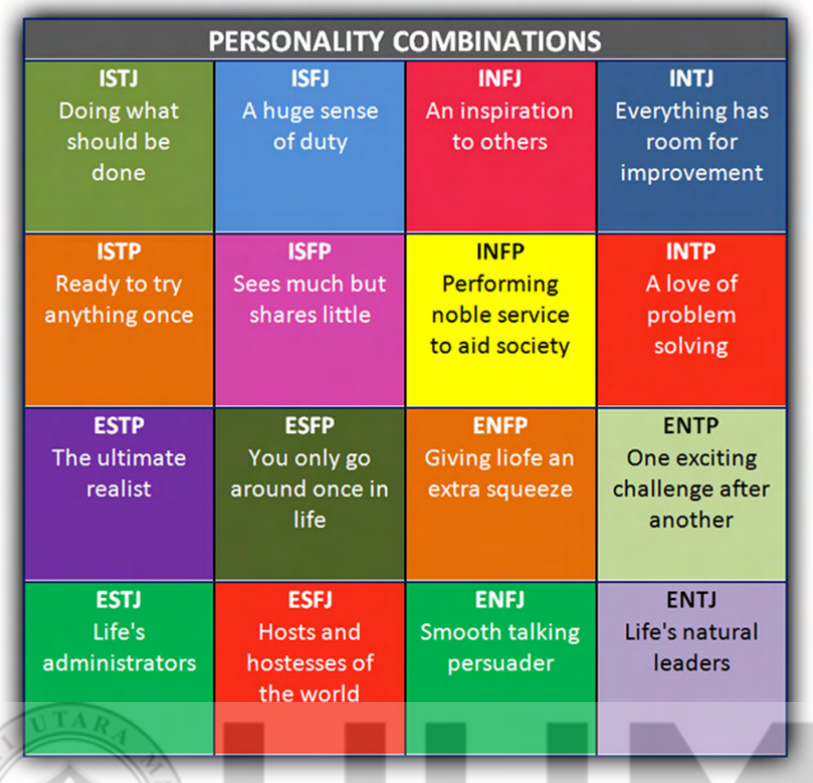


Figure 2.16. Personality Combination of MBTI (McCrae & Allik, 2002)

2.4.2 The Big Five Model

In contrary to the MBTI, the Big Five Model (see Figure 2.17) declares five-factors that have received strong evidence (Robbins & Langton, 2007). The big five model assessment of personality is the famous model that is already examined in various cultural situations (McCrae & Allik, 2002) and has been acknowledged around the world to be the most reliable and systematic model for identifying of human personality (Goldberg, 1990). The following are the big five factors:

- *Extroversion*: This dimension shows the individual's comfort level in terms of relationships. Similar with the previous MBTI model, that

people who tend to be sociable and outgoing are categorized as Extrovert types. While the quite, shy, timid, and reserved are Introverts types.

- Agreeableness: The indicators in agreeable dimension portrays individual who tend to defer toward others. The high score in this dimension means they are trusting people, more cooperative and warn people. Meanwhile, the low score means that this people on contrary tend to be disagreeable person, antagonist, cold, and do not hear person's opinion.
- *Conscientiousness*: The indication for people in perspective of reliability can be seen in this dimension. The high score for this dimension is depicted by personality of people who can be relied on due to their responsibility, these people also organized, persistent, and dependable. Meanwhile, the low score of this type is disorganized in their life, unreliable, and easy to be distracted.
- *Emotional stability* (another name: *neuroticism*): the indication of people in terms of withstanding against the stress. This dimension consists of two types: positive and negative types. The people who are positive types have stability in their emotion; he or she has big control of themselves. This positive dimension is also about calmness, confident, and fell secure about the situation. Different from positive, negative side on this dimension characterized to be easily stress, panic, insecure, and nervous.
- *Openness to experience*: The indication of this dimension is marked by people interest towards something new in their life. The people who are included as openess group have creativity, curiousness, and artistic. While, on the other side, the opposite of openess are people who are old

style people or conventional thinking and just relied on something they familiar with.

Figure 2.17. Big Five Personality Traits

2.4.3 Several additional personality attributes:

- **Core Self-Evaluation (Bono & Judge, 2003):**

  This dimension is divided in two different scales: positive and negative. The individuals who are positive in this dimension enjoy and like themselves. Moreover, they always have big confident about their capability, effectiveness, and are able to control their circumstance. While, on the other side, the negative ones dislike themselves, not confident with their capability, and see themselves as uncontrolled towards the environment. There are two major elements which determine people's core self-evaluation:

  a. Self-esteem

  This element exhibits an individuals' degree in terms of his perception about himself whether it is about appreciating himself as worthy people or he is comfortable with himself. The high level of this dimension are people who are always thinking positively about themselves and they are confident with their capabilities as valuable

people (Pyszczynski, Greenberg, Solomon, Arndt, & Schimel, 2004). While, those who are low self-esteem, on contrary, are more susceptible from external influences, they tend to depend on the positive evaluations from people around (Pyszczynski et al., 2004). This has made the people who are low level of this category tend to ask people opinion before they continue further about their decisions.

b. Locus of control

This element shows people's believe in mastering their own fate. The internal level of this element are individuals who have a believe that they are able to control their environments or what happen to them (Wallston & Wallston, 1981). While, external level shows that people believe in what occurs to them is managed by outside forces, such as chance or luck. This dimension indicates core self-evaluation side due to the people who presume they have lack of capability to control the circumstance around or shortage of confidence towards the environment. For instance, if people assume the successful of their school is resolved by blind luck, this displays possibility that these people do not have enough confidence in their ability.

- **Narcissism:** The narcissism is the element of personality about people that have extraordinary feeling about themselves, excessive to be admired, have privilege sence, and mostly are arrogant (Davis, Claridge, & Brewer, 1996). The narcissist term firstly came from Greek myth of Narcissus, the story about the man who excessively admired himself and

become so vain to see his own picture for very long time (Raskin & Hall, 1979). Another thing from narcissism, the researchers found that the people who have this traits are always thinking they are the best to be the leader, however their teachers or supervisors think they are worse leaders (Raskin & Hall, 1979). Narcissists always want to get the admiration of others and accept the affirmation of their excellence. In addition, narcissists also prone to be exploitative and selfish, and they have attitude to think that others exist for their advantage.

- **Self-monitoring:** The people who are high for this element (self-monitoring) display significant ability to be always adapting in synchronizing attitude toward their environment. They have a high level of sensitivity towards external signs and can behave differently in different situations. Meanwhile low self-monitors tend to show their true character and attitudes in every situation; therefore, they show consistency of their behavior. The evidence shows that high self-monitors like to pay closer attention of others' behavior and ve more capability of adapting than low self-monitors.

2.4.4 Implication of Personality Traits

As can be seen in the previous explanations, there are some dimensions of personality that distinguish some groups with the others. However, as Yi (2012) advocates for visualization and its relationship with personality, he states that not all personality traits dimension are included or could affect towards visualization; it must be exactly precise to which personality that fits style of visualization design. In other words, in order to adjust visual features, one

should identify personality traits that have correlation to visual properties. For instance, those suggested by Bono and Judge (2003) are not appropriate for visual properties.

2.5 Color Theory

This section discusses color one of the visual properties that is deployed in this study as tag cloud visualization that is adjusted based on personality traits. In the literature, the color can be defined as the sight of the excitement generated in the retina by the visible light emission, i.e. The 380-760 nm wavelength of electromagnetic irradiation (Cigic & Bugarski, 2010). The ways in which persons define a color pertain to their conception of that color. The conceptions of the color could also play a role in the impact that color has on the individual. Many kinds of colors have been interpreted in different ways, for instances "red defines as happy felling and blue as both dignified and calm" (Jacobs & Hustmyer JR, 1974).

Hemphill (1996) stated that yellow color was indicated as positive feeling and visible as bright, like the sun and green was related to the environment, such as trees, forests, and nature. Red was also seen as positive because it represents strong positive color and also 'warm color' (Hemphill, 1996). Jacobs and Hustmyer JR (1974) reported that red color has also been stated as more arousing, attention-drawing, awakening.Whereas, blue was found as a favourite color and received a large amount of positive responses. He explained this has happened due to blue was usually related to the sky or ocean and perceived as calm, limitless or quite (Hemphill, 1996).

2.5.1 Classification of Color

The spectrum could be apportioned into several parts, which when gathered together regardless of their number, it will generate the white light. If the spectrum is emitted through a prism then become three equal segments, three prime colors are obtained. The first classification of colors consists of the primary and complex colors. Three prime colors are yellow, red, and blue. Three complex colors are generated by combining these prime ones: yellow + red = orange, yellow + blue = green and red + blue = violet. These kinds of colors are also called secondary. The tertiary colors are generated by combining the primary and secondary ones (for example, yellow greenish and blue greenish, etc.).

Another classification of colors consists of the warm colors (yellow, red, orange) and cold (violet, blue, green) colors. This classification has resulted from the fact that these colors can in nature be related to each thermal condition (such as blue – sea, red– fire). Meanwhile, the neutral colors consist of brown, coffee color or alike. Wilhelm Ostwald, the German physicist, was the first who formulated color classification depending on their features of chromatic that has been generally acknowledged nowadays(Jacobson & Ostwald, 1948). Based on their chromatic features, the color classification is divided into variegated and non-variegated, that are also called chromatic and non-chromatic, or chromatin and achromatic (neutral). Chromatic colors are included within the Sun Spectrum, and black, white and gray are included as achromatic colors.

2.5.2 Personality Traits and Colors Preferences

Based on many studies, the mood could be affected by colors, so that affecting the way people adapt to the environment. The more important part to be taken into account is that the individual preference toward one particular color over the other colors has significant effects toward their performance. Eysenck and Zuckerman (1978) advocated that people who are introverted types have high level for their arousal (i.e., prone to be more always feeling burdened with their own feeling or thought compare to the extroverted types), thus they prefer to be alone in order to decrease or stabilize their arousal optimum level. Therefore, the introverted people prone to feel uncomfortable when they are with many people, due to their arousal level have exceeded the limit. Many preceding studies proved the significant effect of color towards arousal level and the relation with personality people have. In particular, the people who have high internal arousal level (Introverts) tend to choose or prefer "calm" colors like blue, and thus reduce their arousal level, meanwhile the low internal arousal (Extrovert) have preferences for "Exciting" color such as red, to raise their internal arousal level (Luscher, 1971).

The color is a notable aspect of our attempt to establish people privy environment they like. Since the 1970s, research has been carried out concerning the influence of color on individuals' behaviors and moods (Luscher, 1971). Luscher (1971) produced one of the most eminent theorists stating that personality and color preferences are linked. He was a Swiss psychotherapist who concluded in 1971 that individuals with similar preferences of color tend to have similar characteristic of personality (Lange & Rentfrow, 2007). The subjects who tend to choose the primary colors (such as blue, red, yellow and

green) represent their basic psychological needs. For instance, someone, who does not like red, unconsciously reflects anxiety (Luscher, 1971).

The studies of the effect of color on stimulus have shown that there is a correlation between personality traits and color preferences. In particular, the introverts tend to choose calm colors (such as blue), because they diminish the stimulus level, whereas the extroverts like to choose exciting colors (such as red), as they increase the stimulus level (Luscher, 1971). Another study by Spiegel and Keith-Spiegel (1971) in which the findings showed that extroverts prefer warm colors compare to introverts. Lange and Rentfrow (2007) speculated that various color preference patterns could reflect similar personality traits, for instance, the high creativity are pertinent with the red or yellow color preference at the first sequence, and prefer for blue color at the last sequence.

The relationship between color and personality in psychological studies has been majority reviewed by Schaie (1961), in which he proposed that the color shades from red to purple which are contained in the spectrum order reflect a series of emotions, from cheerful, unrestraint, direct and continued impulsive discharge (red), stability of calmness (green), to anxiety (violet). Meanwhile, Birren (1956) has reported an association between the cool colors and passive and calm moods, and between the warm colors and energetic and excited moods.

According to Luscher (1971), the subjects who prefer grey in the color test are having behavior to keep a space from anything; they tend to protect themselves or avoid from any external influence. Meanwhile, the subjects who prefer brown color have the need for physical relaxation (Luscher, 1971). In addition, another result proved that violet lovers are more sensitive than other color lovers like

red, yellow, green, or blue successively. The most current study by Cigic and Bugarski (2010), they investigated about the tendency of dark color and bright color. They reported that individual who has introversion and neuroticism personal traits preferred cold and dark colors (such as black, brown, and grey), whereas those who are aggression and activity preferred with bright colors (such as yellow and red).

2.5.3 True colors and MBTI (Personality Model)

As discussed in previous section, it is shown that many studies have proved that colors have significant relation towards personality traits. Nevertheless, all these findings are still unclear in terms of what kind of personality types specifically that divide people in-group of represent color. In other words, the previous investigation in certain ways does not answer precisely what is the relation between personality patterns type and colors. Most of them just explained colors preferences in general. For instance, from the explanation above, the extrovert types are labeled as group of people that prefer brighter colors such as red, yellow, and green. This is still unclear to be defined and used, because most of them just analyze one or two variables of personality elements to represent colors preferences. In this study, the relation between personality traits assessment model and specific colors must be defined clearly and concisely.

After many years of attempts done by many researchers (Isabel Briggs-Myers, Katherine Briggs, and David Keirsey), Don Lowry, a student of Keirsey (MBTI developer), successfully created a new approach,, which is called as true color theory (Miscisin, 2001). True color is a model that categorizes individual into four primary colors (Orange, Gold, Green, and Blue) (see Figure 2.18). Each

color represents individual's personality types and style. In this model, it can be described that human essentially has some degree for each color, but only one that prominently has the highest predominant.

Figure 2.18. True Colors of Personality (Cooper, 2009)

This true color has strong relation towards MBTI (The Myers-Briggs Type Indicator) model based on research from Honaker (2001). He stated that personality types division in MBTI model are related to true color dimension of each person. The table 2.2 shows the interrelationship for each other.

Table 2.2

The relation between true colorand MBTI personality types

No	MBTI Personality Type	True Color Type	Description
1	ESTJ, ISTJ, ESFJ, and ISFJ. (These types are known as **Guardian types**)	Gold	The group of people have similarity in terms of willingness to provide service towards other people in concrete form, such as community service. Judging trait that is included in all these types has made them to always respect the schedule and plan.
2	ESTP, ISTP, ESFP, and ISFP. (These types include in **Artisan types**)	Orange	This group has spontaneous individuals that loves fun. On contrary to Guardian types, this group has perceiving traits. This means, they are more spontaneous, flexible and not really stick to the plan.
3	ENFJ, INFJ, ENFP, and INFP. (These types are known as **Idealist types**)	Blue	This group of this people are related to personal growth and development due to both types having higher levels of empathy and personal integrity. The one prominent thing that this types has is that they have Intuition personality dimension and feeling dimension. This makes them they have emphatic to others and also are always being aware towards bigger picture in their live.
4	ENTJ, INTJ, ENTP, and INTP (These types include as **Rational types**)	Green	This type is known as skeptical type, but ingenious. They also have even-tempered nature. This group has NT (Intuition and Thinking) dimensions, which indicates that they most likely tend to look at the big picture. they are not emotional and do not need concrete details to perform something.

(Honaker, 2001)

Note: Extrovert (E), Introvert (I), Sensing (S), Intuition (N), Thinking (T),

Feeling (F), Judging (J), and Perceiving (P).

2.5.4 Implication of Colors

Many studies aforementioned proved that people prefer to choose the colors they like which are appropriate to their personality traits. For instance, energetic individuals prefer to pick vivid, strong, or active colors (such as red, yellow), meanwhile anxious and introverted individuals prefer to select cold color (such as gray, blue, green, violet) (Cigic & Bugarski, 2010). By understanding the theory of colors and previous related work, it can be seen that colors really have relation toward people preferences. People who prefer to choose one color over another have a different personality with other people who choose different color. However, these collections of study are not adequate to be used in this study. Therefore, the discussion of true colors of people is elaborated as the strong foundation to divide people into several groups based of MBTI personality assessment model. These findings from literature of true colors theory are then summarized in order to create knowledge database for this study as part of tag cloud algorithm with the inclusion of personality traits.

2.6 Shape Theory

This section discusses, the second visual properties, which is shape as tag cloud visualization based on personality traits. In this study, as mentioned earlier, the link between visual properties and personality must be identified in attempting to discover the appropriate visual properties to be displayed. In this section, the shape theory that is linked to personality traits is discussed.

Initially, Dr. Susan Dellinger who is a specialist in communication and also the author of "*Communication beyond our differences*" in 1978 constructed an

approach in order to identify the individual's personality and communication style by using the preferences toward five particular geometric shapes (Dellinger, 1996). Those shapes are divided into: rectangle, triangle, box, circle, and zigzag. This has been known as "*common shape language*", the person who prefers one shape over the other has different meaning behind it. This is a simple way, effective and efficient to identify what kind of personalities, education, attitude and experiences people have (Dellinger, 1989). Moreover, the dominant brain function also could be identified through individual choices. These shapes have helped people to knowing themselves further, the way they behave and think. This approach is known as "Psycho-Geometrics" is related to Carl Jung's model about personality types of individual (MBTI Personality Model). Dr. Susan Dellinger has applied this model (Psycho-Geometrics) for teaching and explaining in art and science of communication.

The notion of Psycho-Geometrics approach is that people is attracted significantly to particular shapes and forms due to many factors based on their personalities, attitudes, education, experiences, and also the way the individual brains function (Dellinger, 1989). If the users chose the box, triangle, or rectangle, it means, they chose a linear shape. The people who are attracted to these shapes are categorized as left-brain users; tend to dominantly using logical mind approach in their life.

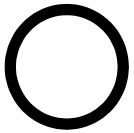
If some people tend to choose the circle or zigzag, it means they are categorized as a right brain thinker. The way of these people think are less linear and more configurable way, and more interested in the whole rather than individual parts. Right-brain thinkers, on the other hand, place emphasis on creativity and

intuition. Each of the shapes displays different characteristics of people, which are shown in the table 2.3 below.

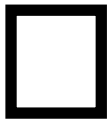
Table 2.3

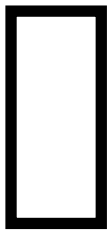
Psyco-Geometrics Personality

Shapes	**Strengths**		**Weaknesses**	**Typical Jobs**
TRIANGLE (NT – Intuition and Thinking) 	Abstract Controlling Critical Innovation Intelligence Logical Perfection Power Precision Skeptical Systematic Vision	Ambitious Athletic Bottom-line Competitive Competency Decisive Focused on goal Hierarchical Leadership Left-brain Political Wisdom	Dogmatic Driven Impatient Overloaded Political Self-centered Status oriented	Administrator Analysts Architecture Business owner Conductor Consulting Design Economists Entrepreneur Executive Law firm partner Manager/supervisor Math Military officer Orchestra Pilot Politician Teacher/Professor Union organizer

CIRCLE (NF – Intuition and Feeling) 	Caring Empathetic Honesty Idealistic Imaginative Integrity Lovers Peacekeepers Relations Romantic Searching Spiritual Unique Unity	Creative Empathic Friendly Generous Harmony Integration/ holistic Listeners Nurturing Persuasive Pleasers Problem solvers Sensitive Stabilizing Reflective Team players	Apolitical Emotional Gossipy Indecisive Lazy Manipulative Melancholy Over personal Self-blaming	Acting Advertising Analyst Camp leaders Consultant Consulting Counselor Historians Housewife Human resources Medical Minister PR Sales Sales Secretary Teacher Teaching Waiter Writing
ZIGZAG (SP – Sensing and Perceiving)	Action Adventurer Competitive Motivating Creativity Endurance Bold Fun motion Open-ended Physical	Conceptual Excitable Future oriented Impulsive Independent Innovative Integrative Right brain	Disorganized Eccentric Evangelistic Illogical Impractical Naïve Uninhibited Unrealistic	Agent Artist/performer Astrologist Decorator Entrepreneur Evangelist Independence Inventor Musician

	Spontaneous Risks Sensuous	Start-up Stimulation Variety Witty		New product specialist Professor Promoter/PR Researcher Sales Tools: instruments, carpentry, etc.

Shapes	**Strengths**		**Weaknesses**	**Typical Jobs**
BOX (SJ – Sensing and Judging) 	Authority Belong Dutiful Judicious Organized Parental Practical Perseverance Predictable Responsible Sensible Serious Service Structure Useful	Administrator vs. manager Analytical Conservative Detail-Oriented Determined Follow plans Hard Worker Knowledgeable Likes to know rules Logical Need predictability Organized Patient Perfectionist	Complaining Cool & aloof Loner Meticulous Nit-picking Procrastinating Resist change	Accountant Administrator Author/editor Bank teller Business Computer programmer Construction Doctor-specialist Engineering Government worker Inspector Manual laborer medicine Paper processor Secretary Selling Teacher

Shapes	Strengths	Weaknesses	Typical Jobs
RECTANGLE 	*Transition in life* Dissatisfied Confused Growing Unpredictability Searching Learning Exciting Inquisitive Courageous	Low self-esteem Inconsistent Gullible Not genuine Unpredictable	Entry-level Recent graduate Newly promoted Life crisis Adolescents Entrepreneurs Performers new retirees

(Dellinger, 1989)

2.6.1 Implication of Shape

In this study, the shapes are used as another visual feature that is applied as tag clouds layout. Five shapes according to previous discussion are related to the personality of the humans. The tendency of people to choose shape is in accordance to their personality. Thus, these shapes are incorporated with color in tag clouds visualization layout.

Each shape has a combination of prominent elements from MBTI personality type's model. In particular, each shape includes two elements from eight different elements provided in MBTI personality models. These combinations determine what shape to be displayed towards certain group or personality types. Therefore, these data are stored as knowledge based, which is useful to accomplishing the main objective in this study.

2.7 Artificial Intelligence Techniques

In this study, the appropriate color and shape are determined based on the analyzing part of combination of personality traits from MBTI model (as knowledge based). Therefore, it is imperative to select an appropriate approach that could analyze those patterns (collection of knowledge based).

Artificial Intelligence techniques support to find out the solutions regarding analyzing those patterns. There are many prominent artificial intelligence techniques across literature, but only two are reviewed, since these two techniques are mostly used towards similar purpose of the intended autcome of this study (Chen, Jakeman, & Norton, 2008). They are Case Base Reasoning and Rule Base System.

2.7.1 Case Base Reasoning

The first method to be reviewed is Case-based reasoning (CBR). CBR is an approach to solve the problem that stresses on the role of previous experience during solving future problem (i.e., by refering from the previous case solution, the problem is solved by using similarity value method) (Watson, 1998). CBR is memory based, so that emulating the way of human utilizes storage problems and as a result to give solutions in order to obtain new problem solving as a starting point. The concept based on CBR is that the similar problem has similar solution (Leake, Kinley, & Wilson, 1997).

The way in which CBR solves the problem is that by gaining the description of the problem. After that, it continues measuring the similarity of the recent problem by comparing to the past problems, which are stored in a database with their available solutions, in order to retrieve the similarity of the cases and try to reuse the proposed. At the end, the proposed solution of the system is then evaluated (such as, by being assessed by a domain expert or applied to the initial problem). It is also possible, if required during evaluation, to make a revision of the proposed solution. Then, the description from the problem itself as well as the solution will be retained as a new case, and a new problem is stored in the system database (Pal & Shiu, 2004).

Figure 2.19 displays Aamodt and Plaza (1994) classic model of CBR's problem solving cycle. CBR cycle involves four steps: retrieve, reuse, revise, and retain (short name "4 REs"). This is because of the imperative function, which is part of retrieval phase in CBR cycle, most of studies focus on the retrieval phase and the similarity. The illustration is depicted in Figure 2.20 is about the role of similarity during the

concept of retrieval and adaptation distances. In Leake (1996) diagram also captures the relationship between solution spaces and problem in CBR.

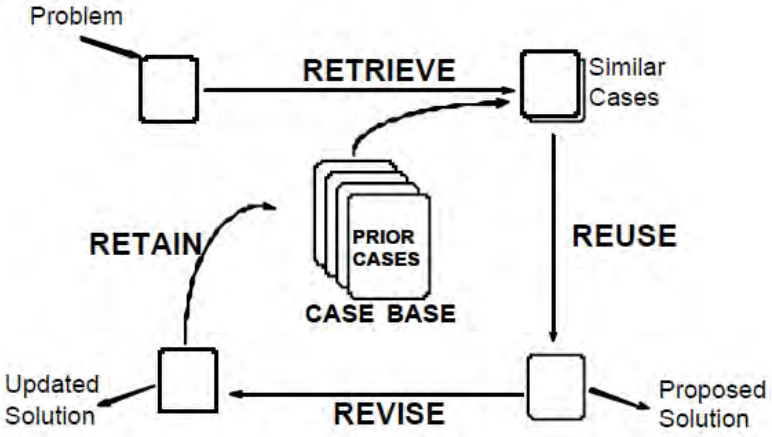


Figure 2.19. The process of CBR circle (Aamodt & Plaza, 1994)

The retrieval distance "R" in Figure 2.20, raises up as a result from the measurement of similarity value between a stored problem in case base and the current problem that is smaller (i.e., lower similarity creates greater distances). The general assumption in CBR study is that the equivalence between distance of R and A indicates the effort of adaptation distance.

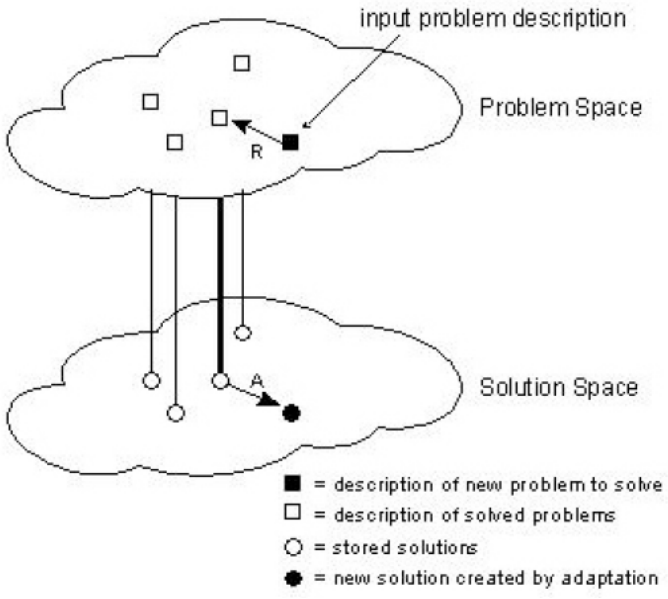


Figure 2.20. The illustration of distance creation between problem and solution in CBR (Leake, 1996)

The CBR algorithm has capability to enhance its accuracy, reasoning ability and performance. CBR can handle large amounts of data and multiple variables. However, CBR has weakness in terms of drawing inferences towards problems that have no similarity compare to past cases (Nagori & Trivedi, 2014). The CBR is also time consuming approaching since it is compared to all available data that are stored in database. This CBR technique does not need comprehensive data, as the data are always growing up, to predict come out solution. Therefore, this technique is usually used at environmental applications, such as planning fire-fighting, managing waste-water treatment, monitoring air quality and weather prediction (Chen et al., 2008).

2.7.2 Rule-Based System (RBS)

Rule based system (RBS) is a way to store and manipulate knowledge to interpret the information in a useful way. RBS can be used to perform lexical analysis to

compile or interpret a computer program, or in natural language processing (Hayes-Roth, 1985). The RBS uses "IF-THEN" rules statement that can be used for inference engine for searching the patterns that at last come out with the provided solutions (Negnevitsky, 2005). The inference engine here has purpose to give reasoning until expert system can achieve its solution. The "if" statement means the certain conditions is settled, and "then" statement means if the condition is fulfilled then action is performed (Negnevitsky, 2005).

The way of RBS works is by matching between "IF-THEN" rule statement and FACTS. If it is matched, then the rule is executed. The IF-THEN rules here represent the bunch of domain knowledge that are gathered for some particular purpose, whereas FACTS means the current conditions that are given. Each rule has different function, it can show a relation, strategy, directive, recommendation, or even contain the other rules function. When a fact is match with a rule, then the rule is fired which lead to execute the action in THEN statement part.

Usage of RBS includes for examples:

- Agriculture & Livestock: used to estimate / forecast the current management and future
- The field of medicine / health: used to identify the disease - a disease and can be used as a suggestion for an alternative treatment

There are many benefits from using RBS. RBS is easy to be expanded in the system, since the rules if-then statement can be used to inferences engine. Moreover, RBS also can improve quality of solving problem, since the rules can be constructed based on available knowledge given (Nagori & Trivedi, 2014).

However, there are some weaknesses of a RBS (Nagori & Trivedi, 2014):

1. Requires the right conditions - a right that a rule can be used
2. It is limited due to can only be utilized if comprehensive knowledge is available
3. The rules inside of RBS have no learning methods.

Examples of IF-THEN statements are:

IF (Saturday OR Sunday) THEN Watch cinema

IF (Not Saturday OR Sunday) THEN Work

IF (Watch cinema) THEN Going out

IF (Cannot go out) THEN stay at home

IF (good weather) THEN can go out

IF (Work) THEN cannot go out

IF (Not Rain) THEN good weather

These examples above show, all the rules that may exist as knowledge based and each is an independent piece of knowledge. Some rules have some patterns to describe solutions. In order to draw these patterns in an organized way, there are two types of inference techniques that RBS has namely forward chaining and backward chaining inference.

Forward chaining, which is also known as data-driven reasoning, due to it starts from analyzing existing knowledge or facts and look for the appropriate rules, which is then applied to the facts until a goal is achieved (Buchanan & Shortliffe, 1984). At the same time, rules can also be backward-chaining, which is also known as goal-driven reasoning, due to it starts from a goal and then generated for rules which is

then applied to that goal until a conclusion is achieved. In summary, the RBS can be applied if the complete data knowledge is available and clear to be stored.

2.7.3 Comparative Analysis of CBR and RBS

In determining which technique caters for the need of this study, a comparative analysis was conducted. Table 2.4 lists the strengths and weaknesses of each technique.

Table 2.4

Overview of comparative analysis of CBR and RBS

Artificial Intelligence Techniques	**Strengths**	**Weaknesses**
CBR	1. Fast retrieval speed 2. Accuracy and performance ability are stable	1. Slow retrieval speed when the case base is large 2. time-consuming process 3. Impossible to come out with the solution if there is no similar data
RBS	1. Simple 2. Increase output and productivity 3. Easy to expand system 4. Increase problem solving ability 5. Improving Quality	1. Requires the right conditions 2. It is limited cause can only be utilized if comprehensive knowledge is available 3. The rules inside of RBS do not have learning methods, since required static data.

(Chen et al., 2008)

2.7.4 Implication of Artificial Intelligence Technique

Two techniques were reviewed, which are CBR and RBS. Both are commonly used as the techniques that employ database knowledge of data structure. Both of these techniques have advantages and weaknesses. CBR is the technique that does not need comprehensive data to solve problems. It expands and always learns the data to come out with solutions based on comparison of similarity data that are coming from previous data. However, CBR is time consuming, since the data are always compared into a bunch of data, which are stored as previous comparison knowledge, and then come out with the biggest similarity solution. Even though, CBR has advantages in terms of accuracy and performance, this approach also has lack of solutions, if similar cases are not available in the cases databases.

Meanwhile, RBS in contrary, does not learn the data, as the analyzing part in this approach uses rules that are constructed by using "if-then" statement approach. This "if-then" statement is a simple statement that could be utilized for inferences engines, which means the rules will be easier to be translated into a system (source code). However, this technique really needs comprehensive data to achieve solutions; this approach is static that must be created from available facts or adequate domain of knowledge as provided solutions.

The solutions as discussed in color and shape theory are seen as fulfilling the criterion of comprehensive data. Therefore, the RBS technique was selected. The personality traits, color and shapes data are believed to be able to provide solutions, with "if-then" statements.

2.8 Multiple Intelligence

Multiple intelligence (MI) theory was firstly developed by Howard Gardner, Ph.D., Professor of Education at Harvard (Gardner, 2003). This is due to in 1993, Howard Garner in his publishing *Frames of Mind*: *The Theory of Multiple Intelligence* made a statement based on the result of his research that intelligence of human comprises many facet (Shearer & Luzzo, 2009). The initial theory from Gardner was started by classifying seven intelligences (Verbal-linguistic, Logical-mathematical, Spatial-visual, Bodily-kinesthetic, Musical, Interpersonal and Intrapersonal), and later on he added two more intelligences in his book, which is entitled "Intelligence Reframed" in 1999. There are Naturalistic and Existential, which are the additional intelligences that Gardner added, but the latter was not acknowledged by global acceptance (Gardner, 1999). The description of each intelligence can be seen in table 2.5.

Table 2.5

The Eight Intelligences Based on Gardner's Theory

Intelligences	**Description**
Linguistic	The capability of human in terms of analyzing information, as well as the ability to develop product that include written language and oral, for example, writing books and article, and ability to deliver the speeches.
Logical-Mathematical	This capability involves human to think logically, solve the problem in equations, calculation and abstract things.
Spatial	The capability by using their eyes to easily know or recognize something that related to images or graphics, whether in big scale or spatial scale; they also could

	manipulate them.
Musical	This capability related to music or sound; he or she has ability to create, memorise, and as well as distinguish different patterns of the rhythm which are produced from the sounds.
Naturalist	The capability of human to be able distinguish different kinds from natural enviroment such as plants types, animals, sign of weather that related in natural world.
Bodily-Kinesthetic	The capability to have big control for body movement, using body to solve problem or mastering some movement in sport and dancing.
Interpersonal	The capability to identify or recognize other people; in other word these people could read people in particular condition, such as, moods, emotion, feeling, desire, and so forth which are related to other people. The individual who has this ability could motivate or advice other people to be better. So many people come to this type of person to ask her or his opinion to solve their problem.
Intrapersonal	The capability of people to recognize themselves. The control involves the emotion, feeling, thinking, motivation, desires, and so forth.

(Gardner, 1999)

The Gardner's Multiple Intelligences theory can be used for curriculum development, planning instruction, selection of course activities, and related to possible careers or work choices. As the purpose of this study, the theory is used in

order to relate to a career or occupation area that represents each of the intelligences. Table 2.6 represents each of intelligences related to career areas as proposed by Reardon (2009).

Table 2.6

Gardner's Eight Intelligences related career

Intelligences	**Career Areas**
Linguistic	Linguist, writer, radio or television announcer, politician, poet, historian, folklorist, literary critic, philosopher, humanist, author, editor, speaker, playwright, attorney, journalist, talk-show host, storyteller, translator, reporter, lecturer, teacher, executive leadership, interpreter, librarian
Logical-Mathematical	Scientist, engineer, mathematician, physicist, tax accountant, researcher, statistician, astronomer, computer programmer, computer analyst, logician, math/science teacher, detective, economist, medical doctor, technologist, cataloguer
Spatial	Sailor, mathematical topologist, engineer, physical scientist, surgeon, chess player, sculptor, commander, cartographer, theoretical physicist, architect, art historian, artist, craftsperson, experimental psychologist, navigator, hunter, interior designer, explorer, guide, inventor, mechanic, airplane pilot, anatomist, painter, graphic design artist, air traffic controller, photographer, illustrator, scout, explorer, builder

Musical	Composer, performer, instrumentalist, aficionados, singer, disc jockey, conductor, band member, opera director, choir member, those who enjoy, understand or appreciate music, rock group member, dance band, music teacher, vocalist, music therapist
Naturalist	Geologist, Chef, landscape architect, ecotourism, birder, botanist, astronomer, anthropologist, hunter, cataloguer, guide, anatomist, farmer, gardener, animal handler, meteorologist, naturalist, biologist, wildlife illustrator.
Bodily-Kinesthetic	Inventor, instrumentalist, dancer, juggler, actor, personal fitness trainer, typist, acrobat, athlete, programmer, mechanic, craftsperson, engineer, clown, artisan, surgeon, carpenter, forest ranger
Interpersonal	Police officer, helping professions, politician, executive, teacher, therapist, travel agent, counselor, psychologist, novelist, a psychiatrist, salesperson, social worker, business person, actor, community organizer, arbitrator, public relations, administrator, nurse, sociologist
Intrapersonal	Introspective novelist, psychologist, police officer, self-employment, executive, researcher, leadership, theorist, entrepreneur, philosopher, theologian, therapist

(Reardon, 2009)

Silver, Strong, and Perini (1997) stated that introvert individual who has high intelligence in linguistic prefers to be a poet, meanwhile the extrovert one prefers to be debater most likely.

2.9 Summary

Tag clouds visualization is one of the new techniques of information visualization that is usually employed in order to show the relevant content representation. Tag clouds represent the information to be visible as visualization representation by using words or tags, which appear as a bunch of tags that makes clouds form. The difference in font-size of each tag indicates the frequency used or number of viewers who have clicked on it; the more clicks, the bigger the font will be. A tag within tag clouds usually appears as a link, to navigate users to particular content. Moreover, nowadays tag clouds have been widely used and become popular for other purposes, such as to show the speech of people, as surveys results, articles (to see the content overview), recommendation results, and so forth.

Tag clouds visualization considers human perception in terms of pre-attentive theory. Nevertheless, none of the current studies has investigated human differences in terms of personality to be examined in tag clouds visualization. In fact, some studies in the literature have proved that individual differences, especially in personality traits perspective has significant effects towards people viewing display.

Therefore, this study focuses on personality traits. Colors and shapes theories are underlined to be involved to achieve the main goal of this study, which is developing algorithm of tag clouds with the inclusion of personality triats. Meanwhile, the relation between them are linked and stored to be knowledge based. The figure 2.21

illustrates the overview of the literature study conducted in accomplishing the research objectives.

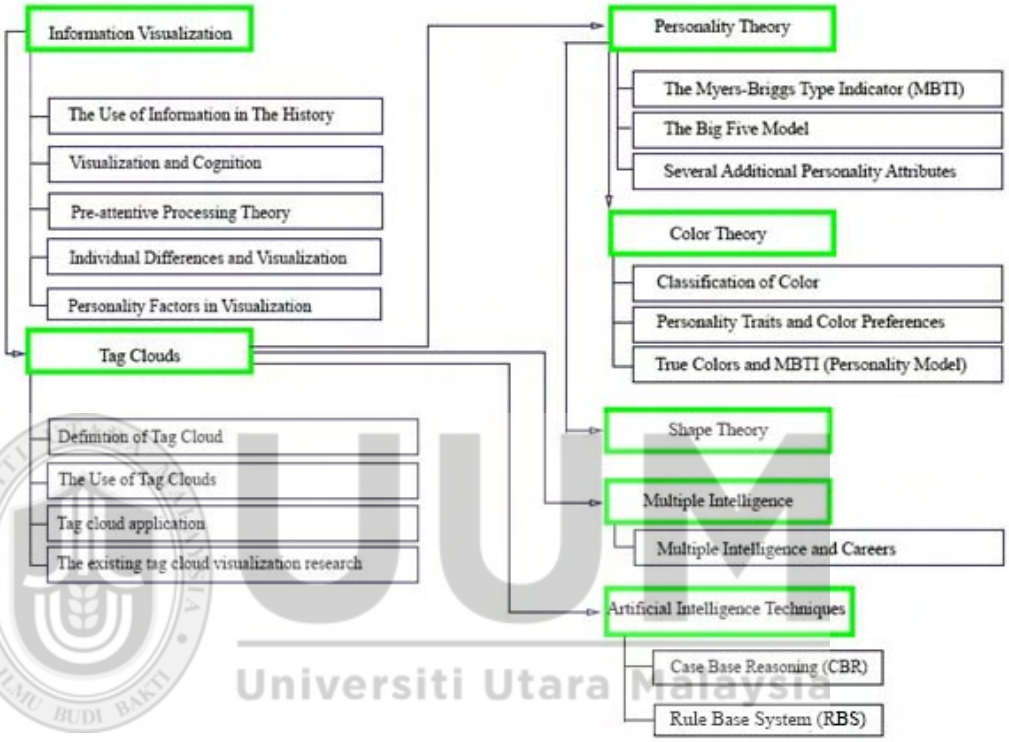


Figure 2.21. Overview of Literature Study

CHAPTER THREE
RESEARCH METHODOLOGY

3.1 Introduction

This chapter explains the systematic processes in order to accomplish the objectives in this study. By adapting design science research information system, the processes are used as the methodological approach. The details of each phase are elaborated in this chapter.

3.2 Design Science Research

Design activities are central to most applied disciplines. Research in design has a long history in many fields including architecture, engineering, education, psychology, and the fine arts (Cross, 2001). The design science research paradigm is highly relevant to information systems (IS) research because it directly addresses two of the key issues of the discipline: the central, albeit controversial, role of the IT artifact in IS research (Orlikowski & Iacono, 2001).

Design science as conceptualized by Simon (1996), supports a pragmatic research paradigm that calls for the creation of innovative artifacts to solve real-world problems. Thus, design science research combines a focus on the IT artifact with a high priority on relevance in the application domain. In addition, Norshuhada and Shahizan (2010) state that the valid artifacts in design science research could be in form of: algorithm, working prototype, user interfaces, processes, techniques, methodologies and frameworks. As mention in chapter one, the result of this study is a form of artifact, which is algorithm. Therefore, the design science research as the selected approach is appropriate in this research.

Design science research (DSR) is one of the research paradigms that creates and evaluates IT artifacts proposed to solve identified organizational problems. Such artifacts are represented in a structured form that may vary from software, formal logic, and rigorous mathematics to informal natural language descriptions. There are roots in engineering and the sciences of the artificial of the design-science paradigm (Simon, 1996). It is fundamentally a problem-solving paradigm. The idea is to create innovations through the analysis, design, implementation, management, and use of information systems that describe the ideas, practices, technical capabilities, and products that able to be effectively and efficiently accomplished (Denning 1997; Tsichritzis 1998).

Norsuhada and Shahizan (2010) stress that design research is based on Iterative Triangulation Methodology (ITM), where theoretical, development and empirical aspects of research are triangulated to achieve the design research objectives. Many researchers have suggested an appropriate process in design science research. Peffers et al. (2007) reviewed and evaluated the process for conducting design science research in information systems. Hevner, March, Park, and Ram (2004) also suggested seven steps guidelines for design science research processes. However, the design science research in this study adapts from the proposed guidelines by Offermann, Levina, Schönherr, and Bub (2009). The reason is because this design science research has advantage in terms of research processes, it has more detailed step by step research process than the other suggestion processes in design science research (Mahfuzah, 2011).

3.3 Research Methodology Phases

This study is conducted through three phases as proposed by Offermann et al. (2009): (1) problem identification, (2) solution design and (3) evaluation. The Figure 3.1 depicts the activities, which are involved in each phase. The involved steps or activities in this study are conducted iteratively in order to get better outcome especially the algorithm construction.

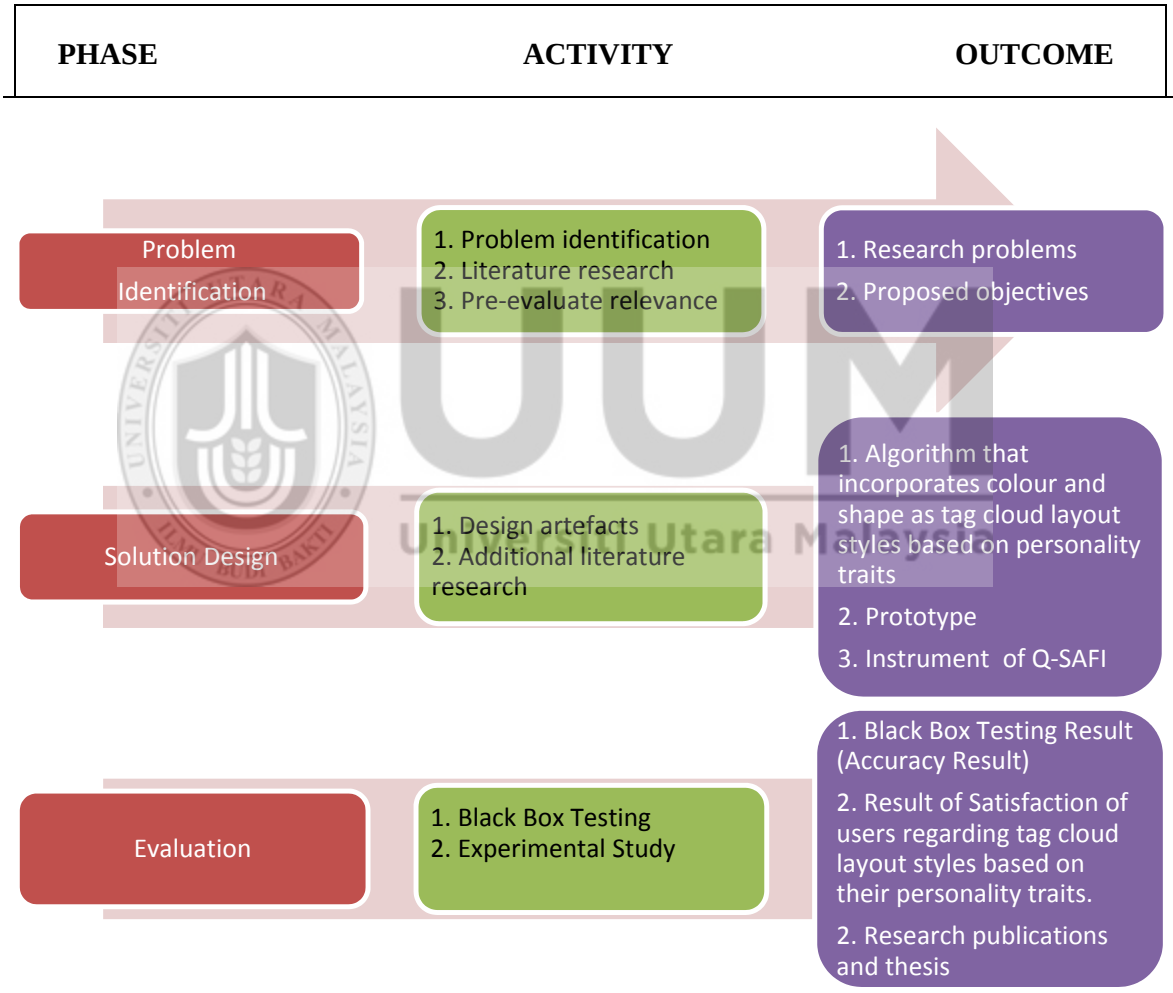


Figure 3.1. Phases in the Research Process

3.4 Phase 1: Problem Identification

The first and foremost phase of this study is problem identified. In this phase, the following steps are involved: (1) identify the problem, (2) literature research, (3) pre-evaluate relevance. In this study, in order to verify the research gaps, the steps: 2, 3, are performed iteratively. Then, the identified research problems are described as well as the proposed solution towards the problem. The detailed of each step is elaborated further in the next sub-section.

3.4.1 Identify Research Gap

In order to identify research gaps and then come out with problem statement, Norshuhada and Shahizan (2010) emphasize a systematic and critical literature review process must be performed. In other words, the organized literature research could assist the researchers to find their problem statement through a number of gaps. Moreover, they also suggest that the worthy research gaps should have several criteria, which are:

- Justify the research.
- Provide the rationale for the research.
- Allow researchers to establish the conceptual framework and methodological focus.
- Provide conceptual and theoretical context in which topic can be situated.
- Point out major flaws in previous research.
- Outline issues pertinent to future study.
- Shape problem statements and questions.

3.4.2 Literature Research

As mentioned previously, literature research could assist researchers to find their problem statement. In this study, the related literature is organized and collected, namely visualization information theory, personality theory, tag cloud, color and shapes related to personality types, Multiple Intelligence theory, the review of CBR technique and RBS technique. These collections in this step are reviewed through content and comparative analysis. As a result, this step assists researchers to identify the differences or indicate contradiction, highlight lacking of information in previous study and so forth (Norshuhada & Shahizan, 2010). This is organized and useful for strengthening the problem statement given.

3.4.3 Pre-evaluate Relevance

After identifying the statement of problem, research questions are formed. A research question is a way of researchers to express an interest towards problem or phenomenon (Boudah, 2010). Identifying a good research question will prepare greater focus to research elucidate the direction of investigation (Boudah, 2010). In addition, a good research question should have several criteria: specificity and answerability; scale and scope in relation to available resources and time; being clear and concise (Norshuhada & Shahizan, 2010). In this study, a number of research questions (RQ) were formed:

1. What is the appropriate combination of color and shape for algorithm used to develop tag cloud layout styles based on the personality traits of users?
2. How satisfied is the produced tag cloud layout styles that is generated from the proposed algorithm to the users?

3.5 Phase 2: Solution Design

This second phase is about the solution design towards the identified problems, which were reviewed in the first phase. This phase consists of two main steps: (1) design artifacts and (2) additional literature research. All related literatures are taken into account in order to provide the solution in this phase. The outcome in this phase is the algorithm that incorporates color and shape as tag cloud layout styles. This algorithm is designed as an achievement to objective 1 (refer to chapter 1). The detail information of each step in this phase is elaborated further in the next sub-sections.

3.5.1 Design artifacts

In this activity, there are several methods that are used, namely, content analysis and comparative study. Designing artifacts is done iteratively. Thus, it will produce the generated artifact design that will be revised if necessary.

3.5.1.1 Algorithm Construction

In order to accomplish the main objective in this study, an algorithm is constructed. In general, algorithm is sequential logical step that could be utilized by computer in order to solve the problem (Lee & Lu, 2009). Meanwhile, according to Kowalski (1979) algorithm can be defined as combination of logic component and control component that use knowledge strategy to be determined in order to solve problems. In another definition, algorithm could be defined as a set of procedures which is provided sequentially as problem solution (Daviduck, 2009). A simple example that could describe the form of algorithm in daily life is recipe in a cookbook (Daviduck,

2009). The recipe contains procedure systematically how to cook, including requirements such as a number of ingredients to cook a dish.

In computer, the form of algorithm is interpreted as a program that encompasses a set of procedure for achieving problem solution. The effectiveness of using algorithm is characterized by the conveyance the algorithm itself into computer code (program) which is in the form of commands that similarly represent processes in algorithm (Daviduck, 2009).

In this section, the content analysis and comparative analysis are involved in order to identify the important components of personality traits to provide potential solutions for achieving objectives of this study. According to Yi (2012), in understanding the individual differences especially personality traits must be derived from literature of study especially in psychology perspective. In other words, this leads to identifying towards what kind of personality traits that are mostly related to visual properties (colors and shapes). This is because, not all personality traits have relationship towards these visual properties.

Then, the identified personality traits as well as the result of colors and shapes are stored into knowledge database as bunch of rules that are useful in this study. The database contains of possibilities of results to determine what kind of colors and shapes to be displayed. In order to analyze this database, an approach must be utilized, so that the expected result could be fulfilled. Therefore, as mentioned in chapter two, the use RBS is implemented. This technique uses “if-then” statement to constructing rules between personality traits and different colors and shapes as the outcomes solution. The rules are created based on gathering facts or knowledge that are from collection of colors and shapes theory.

The identified findings from all the previous mentioned activities are integrated into the algorithm. The proposed algorithm is then produced at the end as an outcome through a number of series of systematic investigations. The algorithm itself has some forms before interpreted to source code programming or to be implemented, which are Flowcharts and Pseudocode.

3.5.1.1.1 Flowcharts

Flowchart is a diagram that contains graphics symbols (such as boxes, diamonds and other shapes) in which each shape displays step and sequence of process, and how they are connected each other. Flowchart shows the combination of symbols and arrow line represents the operation of algorithm. The examples of flowchart can be seen in Figure 3.3.

3.5.1.1.2 Pseudocode

Pseudocode is one of the tools that can be used for writing prefix plan before computer program is constructed. Pseudocode is written in a way similar with real programming code, but it is a model that cannot be executed on a real computer (Horowitz, Sahni, & Rajasekaran, 1997). The pseudocode is written in various forms, which mostly resemble to famous code programming (such as C, Lips, or FORTRAN). In addition, many languages (such as PASCAL) have similar way of writing with pseudocode and therefore make it easier for translation from design form into the real programming code. This following example (see Figure 3.2) displays pseudocode that exhibits algorithm to calculate the average number of six.

```
Start
Get the sum
Average = sum / 6
Output the average
Stop
```

Figure 3.2. Pseudocode for displaying result of average six

While, the correspondence flowchart will be displayed as follows (see Figure 3.3):

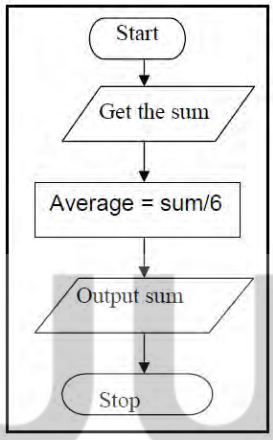


Figure 3.3. The flowchart from algorithm average of number six

Another example depicts the pseudocode of algorithm that displays selection structure that presents two alternative selections (see Figure 3.4).

```
If condition is true
    Then do task A
else
    Do Task-B
```

Figure 3.4. Pseudocode for alternative condition of selection structure

Then, the flowchart of this pseudocode is as shown in Figure 3.5.

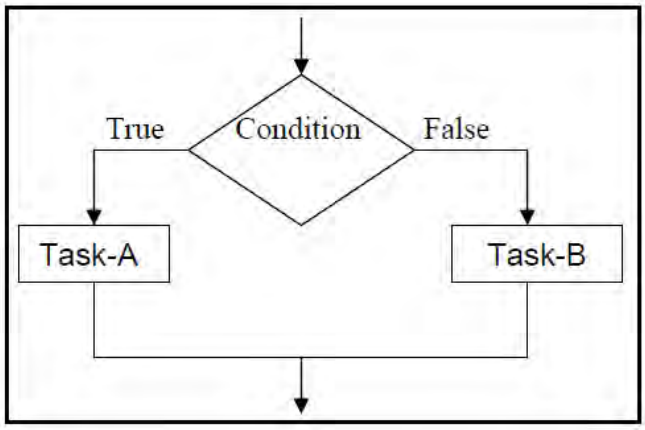


Figure 3.5. Flowchart of algorithm for two alternative conditions

3.5.1.2 Prototyping

In order to test the algorithm a prototype as another artifact is then constructed in this study. Particularly, the algorithm will be tested in order to measure the satisfaction of end-users (i.e the participants) upon the styles of tag clouds display. Prototyping is the way to interpret the system specification into an actual outcome, in attempting to obtain users' feedback (Dix, Finlay, & Abowd, 2004). The prototype is built as a case study in youth career recommendation system. In brief, the prototype uses Multiple Intelligence (MI) theory (refer to section 2.8) to produce the career results as recommendation towards users. Youth career recommendation is opted as a case study due to the needs of such system in assisting youth to make decision in their crucial age stage.

3.5.1.3 Instrument Design

As mention in the previous section, in the evaluation phase, data are gathered from the participants to measure their satisfaction towards the suggested tag cloud layout style. Thus, an instrument is constructed in the study called Q-SAFI (Questionnaire

of Satisfaction) (see appendix C). The construction of Q-SAFI is adapted from USE Questionnaire (Lund, 2001). The USE stands for Usefulness, Satisfaction, and Ease of use. Meanwhile, this study just focuses on satisfaction part as the second objective; therefore, the adaption of the satisfaction section only of USE is taken. Then, this Q-SAFI questionnaire has three dimensions, which are included as the satisfaction measurement, which are satisfaction in terms of overall tag cloud layout styles, satisfaction in terms of tag cloud color, and satisfaction in terms of tag cloud shape.

The overall tag cloud layout styles element consists of 7 items, which labeled as AQ1, AQ2, AQ3, AQ4, AQ5, AQ6, and AQ7. Meanwhile, the color dimension has 6 items, which are BQ1, BQ2, BQ3, BQ4, BQ5, and BQ6. Last, the shape dimension also has 6 items, namely CQ1, CQ2, CQ3, CQ4, CQ5, and CQ6. The table 3.1 shows each item in the questionnaire.

Table 3.1

Items for Satisfaction Evaluation

Labels	Items
Dimension 1: Satisfaction in terms of overall layout	
AQ1	The design of tag cloud is really attractive
AQ2	After viewing the figure I would recommend it to my friend
AQ3	The design of the tag cloud triggers my imagination
AQ4	The combination of color and outlook is wonderful
AQ5	After viewing it for the first time, I hope to see it for the second time
AQ6	The figure appears pleasant to my eyes
AQ7	Overall I am satisfied with the design of tag cloud
Dimension 2: Satisfaction in terms of color	
BQ1	The color of tag cloud soothes my mind
BQ2	I feel comfortable with the color of the tag cloud

BQ3	The color of tag cloud is nice to the eyes
BQ4	The color of tag cloud does not make my reading stressful
BQ5	The color of the tag cloud stimulates me to read further into it
BQ6	Overall I am really satisfied with the color of the tag cloud
Dimension 3: Satisfaction in terms of shape	
CQ1	I am not stressful when looking at the shape of the tag cloud
CQ2	The shape of tag cloud is nice to the eyes
CQ3	The shape of the tag cloud excites me to read further into it
CQ4	The shape of the tag cloud makes my mind calm
CQ5	The shape of the tag cloud makes me feel comfortable
CQ6	Overall I am really satisfied with the shape of the tag cloud

3.5.1.3.1 Reliability

According to Bollen (1990) and van Teijlingen and Hundley (2002), the reliability of a measuring instrument is the degree of consistency of the measurement. In sum, reliability is the extent to which measurements are repeatable or the stability of measurement over a variety of condition in which fundamentally the same results should be obtained. Consequently, the reliability test must be conducted towards questionnaire (Q-SAFI) in order to check its consistency. The indication to see the reliability can be known from the value of Cronbach coefficient alpha to be computed (Sekaran, 2003).

In order to establish the reliability of the questionnaire, a pilot study was conducted on 30 respondents. The number of 30 is adequate to gain reliable result in statistical test (Sekaran, 2003). The respondents age range from 18 to 25 years old. This is because of the prototype that was tested as explained previously is from youth community. The result obtained of the reliability of the questionnaire can be seen in the following table (see table 3.2).

Table 3.2

Summary of Reliability of Q-SAFI Questionnaire

Name of Questionnaire	Dimension	Item	Mean	Cronbach's Alpha
Satisfaction	Layout	AQ1	5.000	.965
		AQ2	4.477	
		AQ3	4.577	
		AQ4	4.600	
		AQ5	4.700	
		AQ6	4.933	
		AQ7	5.033	
	Color	BQ1	5.077	.962
		BQ2	5.177	
		BQ3	5.033	
		BQ4	4.977	
		BQ5	5.233	
		BQ6	5.100	
	Shape	CQ1	5.077	.956
		CQ2	5.033	
		CQ3	4.733	
		CQ4	4.833	
		CQ5	4.977	
		CQ6	5.300	
Average of All Items				.986

Refer to Appendix D for Pilot tested version Q-SAFI

As can be seen it table 3.2, all values of the cronbach's alpha for all dimensions are more than 0.7. These results show that the items were consistent (Field, 2009). Therefore, this measurement is able to be used for data collection in this study.

3.5.2 Additional Literature Research

This additional literature research here means that all related reviews are provided in order to support the algorithm, which is produced in the study. In other words, the reviewed related literature is used to give tangible evidences of the proposed solutions.

3.6 Phase 3: Evaluation

Evaluation phase is the last phase in the study. Offermann et al. (2009) stated that the evaluation could be started after the solution phase is adequate. There are two steps included in this phase, namely, black box testing and experimental study. The black box testing is conducted in order to measure the accuracy of expected result based on particular personality types of user (chapter 5 will detail this process). Then, after that, the experimental study could be performed as fulfillment upon second objective in this study.

3.6.1 Experimental Studies

Offermann et al. (2009) explain that experimental study is a way to evaluate research that can be performed either in laboratory or field experiments. In this study, the experiment is performed in the laboratory. The experimental study started by asking participants, who are youth aged 18 to 25, to operate the prototype with the youth career recommendation (YouthComPDA) case study installed at their own pace. The prototype consists of Multiple Intelligence Test (See Appendix A) and Personality Test of MBTI (See Appendix B). The multiple intelligence theory is used in order to extract on which prominent intelligence that the user has, and then it will be related to user's career. Then, the prototype will show result of the career recommendation in tag cloud visualization layout most suited to the participants based on personality traits theory (chapter 5 details this process).

To ascertain whether the displayed layout is the preferred choice, the prototype also displays the other tag clouds layout styles. At the end of the session, the participants were asked to fill up the given questionnaire (Q-SAFI). The Q-SAFI is built in English language only; therefore, the respondents were asked their understanding of

each question before fulfilling the questionnaire. Once the respondents understand the all questions, they are allowed to fill up the questionnaire.

3.6.1.1 Sampling

Sampling can be defined as the process to select appropriate number of respondents from population in order to generalize accurate properties or characteristic of the right element (Sekaran, 2006). Accordingly, convenience sampling was used, in which the responses were attained from any members of the population who are conveniently available to provide it (Bougie & Sekaran, 2010). In addition, Roscoe (1975) stated that in order to determine the sample size, the following rules of thumb could be used:

i. Sample sizes larger than 30 and less than 500 are appropriate for most research.
ii. For simple experimental research with tight experimental controls, successful research is possible with samples as small as 10 to 20 in size.

Therefore, overall this study managed to gather 30 responses in measuring the satisfaction of tag cloud layout styles as fulfillment of second objective in this study through application built in this research. The time usage to fulfill all the requirements (fill questionnaire MI and MBTI) in application is 30 until 40 minutes. The experiment was conducted at October 2014.

3.6.2 Data Analysis

Data analysis results are the evidence to prove each finding in this study. In this study, descriptive analysis feature from SPPS was used in order to see the general

findings in the experimental study. The satisfaction dimension is measured based on the descriptive analysis of frequency. SPSS Version 22 was used as a tool in analyzing the data and producing the visual representation of the analyzed data.

3.7 Summary

Three main phases created by Offermann et al. (2009) together with Dix et al. (2004) processes were involved in this study. Problem identification, solution design and evaluation phase were executed accordingly to ensure the realism of the expected outcomes. The major phases included algorithm development, prototype construction, black box testing and an experimental study.

CHAPTER FOUR
DEVELOPMENT OF ALGORITHM AND PROTOTYPE

4.1 Overview

The construction of algorithm and prototype are described in this chapter. Therefore, the identified colors and shapes, which have been discussed in chapter 2, are incorporated as main elements of algorithm in this study. Furthermore, RBS was utilized to integrate those elements. Generally, four main activities were performed. The figure 4.1 exhibits the summary of the activities before constructing algorithm.

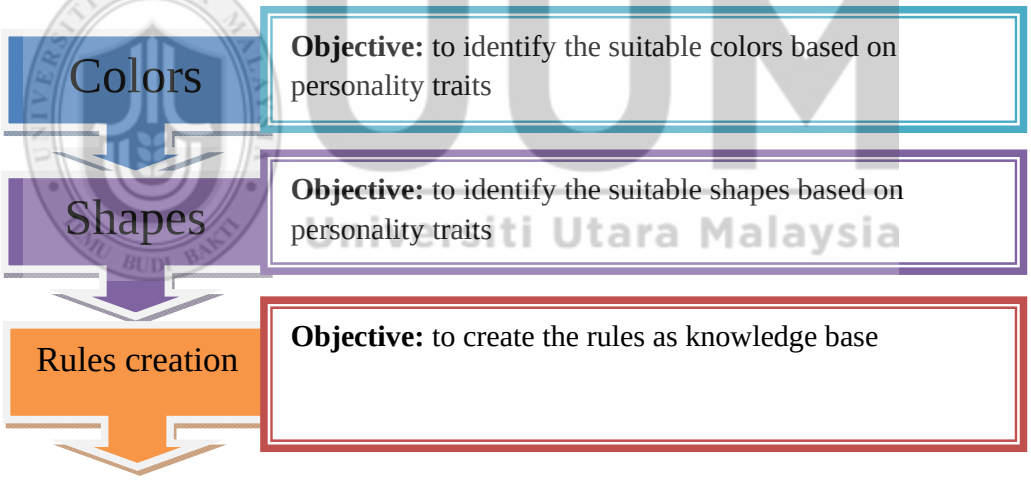


Figure 4.1. Summary of activities in constructing the algorithm of tag cloud layout

4.2 Colors for Algorithm of Tag Cloud Layout

In brief, the literature review about correlation between colors and people preferences has been discussed in chapter 2. The theory that was used in this research is Lowry True color theory. True color is a model that could categorize people into four primary colors (Orange, Gold, Green and Blue) (Miscisin, 2001).

This theory has a clear correlation between elements that are included in MBTI assessment for each color (Cooper, 2009; Honaker, 2001). Whichard and Trainer (2006) also confirmed that MBTI and True Color have really strong relationship in which the findings from their research showed that the correlation coefficient for all relationship based on the statistical analysis of 132 respondents is close to 1.00 (see Table 4.1).

Table 4.1

Relationship of the MBTI and True Colors (n=132)

Myers-Briggs MBTI	**SP** (Sensing-Perceiving) **Perceptive**	**SJ** (Sensing-Judging) **Judging**	**NT** (Intuition-Thinking) **Thinking**	**NF** (Intuition-Feeling) **Feeling**
Lowry True Colors	Orange	Gold	Green	Blue
Correlation Coefficient	*.751	*.776	*.861	*.834

As a result, each color represents four types from MBTI personality types. Essentially, the MBTI personality tool divides 16 personality types based on 4 basic scales, which can be seen in the following figure (see Figure 4.2). The first scale is Extrovert (E) – Introvert (I), the second scale is Intuition (N) – Sensing (S), the third scale is Thinking (T) – Feeling (F), and the forth scale is Judging (J) – Perceiving (P). In true color theory, the 16 personality traits are categorized into 4 groups. Figure 4.3 depicts the division of 16 personality types of MBTI within the True color theory.

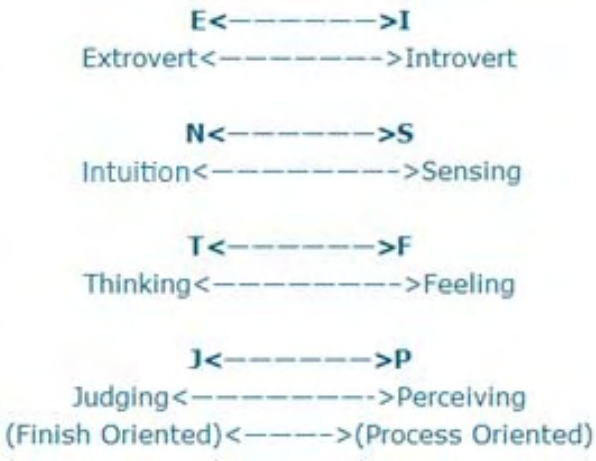


Figure 4.2. Four Scales of the MBTI personality assessment

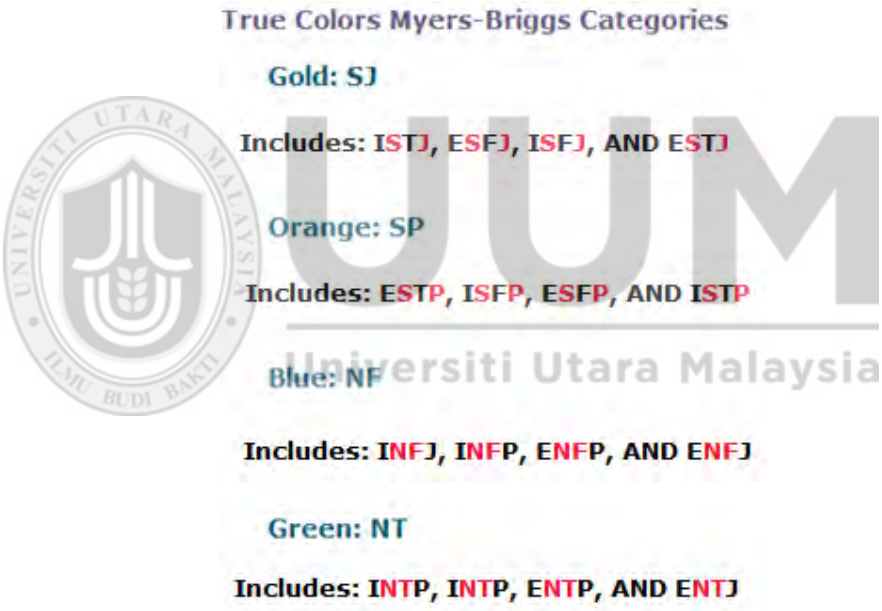


Figure 4.3. True color and the MBTI elements (Honaker, 2001)

As can be seen in figure 4.3, each color has similarity in two MBTI elements. For instances, gold color represents two elements: sensing (S) and judging (J). In other words, four personality types which are grouped in this color have similarity in two elements. The same things apply on the other colors, Orange (SP) = sensing and

perceiving, Blue (NF) = Intuition and feeling, Green (NT) = Intuition and thinking. These similarities will be constructed as the rules that are used for determining the appropiate colors for different two element combinations.

Other rules that will be implemented is from the first scale (Extrovert (E) – Introvert (I)). Based on visualization studies, extroverts tend to choose brighter colors, whereby introverts choose lighter color (pale color) (Petrovici, 2013; Rider, 2010). This is also aligned with Karsvall (2002) that describes extroverted is categorized as higher contrast color (saturated color), whereby introvert prefer lower contrast or desaturated color. Accordingly, this scale (extrovert (E) and introvert (I)) is relavant to saturated and desaturated color. Therefore, this leads to be part of knowledge based in this study.

4.3 Shapes for Algorithm of Tag Cloud Layout

Based on literature, in order to identify the appropriate shapes that will be utilized based on personality traits; the theory called "Psycho-Geometrics" is provided. The shapes consist of rectangle, triangle, box, circle, and zigzag.

The shapes are correlated to Carl Jung's on MBTI model. The elements of MBTI, which relate to these shapes, are depicted in the following figure 4.4.

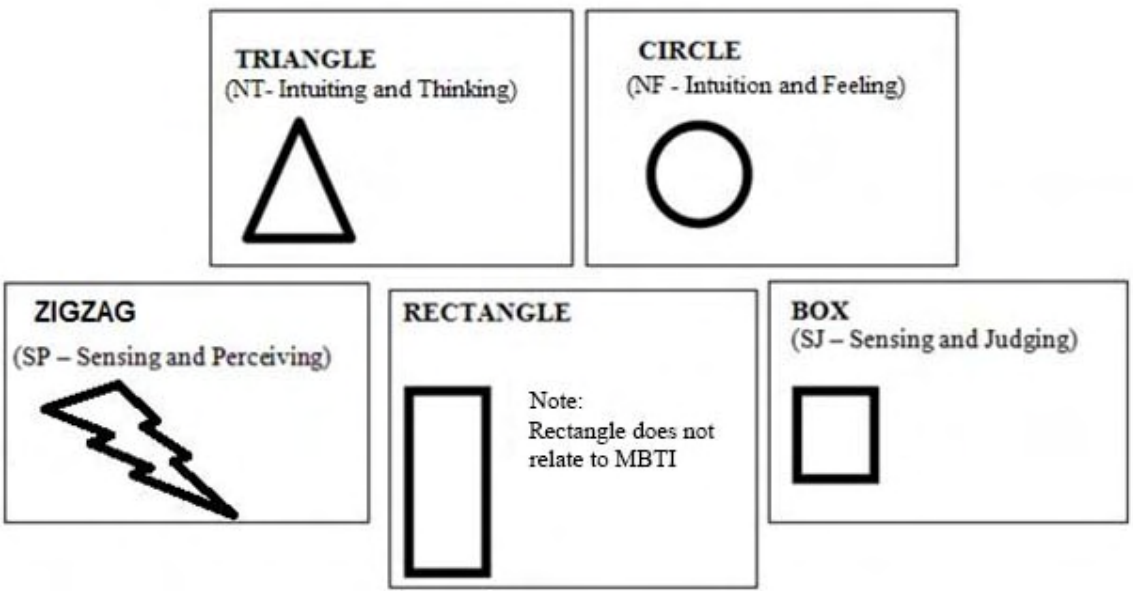


Figure 4.4. Psycho-Geometrics personality assessment tool (Dellinger, 1996)

These shapes are considered as the layout that makes tag cloud visuzalization display. However, not all shapes are implemented in this study. The rectangle is not used since the shape does not have relation with MBTI element types (Dellinger, 1996).

4.4 Rule Construction Algorithm of Tag Cloud Layout

The rules must be established prior to construction of the algorithm is executed. This is because knowledge based on a forward chaining system requires appropriate rules, so that the desired result is achieved. But first, note the rules that will be established are the result of observation of the facts that have been discussed previously (the relationship between visual properties (color and shape) and the MBTI elements). Thus, these facts are combined to form a knowledge base which will be useful in the manufacture of the algorithm in this study. The processes in which the rules are made are discussed in this section.

First of all, the MBTI personality questionnaire as a measuring tool to detect what is the most prominent component of each user should be prepared. Thus, there are 4 basic scales range that will be included in the knowledge base, namely (Extrovert (E) – Introvert (I), Sensing(S) - Intuition (N), Thinking(T) - Feeling(F), and Judging(J) - Perceiving(P)). The MBTI questionnaire consists of 32 questions. Based on the questionnaire, the rules to determine which elements are most prominent in each dimension can be determined from the scores that are calculated.

Accordingly, comparisons can be made with the condition in which the greatest element in each dimension will be defined as a personality element that is owned by that user. For example, in the scale of (sensing(S) - intuition(N)), if S is greater than N, then the user is categorized as a sensing(S) type and vice versa. This condition is also applied to the other scales. These facts will be converted into a form of rules (if-then) statement as a knowledge base. The following rules show eight rules that are made to determine the personality trait for each scale:

- **#Rule 1 (R1):** IF Extrovert(E) > Introvert(I) THEN Extrovert(E)
- **#Rule 2 (R2):** IF Introvert(I) > Extrovert(E) THEN Introvert(I)
- **#Rule 3 (R3):** IF Sensing(S) > Intuition(N) THEN Sensing(S)
- **#Rule 4 (R4):** IF Intuition(N) > Sensing(S) THEN Intuition(N)
- **#Rule 5 (R5):** IF Thinking(T) > Feeling(F) THEN Thinking(T)
- **#Rule 6 (R6):** IF Feeling(F) > Thinking(T) THEN Feeling(F)
- **#Rule 7 (R7):** IF Judging(J) > Perceiving(P) THEN Judging(J)
- **#Rule 8 (R8):** IF Perceiving(P) > Judging(J) THEN Perceiving(P)

Then, the next step is to construct the other rules in which they are related to the fact of aforementioned explanation (color and shape based on personality). It can be seen

that the relationship between personality elements and visual properties (color and shape) are directly proposional each other (see Figure 4.3 and 4.4). For example, the green color is from two personality elements (Intuition (N) and Thinking (T)) in MBTI elements, and also the triangle shape is represented from those two elements. This relationship is also supported by Teriyaki (2010) that stated each color of True Color theory is equivalent to each shape in the Psycho-Geometrics theory. The table 4.2 displays the equivalency of one another.

Table 4.2

Relationship of three components (Personality Element, Color, and Shape

No	**Personality Element**	**Color**	**Shape**
1	Intuition (N) and Thinking (T)	Green	Triangle
2	Sensing (S) and Judging (J)	Gold	Square
3	Intuition (N) and Feeling (F)	Blue	Circle
4	Sensing (S) and Perceiving (P)	Orange	ZigZag

(Honaker, 2001; Teriyaki, 2010)

These relationships could be converted into other rules in this study. Thus, the other rules will be:

- **#Rule 9 (R9):** IF Intuition (N) and Thinking (T) THEN Green
- **#Rule 10 (R10):** IF Green THEN Triangle
- **#Rule 11 (R11):** IF Sensing (S) and Judging (J) THEN Gold
- **#Rule 12 (R12):** IF Gold THEN Square
- **#Rule 13 (R13):** IF Intuition (N) and Feeling (F) THEN Blue

- **#Rule 14 (R14):** IF Blue THEN Circle
- **#Rule 15 (R15):** IF Sensing (S) and Perceiving (P) THEN Orange
- **#Rule 16 (R16):** IF Orange THEN ZigZag

As discussed earlier, the color corresponds toward brigther of softer color that pertains to the first scale which is Extrovert (E) and Introvert (I). In other word, the saturation and desaturation of color are taken into account in the next rules as follow:

- **#Rule 17 (R17):** IF Orange and Extrovert (E) THEN Saturated Orange
- **#Rule 18 (R18):** IF Orange and Introvert (I) THEN Desaturated Orange
- **#Rule 19 (R19):** IF Green and Extrovert (E) THEN Saturated Green
- **#Rule 20 (R20):** IF Green and Introvert (I) THEN Desaturated Green
- **#Rule 21 (R21):** IF Blue and Extrovert (E) THEN Saturated Blue
- **#Rule 22 (R22):** IF Blue and Introvert (I) THEN Desaturated Blue
- **#Rule 23 (R23):** IF Gold and Extrovert (E) THEN Saturated Gold
- **#Rule 24 (R24):** IF Gold and Introvert (I) THEN Desaturated Gold

So in the end, these rules can be formed into a forward chaining graph, as illustrated in the following figure (see Figure 4.5).

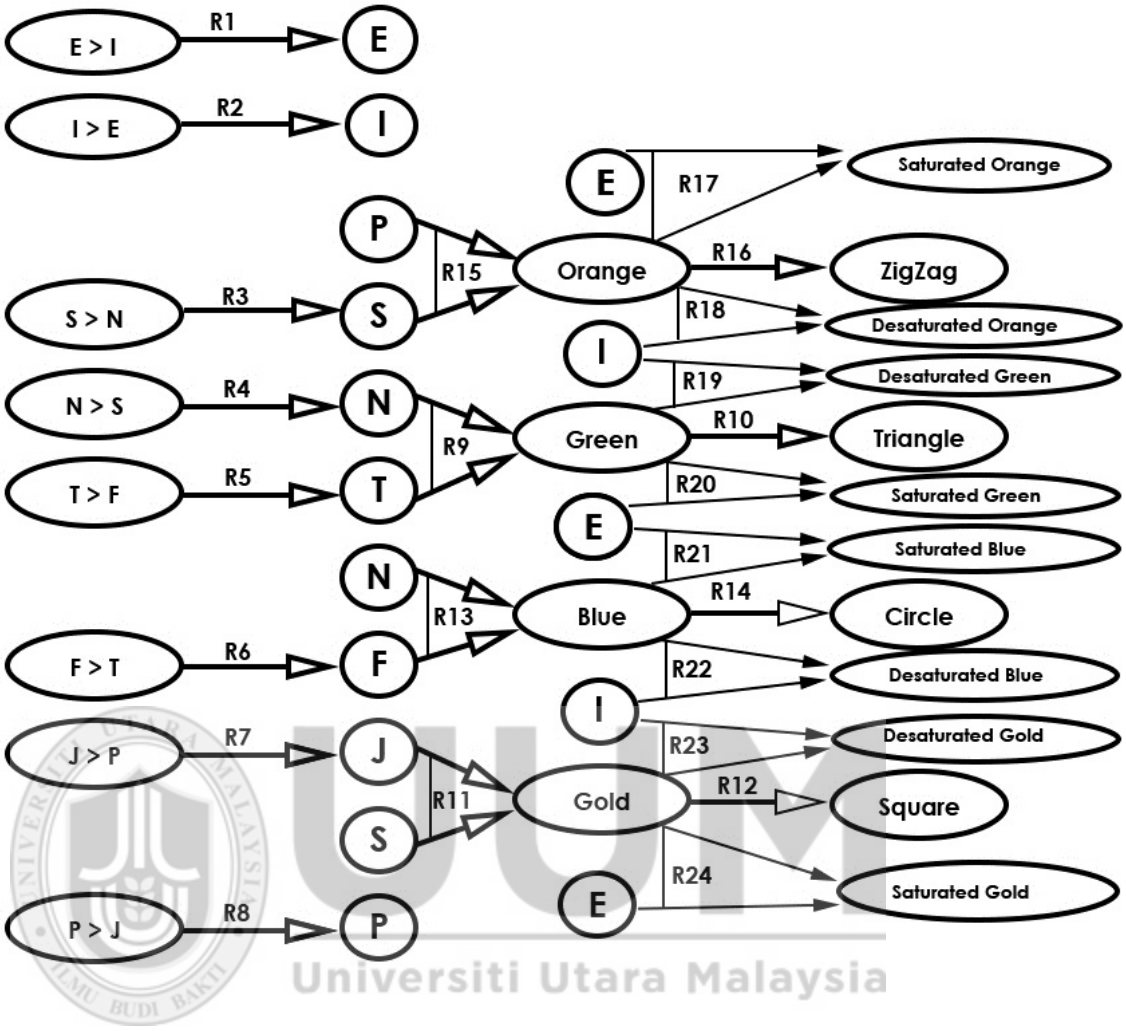


Figure 4.5. Forward Chaining of the rules

Note: Extrovert (E), Introvert (I), Sensing (S), Intuition (N), Thinking (T), Feeling (F), Judging (J), and Perceiving (P).

4.5 The Proposed Tag Cloud Layout Algorithm Based on Personality Traits

In general, the proposed tag cloud layout algorithm based on personality consists of knowledge base, which is supported by color and shape theory that have relation towards personality traits in MBTI elements. As described previously to implement forward chaining algorithm there are two main databases, namely facts and knowledge base. In this research, the facts are obtained from asking user through

personality test, and then the personality elements of user are stored into database. Meanwhile, another database, which contains knowledge base, is provided as part of algorithm rather than to separate it as new database. This is another possible way to implement forward chaining method. In other words, the sequences of rules are written in algorithm, so that inferences could be simpler to be implemented. As consequences, the way the sequences of rules ordered in line of algorithm must be in suitable order based on the map that has been depicted in Figure 4.5; otherwise, the related rules could not be reached the desired goals or conclusions. Therefore, the forward chaining approached, which is sketched in Figure 4.5, is converted into the form of pseudocode algorithms type.

Algorithm (Pseudocode Type)

```
================================================
======
Start

StartPersonalityTest

Calculate E
Calculate I
Calculate S
Calculate N
Calculate T
Calculate F
Calculate J
Calculate P

Get E
Get I
Get S
Get N
Get T
Get F
Get J
Get P

If E > I Then
    Personality1 = 'E'
```

```
else
    Personality1 = 'I'
If S > N Then
    Personality2 = 'S'
else
    Personality2 = 'N'
If T > F Then
    Personality3 = 'T'
else
    Personality3 = 'F'
If J > P Then
    Personality4 = 'J'
else
    Personality4 = 'P'

If Personality2 = 'S' and Personality4 = 'P' Then
    Color = 'Orange'
If Personality2 = 'N' and Personality3 = 'T' Then
    Color = 'Green'
If Personality2 = 'N' and Personality3 = 'F' Then
    Color = 'Blue
If Personality2 = 'S' and Personality4 = 'J' Then
    Color = 'Gold


If Color = 'Orange' Then
    Shape = 'ZigZag'
If Color = 'Green' Then
    Shape = 'Triangle'
If Color = 'Blue' Then
    Shape = 'Circle'
If Color = 'Gold' Then
    Shape = 'Square'

If Color = 'Orange' and Personality1 = 'E' Then
   Color = 'Saturated Orange'
If Color = 'Orange' and Personality1 = 'I' Then
  Color = 'Desaturated Orange'
If Color = 'Green' and Personality1 = 'E' Then
 Color = 'Saturated Green'
If Color = 'Green' and Personality1 = 'I' Then
  Color = 'Desaturated Green'
If Color = 'Blue' and Personality1 = 'E' Then
 Color = 'Saturated Blue
If Color = 'Blue and Personality1 = 'I' Then
  Color = 'Desaturated Blue'
If Color = 'Gold' and Personality1 = 'E' Then
  Color = 'Saturated Gold'
If Color = 'Gold' and Personality1 = 'I' Then
 Color = 'Desaturated Gold'
```

Get Color
Get Shape

Set Layout Color
Set Layout Shape

ShowTheLayout

Stop

==========

======

Note:

E = Extrovert Element

I = Introvert Element

S = Sensing Element

N = Intuition Element

T = Thinking Element

F = Feeling Element

J = Judging Element

P = Perceiving Element

Personality1 = the basic scale of Extrovert (E) – Introvert (I)

Personality2 = the basic scale of Sensing (S) – Intuition (N)

Personality3 = the basic scale of Thinking (T) – Feeling (F)

Personality4 = the basic scale of Judging (J) – Perceiving (P)

4.6 Prototyping of Tag Cloud Algorithm

As aforementioned in chapter three (research methodology), in order to fulfill the second objective in this study, the prototyping is built as another artifact. The second objective is to test the proposed algorithm to determine the appropriate styles of tag

cloud layout styles of particular user. Therefore, in doing so, the application is established. The application is constructed as form of illustration towards proposed tag cloud layout algorithm. As mentioned in chapter three also, the illustration of application is applied in a case study in youth career recommendation. Before discussing about the design and development of application, it is imperative to discuss the career recommendation case study in the following subsection.

4.6.1 Case Study: Youth Career Recommendation

It is important for youth to have guidelines in order to make decision towards their career. By having certain guideline, they are able to make critical decision in the future. In addition, it will affect towards their future as well as the development of country. The reason why is that because youth community has significant role to determine the status achievement of developed country.

However, in fact generally in order to make decision, youth still typically ask their family or friend to get the decision. As a result, in some cases this can cause indecisions matter among youth (Khasmohammadi, Noah, Kadir, Baba, & Keshavarz, 2010). Moreover, the bad decision among youth could also happen because of lack of particular information towards critical options that they commit with (Abbas, Hoffmann, Howard, & Spetzler, 2007).

4.6.2 Design and Development of Application

The design and development of application in this study employs java language programming, which uses NetBeans software IDE 7.3. This NetBeans Platform is based on software from netbeans.org, which has been dual licensed under the

Common Development and Distribution License (CDDL) and the GNU General Public License version 2 with Classpath exception.

The establishment of application is as desktop user interface platform, which means the sources of form components (such as, button, radio button, pull down, text field, image graphic, etc) are readily available in NetBeans IDE software. Also, this application is equipped with database software as well in which it uses SQL language (Xampp v1.8.1 for Windows).

4.6.2.1 Flow Chart of Youth Career Recommendation Application

In this section, the illustration in the following figure 4.6 depicts the flow of the processes in the system. The first process starts by login to the system. Afterward, the following step is to validate the registration in order to check whether a user has registered or not. If a user has registered, the user is able to log in into the system, whereby if not, then a user goes to sign up process to fulfill the required information.

After a user has logged in to the system, the next process is to fill out a profile form. Next step is to answer MI test. The MI test is constructed with checklist style form and has 80 checklist questions. After clicking the finish button in the form, the system will then automatically calculate the result and it will be stored into a database. The next sequence goes to fulfilling personality test (MBTI questionnaire). This MBTI test is built in radio button design style, which has 32 radio-button group questions. Then, as been portrayed in the figure, the following process goes to calculating the personality types. This process yields calculation results for each element of MBTI personality elements. This output is then used in another following

process, which is determining tag cloud layout style. In other words, the proposed algorithm of tag cloud layout based on personality is included in this process.

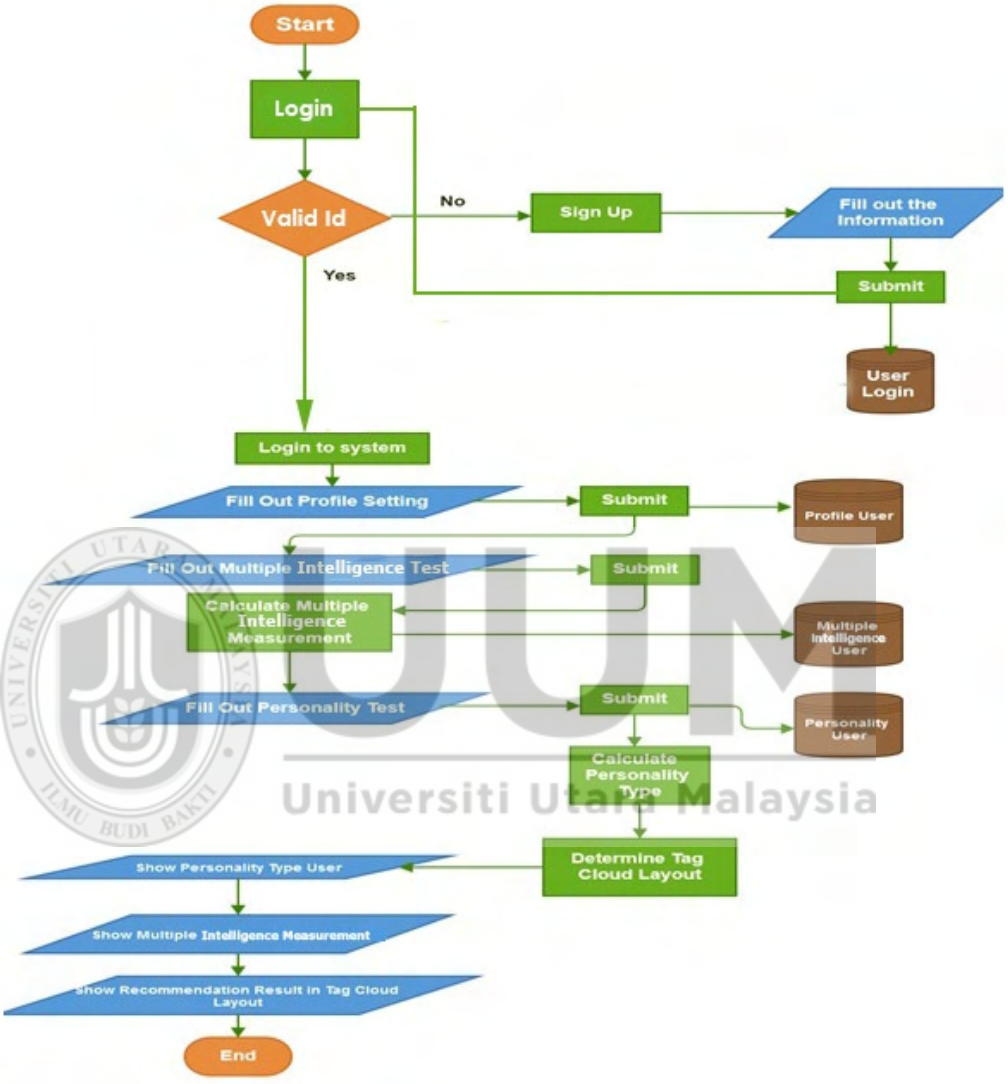


Figure 4.6. The Flowchart of Youth Career Recommendation System

Eventually, the career recommendation result is displayed in the layout, which corresponds to the proposed algorithm. The system will also show a user other possibilities of tag cloud layout to be compared to the recommended layout one. The user can then assess whether the given tag cloud layout is appropriate or not. In order

to do so, the user will have to answer the provided questionnaire regarding their satisfaction of recommendation layout.

4.6.2.2 Translation of Tag Cloud Layout Algorithm in Source Code

As described previously, the application is created by using java language programming. Therefore, this sub-section shows the line of code as a form of translation towards the proposed algorithm in this study.

```
public void forwardChainingAlgorithm()
  {
    if(I > E)
    {
      Personality1 = "I";
    }else if(E > I)
    {
      Personality1 = "E";
    }else
    {
      Personality1 = "E";
    }
    if(S > N)
    {
      Personality2 = "S";
    }else if(N > S)
    {
      Personality2 = "N";
    }else
    {
      Personality2 = "N";
    }
    if(T > F)
    {
      Personality3 = "T";
    }
    else if(F > T)
    {
      Personality3 = "F";
    }
    else
    {
      Personality3 = "F";
    }
    ////4
```

```
        if(J > P)
        {
           Personality4 = "J";
        }
        else if (P > J)
        {
           Personality4 = "P";
        }
        else
        {
           Personality4 = "P";
        }

        String result = Personality1+Personality2+Personality3+Personality4;

//==================================================
======

        if(Personality2.equals("S") && Personality4.equals("P"))
        {
           color = "Orange";
        }
        if(Personality2.equals("N") && Personality3.equals("T"))
        {
           color = "Green";
        }
        if(Personality2.equals("N") && Personality3.equals("F"))
        {
           color = "Blue";
        }
        if(Personality2.equals("S") && Personality4.equals("J"))
        {
           color = "Gold";
        }

        if(color.equals("Orange"))
        {
           shape = "Zigzag";
        }


        if(color.equals("Green"))
        {
           shape = "Triangle";
        }
        if(color.equals("Blue"))
        {
           shape = "Circle";
        }
        if(color.equals("Gold"))
```

```
    {
       shape = "Square";
    }

//=================================================
======

    if (color.equals("Orange") && Personality1.equals("E"))
    {
       color = "Saturated Orange";
    }
    if (color.equals("Orange") && Personality1.equals("I"))
    {
       color = "Desaturated Orange";
    }
    if (color.equals("Green") && Personality1.equals("E"))
    {
       color = "Saturated Green";
    }
    if (color.equals("Green") && Personality1.equals("I"))
    {
       color = "Desaturated Green";
    }
    if (color.equals("Blue") && Personality1.equals("E"))
    {
       color = "Saturated Blue";
    }
    if (color.equals("Blue") && Personality1.equals("I"))
    {
       color = "Desaturated Blue";
    }
    if (color.equals("Gold") && Personality1.equals("E"))
    {
       color = "Saturated Gold";
    }
    if (color.equals("Gold") && Personality1.equals("I"))
    {
       color = "Desaturated Gold";
    }

    }
```

These lines of code in java language generate certain layout for every output based on career matches to MI theory. This means that after the system calculates the result of MI test in order to seek the prominent career of particular user, the system generates those results into the most appropriate tag cloud layout. Based on the

knowledge based that has been formed as an algorithm in this study, there are eight probabilities of various layouts that can be shown to user. In essence, the following table 4.3 shows those eight various tag cloud layouts as well as its figure respectively. To get these results, the following subsection exhibits the screen of application in this study.

Table 4.3

Eight Various Tag Cloud Layout

No	Names of Layout	Example of Figure
1	Saturated Blue Circle	
2	Desaturated Blue Circle	
3	Saturated Gold Square	

4	Desaturated Gold Square	
5	Saturated Green Triangle	
6	Desaturated Green Triangle	
7	Saturated Orange Zigzag	
8	Desaturated Orange Zigzag	

4.6.2.3 Screenshot of Youth Career Recommendation Application

This section shows the screenshots of a youth career recommendation application. The name of this application is YouthComPDA. It was developed to assist the youth

in making decision on their career path. As mentioned earlier, the end-users are required to login to system (see Figure 4.7). After seeing the welcome interface of the system (see Figure 4.8), the users need to fill the profile setting (see Figure 4.9).

Next, the users are required to answer two questionnaires, which are provided in two languages (Malay and English) (see Figure 4.12): MI test (see Figure 4.13) and MBTI test (see Figure 4.14). After completing the questionnaires, the system gives responds by showing the review of personality type result (see Figure 4.15) and MI test results (see Figure 4.16). Lastly, the system will show the most suitable color and shape of career recommendation tag cloud layout styles (see Figure 4.17). The users also can see the other tag cloud layout styles by clicking on next button provided below the results.

Figure 4.7. The Login Interface

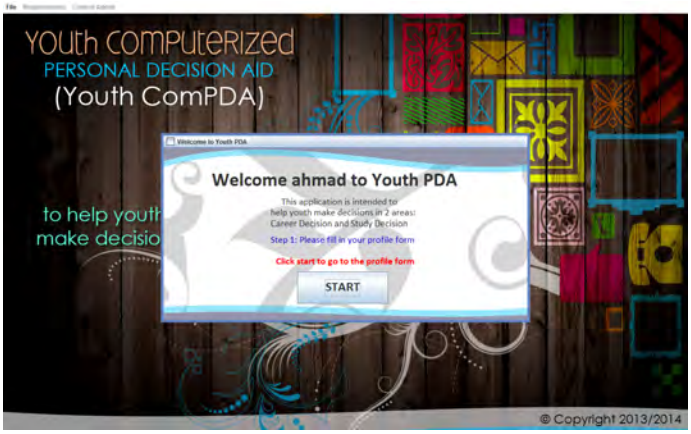


Figure 4.8. The Welcome Interface

Figure 4.9. The Profile Setting System

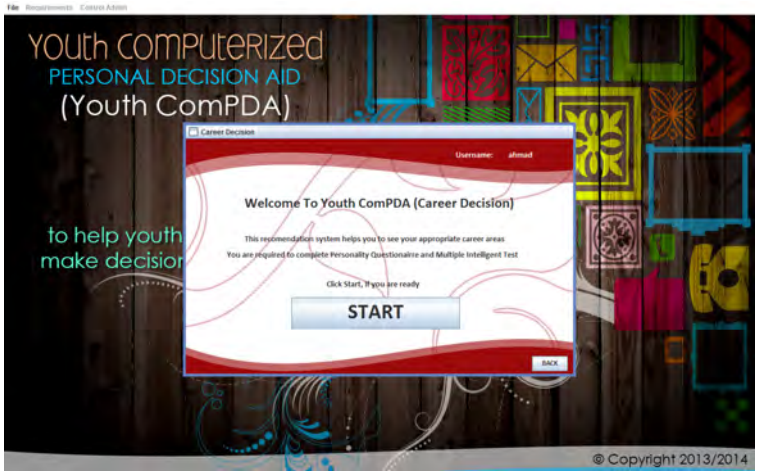


Figure 4.10. The Welcome Career Interface

Figure 4.11. The Main Menu MI and PT

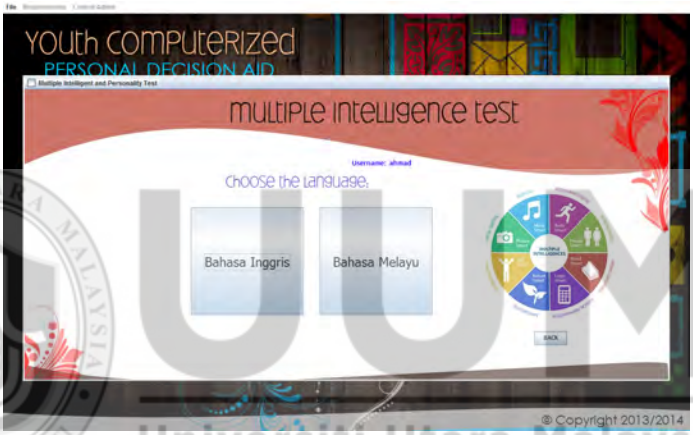


Figure 4.12. The Language Used

Figure 4.13. The Multiple Intelligence Interface

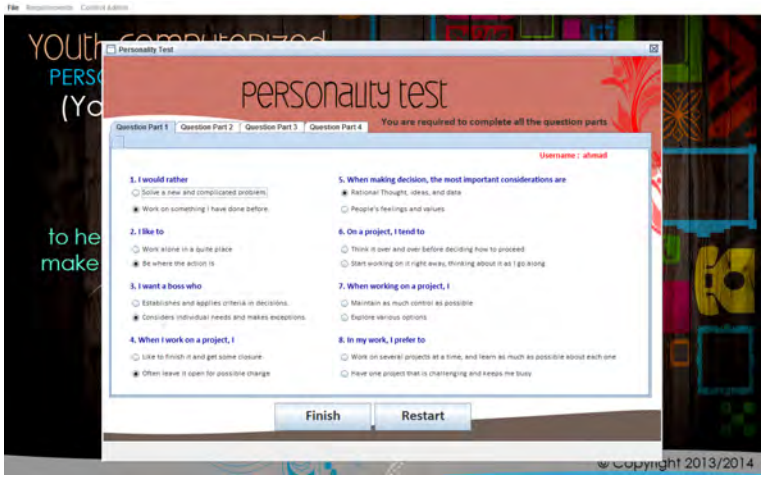


Figure 4.14. The Personality Test

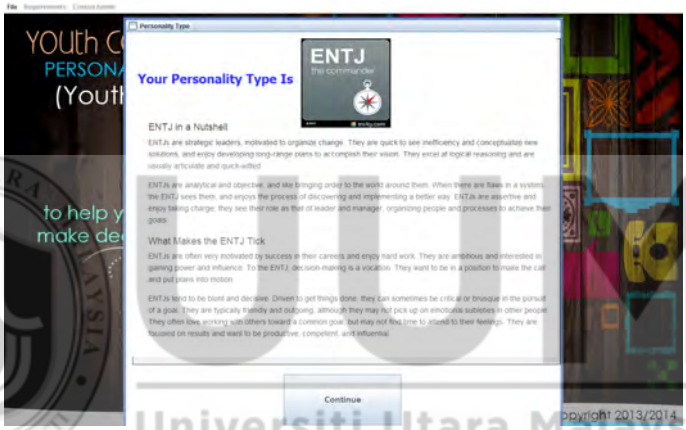


Figure 4.15. The Personality Type Review

Figure 4.16. The Review of Multiple Intelligence Result

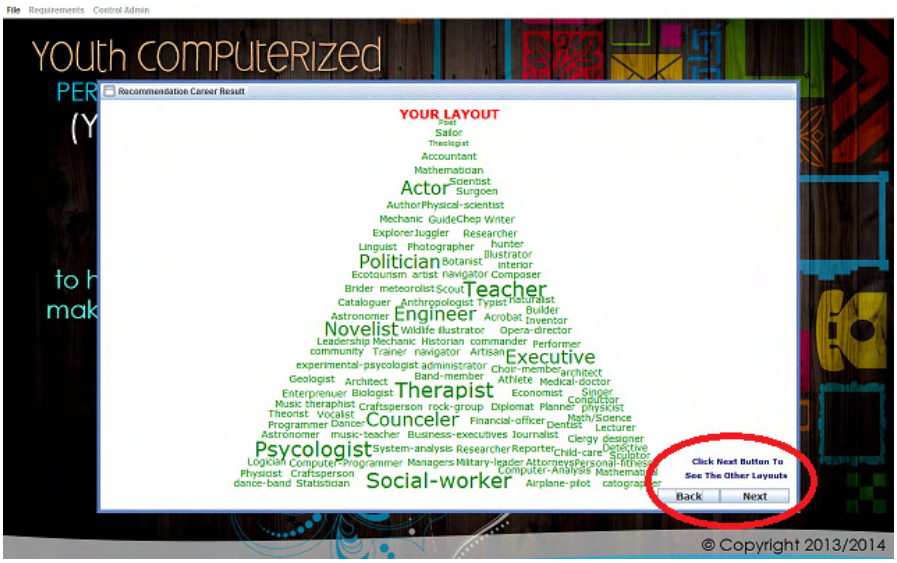


Figure 4.17. The Recommendation Career Result with Particular Tag Cloud Layout

All screenshots in this section explain further the steps taken before coming out with the recommendation result. In particular, in figure 4.17, in the red circle, there are two buttons, namely "next" and "back". The function in this button is to check the other possibility layouts, which have been shown in table 4.3 in previous section. After seeing the other tag cloud layouts, the user can assess their preferences of satisfaction by answering provided questionnaire.

4.7 Summary

This chapter outlines the activities involved in order to produce tag cloud layout algorithm based on personality types of MBTI. The prototype is also briefly discussed. Consequently, the selected case study, a career recommendation system for youth, is constructed. Then, the processes taken to establish this application is also included. Next, the conversion of algorithm into translation in java language programming (source code) as well as screenshots of application are also displayed. This application is prepared in order to collect data to accomplish the last objective

in this study, which is to determine the appropriate styles of tag cloud layout styles, and this is used to measure users' satisfaction towards recommended layout.

CHAPTER FIVE
BLACK BOX TESTING AND RESULT OF USERS' SATISFACTION

5.1 Overview

This chapter outlines the validation testing of the algorithm as well as measurement of users' satisfaction towards layout of tag cloud layout styles that have been generated from the proposed algorithm in chapter 4. The black box testing activity is conducted before measuring the satisfaction elements in this study. This chapter discusses the analysis of data upon testing validation as well as the experimental study to measure the satisfaction.

5.2 Black Box Testing

To test the functionality of the system, the black box testing could be done to determine the accuracy of the system. Black box testing (functional testing) focuses only on the outputs, which are generated by selected input, without seeing the internal mechanism of process (Radatz, Geraci, & Katki, 1990). In other words, in black box testing, the tester does not have authority or access to see the source code as internal mechanism. Black box testing, which has others name: functional testing and behavioral testing, focuses on examining whether the program performs what it is expected based on functional requirements (Beizer, 1995). The tester in black box testing should know exactly the desired output for particular inputs given, as shown in figure 5.1.

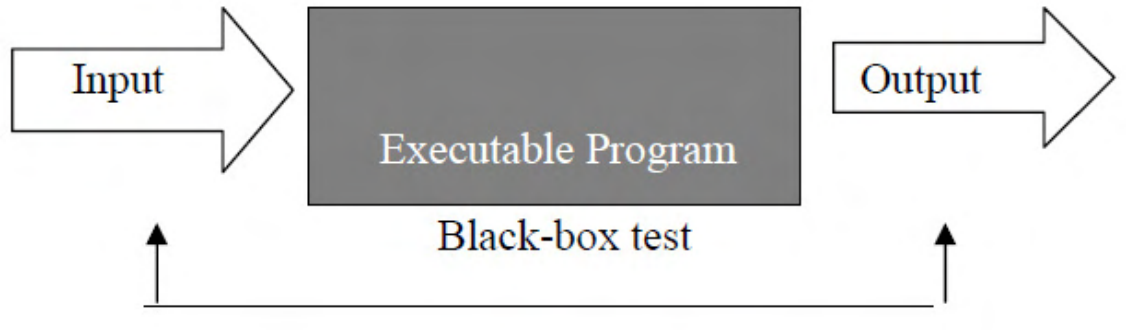


Figure 5.1. Black Box Testing

The black box testing does not consider the internal source code of program, and the focus is only on input and output. Accordingly, this study employs forward chaining method as the main algorithm, which runs bunch of rules in order to determine the appropriate result of particular tag cloud layout. Consequently, this section elaborates the black box testing process as well as the results. In essence, the black box testing aims to check whether the desired results of particular tag cloud layout is displayed appropriately or not based on the rules that have been constructed.

As aforementioned in chapter 4 (sub-section 4.6.2.2 (Table 4.3)), there are eight probabilities type of tag cloud that can be generated from the proposed algorithm. In conjunction with black box testing, based on the requirement knowledge, the expected result of black box should be known before the test begins. Therefore, to make clearer, table 5.1 exhibits probabilities rules that are involved for each result of certain tag cloud layout respectively. Afterward, the discussion upon analysis of black box testing is explained in the next subsection.

Table 5.1

Rules Involved for Each Expected Tag Cloud Design Results

No	Rules Fired	Expected Results	Figure	Personality Elements
1	1. N > S Then N 2. F > T Then F 3. N and F Then Blue 4. Blue Then Circle 5. Blue and E Then Saturated Blue	Saturated Blue Circle		E (Extrovert) N (Intuition) F (Feeling)
2	1. N > S Then N 2. F > T Then F 3. N and F Then Blue 4. Blue Then Circle 5. Blue and I Then Desaturated Blue	Desaturated Blue Circle		I (Introvert) N (Intuition) F (Feeling)
3	1. J > P Then J 2. S > N Then S 3. J and S Then Gold 4. Gold Then Square 5. Gold and E Then Saturated Gold	Saturated Gold Square		E (Entrovert) S (Sensing) J (Judging)

4	1. J > P Then J 2. S > N Then S 3. J and S Then Gold 4. Gold Then Square 5. Gold and I Then Desaturated Gold	Desaturated Gold Square		I (Introvert) S (Sensing) J (Judging)
5	1. N > S Then N 2. T > F Then T 3. N and T Then Green 4. Green Then Triangle 5. Green and E Then Saturated Green	Saturated Green Triangle		E (Extrovert) N (Intuition) T (Thinking)
6	1. N > S Then N 2. T > F Then T 3. N and T Then Green 4. Green Then Triangle 5. Green and I Then Desaturated Green	Desaturated Green Triangle		I (Introvert) N (Intuition) T (Thinking)
7	6. S > N Then S 7. P > J Then P 8. S and P Then Orange 9. Orange Then	Saturated Orange Zigzag		E (Extrovert) S (Sensing) P (Perceiving)

	Zigzag 10. Orange and E Then Saturated Orange			
8	1. S > N Then S 2. P > J Then P 3. S and P Then Orange 4. Orange Then Zigzag 5. Orange and I Then Desaturated Orange	Desaturated Orange Zigzag		I (Introvert) S (Sensing) P (Perceiving)

5.2.1 Analysis of Validation Testing

Based on table 5.1, it can be seen that each particular tag cloud layout is generated throughout five sequences of rules. This means in order to reach particular result, there are five rules that are fired in which it leads to decision of expected result. Beside, table 5.1 also shows each result of tag cloud design has three personality traits elements that must be fulfilled. For example, saturated blue circle tag cloud has three main characteristics in personality traits elements, namely Extrovert (E), Intuition (I) and Feeling (F). These components are extracted as a result from particular rules that represent each tag cloud layout.

Thus, to align with the purpose of validation testing, the items, which lead to particular results, are controlled. The items here mean all personality elements, which are involved for each particular tag cloud layout that are mentioned before.

For instance, to get the result of saturated blue circle, three main elements are required, namely Extrovert (E), Intuition (N) and Feeling (F).

Therefore, as described in the proposed algorithm section (refer to 4.5), to initiate the controlled inputs, the starting point is from fulfilling personality traits test. As for the selected measurement of personality traits, 16 personality types are tested. This is because of MBTI divides category of personality types into 16 groups (see chapter 2). They are ISTJ, ISFJ, INFP, INTJ, ISTP, ISFP, INFP, INTP, ESTP, ESFP, ENFP, ENTP, ESTJ, ESFJ, ENFJ and ENTJ. In other words, the application, which is built in this study, is used to control the input to justify each criterion of each personality types in MBTI. Then, the accuracy can be examined lastly to check either the desired results are true or not. This black box testing approach is the only way to test the accuracy of the ruled base system, since the expected result can be seen after entering the controlled input (Beizer, 1995). The last step is then to calculate the accuracy of all testing data. The accuracy formula is stated below:

Percentage of Accuracy= (the number of valid test / the number of testing) x 100%

The discussion of the testing results is reported in the next subsection.

5.2.2 Results of Accuracy Testing

After controlling the input of personality test to come out with certain personality type, the table 5.2 shows the result of testing for each of them respectively. To check whether the appropriate results is correct or not, the result can be refered to table 5.1.

Table 5.2

Outcomes of Black Box Testing

No	Personality Types	Personality Elements	Expected Result	Testing Result	Status (Valid/Unvalid)
1	ISTJ	I (Introverted) S (Sensing) T (Thinking) J (Judging)	Desaturated Gold Square	Desaturated Gold Square	Valid
2	ISFJ	I (Introverted) S (Sensing) F (Feeling) J (Judging)	Desaturated Gold Square	Desaturated Gold Square	Valid
3	INFP	I (Introverted) S (Intuition) F (Feeling) P (Perceiving)	Desaturated Blue Circle	Desaturated Blue Circle	Valid
4	INTJ	I (Introverted) N (Thinking) T (Thinking) J (Judging)	Desaturated Green Triangle	Desaturated Green Triangle	Valid
5	ISTP	I (Introverted) S (Sensing) T (Thinking) P (Perceiving)	Desaturated Orange Zigzag	Desaturated Orange Zigzag	Valid
6	ISFP	I (Introverted) S (Sensing) F (Feeling) P (Perceiving)	Desaturated Orange Zigzag	Desaturated Orange Zigzag	Valid
7	INFP	I (Introverted) N (Intuition) F (Feeling) P (Perceiving)	Desaturated Blue Circle	Desaturated Blue Circle	Valid
8	INTP	I (Introverted) N (Intuition) T (Thinking) P (Perceiving)	Desaturated Green Triangle	Desaturated Green Triangle	Valid
9	ESTP	E (Extroverted) S (Sensing) T (Thinking) P (Perceiving)	Saturated Orange Zigzag	Saturated Orange Zigzag	Valid
10	ESFP	E (Extroverted) S (Sensing) F (Feeling) P (Perceiving)	Saturated Orange Zigzag	Saturated Orange Zigzag	Valid
11	ENFP	E (Extroverted) N (Intuition)	Saturated Blue Circle	Saturated Blue Circle	Valid

		F (Feeling) P (Perceiving)			
12	ENTP	E (Extroverted) N (Intuition) T (Thinking) P (Perceiving)	Saturated Green Triangle	Saturated Green Triangle	Valid
13	ESTJ	E (Extroverted) S (Sensing) T (Thinking) J (Judging)	Saturated Gold Square	Saturated Gold Square	Valid
14	ESFJ	E (Extroverted) S (Sensing) F (Feeling) J (Judging)	Saturated Gold Square	Saturated Gold Square	Valid
15	ENFJ	E (Extroverted) N (Intuition) F (Feeling) J (Judging)	Saturated Blue Circle	Saturated Blue Circle	Valid
16	ENTJ	E (Extroverted) N (Intuition) T (Thinking) J (Judging)	Saturated Green Triangle	Saturated Green Triangle	Valid

Based on the result of black box testing that is overviewed in table 5.2, the result is:

Percentage of Accuracy *= (the number of valid test / the number of testing) x 100%*

= (16 / 16) x 100 %

= 100 %

It is concluded based on the result of calculation, the accuracy obtained is 100%. This proves that the results obtained by users when using a prototype are equal to the rules that have been implanted into the algorithm.

5.3 Experimental Study: Measuring Satisfaction

An experimental study was conducted in order to measure the satisfaction of user towards layout of tag cloud design through the youth career recommendation prototype. The questionnaire is developed as the main instrument in this experimental study. Chapter 3 described in details the process of constructing the questionnaire, which is named as Q-SAFI. Upon completion of the pilot study, the Q-SAFI is now ready to be used in the main study. The first part of questionnaire is about demographic background of the samples and general findings.

5.3.1 Demographic Background

There are 30 samples involved in this experimental study. Table 5.3 displays the data of the samples' demographic background.

Table 5.3

*Demographic Background of Samples (*Convenience *Sampling)*

Gender

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Male	12	40.000	40.000	40.000
	Female	18	60.000	60.000	100.000
	Total	30	100.000	100.000	

Education

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Bachelor's degree	11	36.700	36.700	36.700
	Postgraduate	19	63.300	63.300	100.000
	Total	30	100.000	100.000	

Age

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	18 - 19 years old	3	10.000	10.000	10.000
	20 - 21 years old	4	13.300	13.300	23.300
	22 - 23 years old	11	36.700	36.700	60.000
	24 - 25 years old	12	40.000	40.000	100.000
	Total	30	100.000	100.000	

Table 5.3 shows 18 participants were females (60%). Meanwhile, males were 12 (40%). As for age, the highest number of frequency belongs to 24 – 25 years old (40%), and then the other categories, namely 18 – 19 years old has 3 (10%), 20 – 21 years old has 4 (13.3%), 22 – 23 is 11 (36.7 %), and lastly 24 – 25 years old has 12 (40%). About the education, the highest category was postgraduate, with 19 (63.3%), as opposed to 36.7% of the bachelor degree.

5.3.2 Experiment Design

In this section, as explained in sub-section 3.6.1, the experiment involves gathering data about youth career recommendation's system by using YouthComPDA prototypes. The table 5.4 explains the experiment procedure, apparatus and techniques.

Table 5.4

Summary of Procedure, Apparatus and Data Collection Method of Experimental Study

YouthComPDA Prototype	**:**	**Youth Career Recommendation System**
Procedure		- Experiment session was advertised to participants. Time and place was set prior. - Control: During the experiment, each participant was ensured in fully control; the factors, which may bring disadvantages, such as failure or error in application, noise within lab, are avoided. - Flow: participants need to complete the required questions using the application. Then, the system will show the recommended career results with particular tag cloud design based on his/her personality traits. The system will also show the other tag cloud layouts. - The experiment lasted approximately in an hour, but it also depends on participants' readiness to proceed.
Apparatus		- YouthComPDA application (Youth Recommendation Career Application) - Questionnaires (Q-SAFI). - Pencil, pen, eraser, blank papers (for note-taking).
Data collection		- Participants answered the questionnaire.

All participants were allowed to start using the application and stop the process at their own pace. Afterward, the system will show the career recommendation results using particular tag cloud layout that is automatically customized based on their personality traits. The system will also show the other layouts of tag cloud design.

Participants were also instructed to complete the instrument (Q-SAFI), which is to measure their satisfaction towards the tag cloud layout styles that was being displayed to them in the prototype.

5.3.3 Hyphotesis Testing

The next step is to gather data from the experiment. Then, the analyzing part is executed into statistical package. This study uses the suitable features of SPSS for accomplishing that purpose. Furthermore, the inference was made using the following statistical procedures to test the hypotheses of this study:

Hypothesis: The mean score of overall satisfaction of tag cloud layout styles is high.

Statistical Tests: Descriptive

Note that samples of experimental studies consisted of 30 participants. In order to test a hypothesis mentioned earlier, descriptive statistics test was used. This means that descriptive analysis is used in order to emphasize the result of hypothesis test. Examples of descriptive statistics are the measures of central tendency (e.g., mean, median and mode) and the measures of dispersion (e.g., standard deviation, standard error and variance).

The analysis results are based on respondents' answers towards the satisfaction questionnaire. Primarily, the descriptive analysis frequencies for all items are discussed, followed by the analysis for each category. Lastly, the conclusion for the overall analysis of satisfaction measurement is included.

5.3.3.1 Descriptive Analysis

Before discussing the mean score of overall satisfaction result that is obtained in this study, it is imperative to discuss all items and categories to check their validity in some aspect properties. The table 5.5 shows all items frequency result properties, such as valid data, mean score, minimum score, maximum score, and so forth.

Table 5.5

Summary Descriptive Analysis of Frequency All Item in Questionnaire

Statistics

	N						
	Valid	Missing	Mean	Median	Std. Deviation	Minimum	Maximum
AQ1	30	0	5.266	5.500	1.015	3	7
AQ2	30	0	4.967	5.000	1.217	2	7
AQ3	30	0	5.067	5.000	1.015	3	7
AQ4	30	0	5.000	5.000	.947	3	6
AQ5	30	0	5.167	5.000	.874	3	7
AQ6	30	0	5.333	6.000	.994	3	7
AQ7	30	0	5.467	6.000	.819	3	6
BQ1	30	0	5.500	6.000	1.280	2	7
BQ2	30	0	5.500	6.000	1.306	3	7
BQ3	30	0	5.500	6.000	1.167	3	7
BQ4	30	0	5.400	6.000	.770	4	6
BQ5	30	0	5.600	6.000	.932	4	7
BQ6	30	0	5.567	6.000	1.006	3	7
CQ1	30	0	5.400	6.000	1.037	3	7
CQ2	30	0	5.467	6.000	1.074	3	7
CQ3	30	0	5.233	5.000	.971	3	7
CQ4	30	0	5.367	6.000	1.217	2	7
CQ5	30	0	5.400	6.000	1.133	2	7
CQ6	30	0	5.667	6.000	.994	3	7

The satisfaction questionnaire comprises 19 questions, which are classified into three groups of dimensions. AQ1 until AQ7 represent the number of items, for the first dimension (satisfaction of tag cloud overall layout). Meanwhile, BQ1 to BQ2 are from the second dimension (satisfaction of tag cloud color), and lastly CQ1 to CQ6

are from the third dimension (satisfaction of tag cloud shape). From table 5.5, it can be seen that all items are valid, in which there is no missing data. Also, the table 5.5 overviews the maximum and minimum number for all items in which they vary from two to four in minimum scale and from six to seven in maximum scale. The mean scores for all items are varied from 5.000 to 5.667.

In more details, the following tables (Table 5.6, Table 5.7 and Table 5.8) show all of those dimensions as well as their distribution frequency in 7-point likert scale.

Table 5.6

Summary of Descriptive Analysis of Overall Layout Dimension

Overall Layout

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Disagree	1	3.333	3.333	3.333
	Neither Agree nor Disagree	6	20.000	20.000	23.333
	Somewhat Agree	8	26.667	26.667	50.000
	Agree	15	50.000	50.000	100.000
	Total	30	100.000	100.000	

Table 5.7

Summary of Descriptive Analysis of Color Dimension

Color

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Disagree	2	6.667	6.667	6.667
	Neither Agree nor Disagree	3	10.000	10.000	16.667
	Somewhat Agree	5	16.667	16.667	33.333
	Agree	16	53.333	53.333	86.667
	Strongly Agree	4	13.333	13.333	100.000
	Total	30	100.000	100.000	

Table 5.8

Summary of Descriptive Analysis of Shape Dimension

Shape

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Disagree	1	3.333	3.333	3.333
	Neither Agree nor Disagree	3	10.000	10.000	13.333
	Somewhat Agree	6	20.000	20.000	33.333
	Agree	20	66.667	66.667	100.000
	Total	30	100.000	100.000	

In order to validate the previous hypothesis, descriptive analyses were undertaken. Table 5.9 displays the results in mean and standard deviation values for each dimension and the overall satisfaction.

Table 5.9

Summary of Descriptive Analysis

Statistics

		Overall Layout	Color	Shape	Overall satisfaction
N	Valid	30	30	30	30
	Missing	0	0	0	0
Mean		5.233	5.567	5.500	5.433
Std. Deviation		.898	1.073	.820	.858

As shown in Table 5.9, the mean score for overall satisfaction of tag cloud layout is 5.433. To interpret this score, the gap classification of interval scales is considered. Regarding the study that uses likert scale of 7 point, according to Zulkarnain (2001), the gap classification of internal scales used in research instrument may follow the formula below:

Gap = (highest score – lowest score)/number of scale

= (7 – 1) / 7

= 0.86

Therefore, the scale of response classification (see table 5.10) is divided into several categories with 0.86 gaps between one another.

Table 5.10

Response Classification

Gap	Classification
1.00 – 1.86	Very low
1.87 – 2.73	Low
2.74 – 3.60	Fairly low
3.61 – 4.47	Average
4.48 – 5.34	Fairly high
5.35 – 6.21	**High**
6.22 – 7.00	Very high

Based on the response classification (Allen & Seaman, 2007) (see Table 5.10), it was found that the mean score of overall satisfaction of tag cloud layout styles (5.433) falls under "*High"*. This means that the result supports the hypothesis. Therefore, the color and shape as displayed by the application using the proposed algorithm are highly satisfied by the participants.

To further analyze, a One Sample *T*-Test was conducted.

H_0: Mean score of overall satisfaction of tag cloud layout styles = 5.35

The *T*-Test also supports this hypothesis. The hypothesis testing of the overall satisfaction variable was performed by entering a testing value of 5.35 (see Figure 5.2) as the minimum threshold in "High" category classification (see Table 5.10).

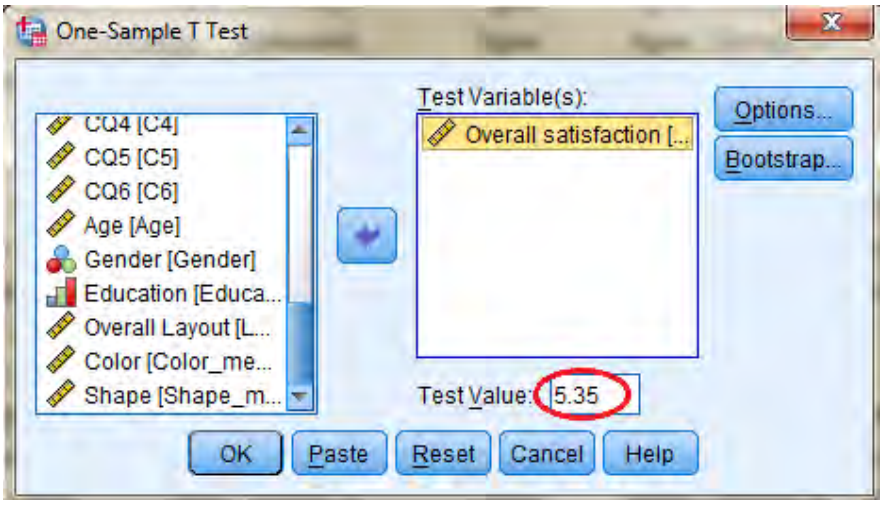


Figure 5.2. Testing Value of One Sample T Test

Note that the mean is 5.433 (see Table 5.11), which is quite close to the hypothesis value. Then, the significance value (p) is 0.599 (see Table 5.12), which is above 0.05, meaning that the hypothesis is supported.

Table 5.11

Summary of One-Sample Statistic

One-Sample Statistics

	N	Mean	Std. Deviation	Std. Error Mean
Overall satisfaction	30	5.433	.858	.157

Table 5.12

Summary of One-Sample Test

One-Sample Test

	Test Value = 5.35					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Overall satisfaction	.532	29	.599	.083	-.24	.40

As mentioned earlier in chapter 4, the end users can see the other layouts by pressing the next button provided in the interface of the YouthComPDA application. This is provided in order to confirm the end users' preferences either they preferred the tag cloud suggested by YouthComPDA the most as compared to the others. Therefore, in order to do so, 10 participants were randomly selected among the 30 and asked their display preferences. The table 5.13 shows the result of this confirmation.

Table 5.13

Summary of Confirmation Preferences

Respondents	Suggested by youthComPDA	Preferences	Agree (1) Disagree (0)
1			1
2			1
3			1

4			1
5			1
6			0
7			1
8			1

9			1
10			0

Based on the results from table 5.13, there are 8 out of the 10 participants (80%) who agreed with the tag cloud layout styles suggested by YouthComPDA. This further confirms that the algorithm proposed in this study is functioning well. However, it is also a question mark of why not all the respondents agreed with the result. According to Johnsson (2009), the reliability of MBTI measurement test is highly important and only can be achieved if the test can be done several times in order to get the same results to be confirmed. Meanwhile, this study only conducted the test one time only, since the lack of research time, so as a result the confirmation of the reliability is not accomplished. This is a drawback of MBTI measurement test in terms of reliability (Johnsson, 2009).

5.4 Summary

This chapter outlines the evaluations process, starting from the validation testing to analysis results of the measurement of satisfaction. The validation testing aims to validate whether all expected results are displayed based on the proposed algorithm

that has been constructed. The result of the validation testing shows 100% score, which indicates that all rules of the proposed algorithm work appropriately in the prototype. The experimental study results show that the majority of the participants are highly satisfied with the tag cloud layout styles.

CHAPTER SIX
DISCUSSION AND CONCLUSION

6.1 Overview

This study was conducted based on these two research questions.

1. What is the appropriate combination of color and shape for algorithm used to develop tag cloud layout styles based on the personality traits of users?
2. How satisfied is the produced tag cloud layout styles that is generated from the proposed algorithm to the users?

Based on research questions discussed above, this study aims to achieve two research objectives as put forth below.

1. To develop the algorithm that incorporates color and shape as tag cloud layout styles based on personality.
2. To measure users' satisfaction towards tag cloud layout styles based on the proposed algorithm.

The next sections discuss each of the provided solutions in order to answer research questions as well as the overall conclusion obtained within this study.

6.2 Research Question 1

What is the appropriate combination of color and shape for algorithm used to develop tag cloud layout styles based on the personality traits of users?

In order to answer this question, some related literature study were reviewed. Since the point of this study is to find solutions customizing tag cloud layout features

based on personality traits, the psychology study has been taken into account. Moreover, this is also due to two prominent visual features of tag clouds, namely shape and color are used, thus the related study about relationship between those two components and personality traits were then elaborated further. In particular, through content analysis the theory of True Color (Cooper, 2009) and the shape theory (Psycho-geometric) (Dellinger, 1989) are chosen as the solution that have significant relation upon personality traits. Next, in order to produce the algorithm that is able to determine to which appropriate tag cloud layout styles towards a particular user, the RBS (Abraham, 2005) was implemented. This RBS is deployed by using forward chaining method (data-driven). In other words, visual components (color and shape) and personality traits elements in MBTI were integrated as the knowledge base. This knowledge base comprises many rules in which each rules has its own role to lead to the others rules and eventually produce the chosen tag cloud layout styles.

6.3 Research Question 2

How satisfied is the produced tag cloud layout styles that is generated from the proposed algorithm to the users?

After constructing the algorithm, it is crucial to test the recommended tag cloud layout styles to users. This was carried out through prototyping. The case study of a career recommendation system for youth was selected. This prototype gives recommended results based on MI theory and the results are then represented as tag cloud layout styles, which is a part to be measured in this study. To know the personality elements of user, the prototype is equipped with personality test based on MBTI measurement beforehand.

Then, before measuring the satisfaction, the initial work was to perform a validation test. This validation test is useful in order to know whether the tag cloud layout styles that will be shown to users are working properly or not based on proposed algorithm. After all, the results present 100% validity, which means the tag cloud are displayed equally in application based on expected results of proposed algorithm.

Eventually, the measurement of satisfaction was performed. In doing so, the constructed instrument named as Q-SAFI was constructed. This instrument consists of three dimensions to measure the satisfaction, which are satisfaction in terms of overall layout, color and shape. This instrument was adapted from USE questionnaire in the satisfaction section and found highly reliable in the pilot study with Cronbach's Alpha for each dimension was greater than 0.7. Based on the analysis result of overall satisfaction by using descriptive analysis frequency, the finding showed that users in general are satisfied with the resulted tag cloud layout. This proves that the theories (True Color and Psyco-geometric theories) which are elaborated in chapter 2 (section 2.5 and section 2.6) have significant influences towards users view in tag cloud layout styles. In other words, the relation between personality traits and these visual properties must be considered for designers of tag cloud.

6.4 Aim and Objectives: Revisit

The main purpose of this study is to propose an algorithm that could customize visual features (color and shape) tag cloud layout based on personality traits. Then, to ensure that the tag cloud view is appropriately displayed or not, the measurement of satisfaction was carried out. At the end of this research throughout a

comprehensive content analysis in chapter 2 the main purpose has been achieved through identification of related studies.

Then, in chapter 4, the elaboration of algorithm is discussed more. The identification towards forming rules between shape and rules are included in chapter 4. These rules are all stored in a knowledge based according to forward chaining method in order to formulate the algorithm. The first objective was then achieved. In chapter five, the second objective was achieved by evaluating the prototype through measuring satisfaction of 30 respondents. The instrument was given to record all answers for data collection.

6.5 Limitation and Recommendation

The limitations of this study can be summarized into two sections: (1) the algorithm, and (2) the prototypes. The following subsections discuss each limitation in details.

6.5.1 The Tag Cloud Algorithm

In constructing the algorithm for tag cloud, two visual features were included: (a) color (b) shape. These elements represent tag cloud visual features in general. However, it could be enhanced if other elements are also considered. For instances, position of each tag in tag cloud, font style management, and background color.

Moreover, the enhancement towards algorithm is also needed in terms of dynamic rule base system. This means the rules inside algorithm are dynamically able to be changed. So that, a programmer who wants to apply this algorithm could edit or delete or even add more rules into algorithm more dynamically when prototyping.

6.5.2 The Tag Cloud Prototype

As elaborated in this study, the prototype in this study is in a case study for career recommendation system for youth. Perhaps, comparing two case studies on selecting different age groups could strengthen the findings.

6.5.3 Conclusion

This study has conducted systematic processes in attempting to develop tag cloud algorithm based on personality traits. Relevant theories are reviewed: visual elements (color and shape) related to personality traits elements and forward chaining method are the main focus areas. Then, a case study in a career recommendation system to apply the algorithm was conducted. Eventually, the evaluation was made to measure the satisfaction of users toward the tag cloud layout styles. The findings indicated that in general users are highly satisfied with the tag cloud layout styles that are generated by the proposed algorithm.

Adapting visual features to suit end-user personality in system development is a crucial design element. Through this study, it has further confirmed that such element is indeed an influence on the usability and satisfaction of a system.

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