Web Based Expert System For i-Faraid

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Web Based Expert System For i-Faraid

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ABSTRACT

Expert system is one of the important Artificial Intelligence application. The design of the web based expert system for Islamic inheritance laws are different from conventional computer programs as they can solve problems by mimicking human reasoning, relying on logic, belief , rules of thumb, opinion and experience in Faraid. This thesis discusses web based expert system for Islamic inheritance law for all Muslims, and identify the rules of wealth distribution as stated in the Quran through a knowledge acquisition process with an expert in Faraid.

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By the Name of Allah, the Most Gracious and the Most Merciful

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LIST OF ACRONYMS

AI	Artificial Intelligence
BERT	Expert System as Bank Expert
CALTREC	California Travel Expense Claim System
CARMA	Computer-Assisted Real Estate Market Analyst,
DFD	Data Flow Diagram
E-Faraid	Electronic Faraid
EIA	Environmental Impact Assessment
ES	Expert System
ESCAPE	Expert System for Claims Authorization
I-Faraid	Intelligence Faraid
OIMES	Online Islamic Medication Expert System

CHAPTER 1

INTRODUCTION

1.1 Overview

Starting with the development of expert systems in the early seventies, and also computer software, scientists always seek to resolve problems through intelligent programmes (Donald, 1986). Expert system is one of the important application oriented branches of artificial intelligence. In the beginning, expert system development is in health and business application . In this study, the area selected is application of expert system for Islamic inheritance laws, relying on rules, from (Al-Quran) and four schools of thought (*Almathaheb*) where Inheritance is one of the most important branches of Islamic family related to *mirath*. In legal terminology means, inheritance is to be divided from the property of the deceased among his successors. In order to understand *mirath*, it is important to understand the sources of Islamic law, an expression which is often used interchangeably with Syariah Law, Hukum Syara or the Syariah. The Syariah is revealed through the Holy Qur'an and the Traditions (Sunnah) of Prophet Muhammad (s.aw). The Islamic Law of inheritance, is designed to serve and its natural and practical approach have also been widely admired by Muslim and non-Muslim scholars alike. Islamic Law of inheritance, in its present form is a fixed scientific and beautifully harmonious system. In Islamic legal philosophy the rules of inheritance propound the ideal way for the deceased to fulfil his duty to his surviving relatives and members of the family. The issue of inheritance is of fundamental importance. If it is applied correctly all heirs receive their just and legitimate shares resulting in clean-heartedness, happiness and *barkat* (blessings).

The Islamic Law of Inheritance, is the most important branch of Shariah (Islamic Law) by providing rigid and clear-cut-rules of inheritance. In Sura al-Nisa (Al-Quran).

لِّلرِّجَالِ نَصِيبٌ مِّمَّا تَرَكَ الْوَالِدَانِ وَالْأَقْرَبُونَ وَلِلنِّسَاءِ نَصِيبٌ مِّمَّا تَرَكَ الْوَالِدَانِ وَالْأَقْرَبُونَ مِمَّا قَلَّ مِنْهُ أَوْ كَثُرَ ۚ نَصِيبًا مَّفْرُوضًا ۩ 7 ۩

{ Surat al-Nisa - **Ayah 7** }

Interpretation of the previous verse: from what is left by parents and those nearest related there is a share for men and a share for women, whether the property be small or large, a determinate share. This verse is chosen in this study because it is important to identify the scope of the study for heirs entitled to receive faraid portion from men, women and relatives. Allah, the Law Giver of Islam, has Himself emphasized the importance and the pride of place, this branch of Shariah enjoys in the life of Muslim as a community. The Prophet of Allah (s.a.w): "Learn the laws of inheritance and teach it to people, for it is half of knowledge" (Narration of Hazrat Abu Huraira (RA).(Sunan Ibn Maja).

The Prophet of Allah (on whom be His blessings and peace) has emphasized forcefully the great need for acquiring the knowledge of the Islamic law of inheritance and transmitting it to others. The Prophet of Allah (s.a.w) also says:

العلم ثلاث : آية محكمة أو سنة قائمة ، أو فريضة عادلة ، وما كان سوى ذلك فهو فضل رواه أبو داود عن عبد الله بن عمرو - رضى الله عنهما . (Sunan Abu Daud) .

Interpretation of the previous hadith: Knowledge has three categories; anything else is extra; a precise verse, or an established sunnah (practice), or a firm obligatory duty. Literally Faraid have many meanings: to Decide, to Halal, to Ensure and Obligate is some of them. In syara', Faraid refer to division of properties when a Muslim passed away. The properties will then be divided within heirs, following Islamic rules. Properties have to be clean from debts, funeral observances, zakat and will that allow by syara . Before splitting the properties, the family must who within heir can acquire the properties by *Ashabul-Furud*, whose *Mahjud,* before splitting the balance to those qualified to receive *Asabah*. This group take fixed portion by syara' of 1/2, 1/3, 1/4, 2/3, 1/6 or 1/8.

They are husband or wife, mother or mother of mother, father or father of father, daughter or daughter of son, full sister, consaguine sister and uterine brother or sister (Khan, A. 2000).

1.2   PROBLEM STATEMENT

For Muslim people, the Quran and Alhadith provide complete guidance on how to distribute wealth among family members and relatives of a person who pass away. Distributing the wealth correctly requires thorough studies or expert guidance, because the rules stated are in details and unique to each person. Besides that, it is complex for normal people who do not have the knowledge on Islamic inheritance to implement the distribution of inherited wealth that was mentioned in the Quran. Thus, it needs someone who has the required knowledge and experience with thorough understanding. Normally, when someone passes away, his or her relatives will refer to someone who has enough knowledge to calculate the distribution, which is costly and time consuming. If it is not applied at all or not correctly, bitterness, hatred, infighting and loss of barkat prevails for ever and family quarrel and unfair distribution is haram.

1.3   OBJECTIVES

The objective of this research is to propose a web based expert system for Islamic inheritance law. The specific objectives are:

- To identify the Islamic rules guiding sharing assets of a deceased person as stated in the Quran.
- To implement the rules identified in a web based expert system prototype.

1.4   SCOPE OF THE STUDY

This study focus on the value of portion from inheritor to inherited and depend on the Islamic rules in inheritance during the Query and questions from an expert system. Besides that, the study focuses on correct distribution of the wealth of a deceased person and money associated with all forms of worship, directly or indirectly. This study involve an expert system containing rules related to 15 male side and 10 on female side with priority and entitlement portion to be receive from the portion of an inheritor to inherited such as show in Table 1.1 and Table 1.2.

Table 1.1: Heir on male side

No.	Heir on male side
1.	Son
2.	Son of Son
3.	Father
4.	Father of Father
5.	Full Brother
6.	Consanguine Brother
7.	Uterine Brother
8.	Son of Full Brother
9.	Son of Consanguine Brother
10.	Full Brother of Father
11.	Consanguine Brother of Father
12.	Son of Full Brother of Father
13.	Son of Consanguine Brother of Father
14.	Husband
15.	Male Slave Master

If all the heirs in Table 1.1 exist only 3 heir entitled to receive portion:

a) Father

b) Son

c) Husband

Table 1.2. Heir on female side

No.	Heir on female side
1.	Daughter
2.	Daughter of Son
3.	Mother
4.	Mother of Mother
5.	Mother of Father
6.	Full Sister
7.	Consanguine Sister
8.	Uterine Siste
9.	Wife
10.	Female Slave Maste

If all heir in Table 1.2 exist, only 5 heirs entitled to receive portion:

a) Daughter

b) Daughter of Son

c) Mother

d) Full Sister

e) Wife

If all 25 heirs in Tables (1.1 and table 1.2) exist, priority is given to only 5 heirs:

a) Father

b) Mother

c) Son

d) Daughter

e) Husband or Wife

1.5 SIGNIFICANCE OF THE STUDY

The research is very important for any Muslim in the world because this science from Allah and jurisprudence, and the Prophet of Allah (s.a.w) says: "Learn the laws of inheritance and teach it to people, for it is half of knowledge (Narration of Hazrat Abu Huraira (RA) (Ibn Maja). Moreover, providing such web based expert system would reduce time and cost for people who request for such service. However the distribution recommended by the expert system need to be validated by checking against the knowledge of an experience and expert in Islamic inheritance law.

1.6 SUMMARY OF THE CHAPTER

This chapter gives the general background information about the study as emphasized by the holy Quran which is the guiding reference for all Islamic laws and principles. It also explains the fundamental aspects of the study like the problem statement, the objectives, and significance of the study.

CHAPTER 2

LITERATURE REVIEWS

This chapter provides information about artificial intelligence, expert system, rules of inheritance in Al - Quran, and various expert systems in business applications domain and in the field of Islam. This chapter will presents the background of the study and discusses related work .

2.1 Artificial Intelligence

Artificial intelligence may be defined as branch of computer science that is concerned with the automation of intelligent behavior (Luger, 2002). AI has several areas of interest, such as robotics, vision natural language understanding and semantic modeling speech artificial neural systems and parallel processing, automated reasoning and theorem proving, game playing, human performance modeling and expert system. One of the major roots of the expert systems is in cognitive science: the way human's process information (the way they think and solve problems).

2.2 Expert System

Expert systems were developed as research tools in 1960 as a special type of AI to successfully deal with complex problems in a narrow domain such as medical disease diagnosis. Expert systems have greatly increased in popularity since their commercial introduction in the early 1980s. Today, expert systems are used in business, science, engineering, manufacturing, and many other fields in which there exists a well-defined problem domain (Giarratano & Riley, 2005). An expert system is a computer program that represents and reasons with knowledge of specialist subject with a view to solve problems or giving advice (Jackson, 1998). Expert systems are suitable for solving the ill-structured (or not entirely defined) type problems, which are usually

difficult or impossible to solve by conventional methods as an example, procedural programming (Noran, 2000).

An expert system is a computer program that provides expert advice (decisions, recommendations or solutions) as if a real person had been consulted. They can retain the knowledge and experience of anyone in an organization (including people who are retiring), per – process in information to increase an expert's productivity, or allow someone with less training to perform functions at a higher level. Expert systems can be used to gain access to expertise immediately, around the clock, by many people at the same time. In addition to the nature of the task that expert systems are suited for, the actual structure or architecture of expert systems differs from traditional software. An expert system is composed of two independent parts which are an inference engine and a knowledge base. The inference engine is the control structure of the program that implements the knowledge represented in the knowledge base. The knowledge base is where the real power of the expert system resides: the coded pool of rules, insights and knowledge that the person doing that task brings to bear on it. This two part structure results in two important features of expert systems :

a) It allows the system to be modified, updated, expanded more readily than traditional programs making it easier to keep the system current with changes in the field, or with changes in users' requirements, and

b) It allows the system to provide an explanation of the reasoning behind it's conclusions which is necessary to provide the credibility and confidence that people require before routinely it's advice (Jackson, 1998).

Figure 2.1 illustrates the concept of a knowledge based expert system (Giarratano & Riley, 2005). The expert system receives facts from the user and provides expertise in return. The main components of the expert system (invisible from the outside) are the knowledge base and the inference engine. The inference engine may infer conclusions (solutions) from the knowledge base, based on the facts supplied by the user.
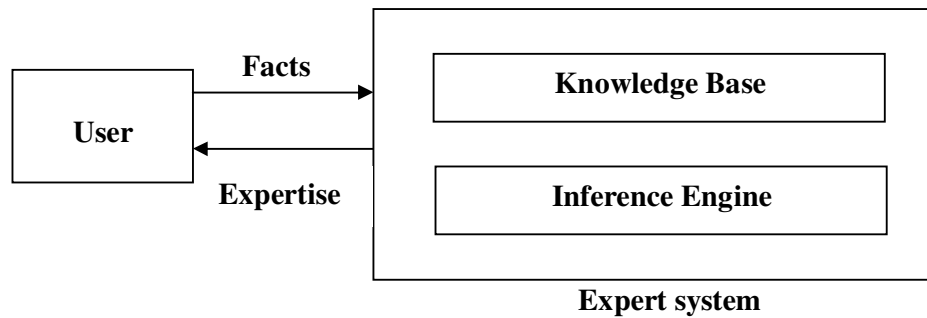
Figure 2.1: Basic Function of an Expert System (Giarratano and Riley, 2005)

Expert systems are developed to support end users in accessing a domain expert's domain knowledge whenever an expert is not available in person. These systems focus on simulating the domain experts' problem solving abilities ,i.e., they simulate human reasoning in performing some portion of the relevant tasks (Jackson, 1999).

The benefit of expert systems is their performance of many different functions (Awad, 1996). The use of expert assist the retention of scarce expertise. Many companies lose valuable expertise when their human expertise retire, move on or lose their edge. Expert systems are able to capture the knowledge of expertise on their way to retirement.

(Engelmore & Feigenbaum ,1993) stated that an expert system consists primarily of a knowledge base and an inference engine, engine and a couple of other features worth mentioning such as reasoning with uncertainty, and explanation of the line of reasoning. To deal with uncertain knowledge, a rule may have associated with it as a confidence factor or a weight. The set of methods for using uncertain knowledge in combination with uncertain data in the reasoning process is called reasoning with uncertainty. Because an expert system uses uncertain or heuristic knowledge (as humans do) its credibility is often in question (as is the case with humans). When an answer to problem is questionable, they tend to want to know the rational. If the rational seems plausible, they tend to believe the answer. So is with expert systems. Most expert systems have the ability to answer questions of the form: Why is the answer X? Explanations can be generated by tracing the line of reasoning used by the inference engine .

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Expert system may be used in a wide area of applications to solve problems related to interpretation, prediction, diagnosis, design, planning, monitoring, debugging, repair, instruction and control.

According to acquire.com (2005), in operation, expert systems can fill a number of functions such as shown in Table 2.1.

Table 2.1: The Function of Expert Systems

Function	Description
as a librarian	Helping people find, organize and interpret information required to carry out task
as an advisor	Embodying and sharing specialized expertise needed by others;
as an assistant	Taking care of routine tasks to free up time for more interesting and demanding aspects of the work

Jackson (1998) has categorized applications of expert systems by problem areas and problem-solving paradigms. The examples of the problem areas are shown in Table 2.2 .

Table 2.2: Major Application Areas of Expert Systems

Agriculture	Business	Chemistry	Communications
Computer System	Geology	Image Processing	Information Management
Law	Manufacturing	Mathematics	Medicine
Meteorology	Military	Mining	Power Systems
Science	Space Technology	Transportation	

Table 2.3 shows the eleven examples of problem-solving paradigms.

Table 2.3: Types of problem solved by Expert Systems

Problem-Solving Paradigm	Description
Control	Governing system behaviors to meet specifications
Design	Configuring objects under constraint
Diagnosis	Inferring system malfunctions from observables
Instruction	Diagnosing, Debugging and repairing students behavior
Interpretation	Inferring situation description from data
Monitoring	Comparing observation to expectation
Planning	Designing actions
Predication	Inferring likely consequences of given situation
Prescription	Recommending solution to system malfunction
Selection	Identifying best choice from a list of possibilities
Simulation	Modeling the interaction between systems components

Based on Table 2.1 the scope of this project is as an advisor system and based on Table 2.2 the focus area is in Business. The problem – solving paradigm that has been used for this project is Design as shown in Table 2.3.

Design systems configure objects under a set of problem constraints. For example designing a computer system under user-defined constraints of needed memory, speed, etc. These systems usually perform their tasks following series of steps, each with its own specific constraints . Complicating   matters, these steps are usually dependent upon each other, which makes it difficult to assess the impact of a change in step have on the other steps. (Durkin ,1998).

Design applications may involve the use of an expert system to collect information about constraints (specifications) relative to a particular product. The system then can be used as the design tool or to assist another design tool (Baur & Pigford, 1990).

Web – based expert systems deliver advice online to support product selection and other decisions. In recent study of an intelligent dialogue for online rule based expert systems Mertens Rosu and Erdani (2004), describes a concept for creating free

configurable, intelligent behaving web dialogues for rule based experts systems. Free configurable is meant to indicate, that the dialogue module developed with this concept is domain independent and being configurable with out needing means of programming intelligence means that in spite of this independency. It can behave in accordance to expert system's knowledge and receive user inputs. As dialogue and reasoning engine only communicate by exchanging facts, it can be used with any expert shell or reasoning tool adapted to provide simple knowledge interchange function. The dialogue itself can be realized in any language that supports server-sided dynamic creation of HTML pages. This concept has been successfully implemented within an online knowledge based system.

2.3 Benefits of Expert Systems

According to (Awad, 1996) expert systems can perform many functions in an organization, benefiting the firm in numerous ways such as.

- Improved productivity. American Express's expert system increased the efficiency of its credit authorizers between 45 and 65 percent.

- Staff training. The knowledge contained in an expert system is a valuable corporate asset in itself, but its value is increased when it is used for teaching, testing, or training new and junior staff. A novice can. gain experience working with the system, especially because of its explanatory powers.

- Retention of scarce expertise. Many companies lose valuable expertise when their human experts retire, move on, or lose their edge. Expert systems are able to capture the knowledge of experts on their way to retirement.

- Upgraded performance of skilled and experienced personnel. This can be an extremely useful contribution.

- Improved production operations. Expert systems free experts from the more routine tasks so that they can devote time to the specialized, "one of a kind"

problems in their domain. This is accomplished, in part, by bringing new employees to an acceptable level of competence more quickly.

- Relatively affordable expertise. Harnessing the experience of seasoned experts in their respective domains provides decision makers with the kind of support that conventional information systems cannot provide. Instead of assisting the decision maker by turning out mere data, expert systems tackle problems head on, essentially making the decision. The only question left to the user is whether to implement or veto the decision. The explanatory power of the expert system adds credence to the solution. .

- Increased output. Expert systems work faster than humans do. For example, XCON enabled Digital Equipment Corporation to increase the speed with which it processes VAX computer orders fourfold and with fewer people. This higher output resulted in lower overall handling costs.

- Standardized approach to problems that require expertise. Once a standardized approach has been developed for an expert system, the system stays on course and does not waver unless new rules or procedures are added. This standardization can minimize errors.

- Utilization of incomplete and uncertain information. Unlike conventional, algorithmic programs, expert systems can give useful answers even when supplied with incomplete information.

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2. 4 Rules of inheritance, in sura Al-Nisa (Al-quran)

These ayaat from Surat al-Nisa explain the laws of inheritance in Islam :

" يُوصِيكُمُ اللَّهُ فِي أَوْلَادِكُمْ لِلذَّكَرِ مِثْلُ حَظِّ الْأُنثَيَيْنِ فَإِن كُنَّ نِسَاء فَوْقَ اثْنَتَيْنِ فَلَهُنَّ ثُلُثَا مَا تَرَكَ وَإِن كَانَتْ وَاحِدَةً فَلَهَا النِّصْفُ وَلِأَبَوَيْهِ لِكُلِّ وَاحِدٍ مِّنْهُمَا السُّدُسُ مِمَّا تَرَكَ إِن كَانَ لَهُ وَلَدٌ فَإِن لَّمْ يَكُن لَّهُ وَلَدٌ وَوَرِثَهُ أَبَوَاهُ فَلِأُمِّهِ الثُّلُثُ فَإِن كَانَ لَهُ إِخْوَةٌ فَلِأُمِّهِ السُّدُسُ مِن بَعْدِ وَصِيَّةٍ يُوصِي بِهَا أَوْ دَيْنٍ آبَاؤُكُمْ وَأَبناؤُكُمْ لَا تَدْرُونَ أَيُّهُمْ أَقْرَبُ لَكُمْ نَفْعاً فَرِيضَةً مِّنَ اللَّهِ إِنَّ اللَّهَ كَانَ عَلِيما (١١) "

{ Surat al-Nisa - Ayah 11 }

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Interpretation of the previous verse: Allah (thus) directs you as regards your children's (inheritance): to the male, a portion equal to that of two females: if only daughters, two or more, their share is two thirds of the inheritance; of only one, her share is a half. for parents, a sixth share of the inheritance to each, if no children, and the parents are the (only) heirs, the mother has a third; if the deceased left brothers (or sisters) the mother has a sixth. (The distribution in all cases is) after the payment of legacies and debts. Ye know not whether your parents or your children are nearest to you in benefit. These are settled portions ordained by Allah; and Allah is all knowing, all wise. This ayat explain heirs entitled to receive faraid portion according to the rules (2/3,1/2,1/6,1/3).

وَلَكُمْ نِصْفُ مَا تَرَكَ أَزْوَاجُكُمْ إِن لَّمْ يَكُن لَّهُنَّ وَلَدٌ فَإِن كَانَ لَهُنَّ وَلَدٌ فَلَكُمُ الرُّبُعُ مِمَّا تَرَكْنَ مِن بَعْدِ وَصِيَّةٍ يُوصِينَ بِهَا أَوْ دَيْنٍ وَلَهُنَّ الرُّبُعُ مِمَّا تَرَكْتُمْ إِن لَّمْ يَكُن لَّكُمْ وَلَدٌ فَإِن كَانَ لَكُمْ وَلَدٌ فَلَهُنَّ الثُّمُنُ مِمَّا تَرَكْتُم مِّن بَعْدِ وَصِيَّةٍ تُوصُونَ بِهَا أَوْ دَيْنٍ وَإِن كَانَ رَجُلٌ يُورَثُ كَلَالَةً أَو امْرَأَةٌ وَلَهُ أَخٌ أَوْ أُخْتٌ فَلِكُلِّ وَاحِدٍ مِّنْهُمَا السُّدُسُ فَإِن كَانُوا أَكْثَرَ مِن ذَلِكَ فَهُمْ شُرَكَاء فِي الثُّلُثِ مِن بَعْدِ وَصِيَّةٍ يُوصَى بِهَا أَوْ دَيْنٍ غَيْرَ مُضَارٍّ وَصِيَّةً مِّنَ اللّهِ وَاللّهُ عَلِيمٌ حَلِيمٌ ﴿12﴾

{ Surat al-Nisa - Ayah 12 }

Interpretation of the previous verse, in what your wives leave, your share is a half, if they leave no child; but if they leave a child, ye get a fourth; after payment of legacies and debts. in what ye leave, their share is a fourth, if ye leave no child; but if ye leave a child, they get an eighth; after payment of legacies and debts. If the man or woman whose inheritance is in question, has left neither ascendants nor descendants, but has left a brother or a sister, each one of the two gets a sixth; but if more than two, they in a third; after payment of legacies and debts; so that no loss is caused (to any one). Thus is it ordained by Allah; and Allah is all knowing, most forbearing. This ayat explain heirs entitled to receive faraid portion according to the rules (1/2,1/4,1/8,1/6,1/3).

يَسْتَفْتُونَكَ قُلِ اللّهُ يُفْتِيكُمْ فِي الْكَلَالَةِ إِنِ امْرُؤٌ هَلَكَ لَيْسَ لَهُ وَلَدٌ وَلَهُ أُخْتٌ فَلَهَا نِصْفُ مَا تَرَكَ وَهُوَ يَرِثُهَا إِن لَّمْ يَكُن لَّهَا وَلَدٌ فَإِن كَانَتَا اثْنَتَيْنِ فَلَهُمَا الثُّلُثَانِ مِمَّا تَرَكَ وَإِن كَانُوا إِخْوَةً رِّجَالاً وَنِسَاء فَلِلذَّكَرِ مِثْلُ حَظِّ الأُنثَيَيْنِ يُبَيِّنُ اللّهُ لَكُمْ أَن تَضِلُّوا وَاللّهُ بِكُلِّ شَيْءٍ ﴿176﴾

{ Surat al-Nisa - Ayah 176 }

Interpretation of the previous verse: they ask thee for a legal decision, say: Allah directs (thus) about those who leave no descendants or ascendants as heirs. If it is a man that dies, leaving a sister but no child, she shall have half the inheritance: if (such a deceased was) a woman, who left no child, her brother takes her inheritance: if there are two sisters, they shall have two thirds of the inheritance (between them): if there are brothers and sisters, (they share), the male having twice the share of the female. Thus doth Allah make clear to you (his law), lest ye err, and Allah hath knowledge of all things. This ayat explain heirs entitled to receive faraid portion according to the rules (1/2,2/3,).

2.5 Computerized Faraid Information System

There is a website from University of Science Malaysia (USM) developed on Islamic inheritance law. The system was built using Malay language. E-Faraid is a complete computerized solution to the faraid management system which is a method of division of inheritance of the deceased's properties among his/her immediate family and relatives according to the Islamic law developed by the department of mathematics, University Sains Malaysia. http://maths.usm.my/faraid/msl/default.html. This software is menu driven and has a user friendly interface system which is specially developed for almost anyone having no previous or limited knowledge or an expert on faraid who is interested to study or resolving a particular problem which is relates to faraid. E-Faraid uses a database approach to solve either a single or multilevel (munasakhat) faraid problem. It consists of an information module which consists of a Malay translation of the Quranic verses on faraid, a summary of the deceased's family tree and those who have the right to stake their claims. A user needs only to key in the relevant information regarding the deceased and his/her family (from key board or a mouse click). Almost immediately, the result will be displayed in fractional form. The results can either be viewed on a computer screen or printed on a paper or special form which is customized to special requirements off any authority or organization. In addition, to the common output, E-Faraid will also display the true result in accordance with a given input value of the deceased's actual properties in any preferred currency or in term of it acreage (for land). Table 2.4   explains the differences between the traditional E-faraid and the proposed I-faraid:

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Table 2.4: Difference between E-Faraid and I-Faraid

Traditional E-Faraid	The Proposed I-faraid
It is not intelligent since it is only based on algorithm.	It is intelligent because since it is rule-based with explanation facility
The information and control are combined	The knowledge is separated from the control
It is difficult to modify and update	Update is made simple

2.6 Online Islamic Medication Expert Systems (OIMES)

According to (Hanita *et al,* 2008) the design and implementation of online rule-based Expert Systems for OIMES focuses on physical and inner illnesses. The knowledge base of the proposed ES contain exhaustively the types of illness or sickness together with their related cures or treatments/therapies, obtained exclusively from the Quran and Hadith. Extensive research and study are to be conducted to ensure that the expert system is able to provide the most suitable treatment with reference to the relevant verses cited in Quran or Hadith. These verses come together with their related 'actions' (bodily actions/gestures or some acts) to be performed by the patient to treat a particular illness/sickness. These verses and the instructions for the 'actions' are to be displayed unambiguously on the computer screen.The online platform provides the advantage to the patient for advising treatment practically anytime and anywhere as long as the computer and internet facilities exist. Patient does not need to make appointment to see an expert for a therapy. She/He may try this alternative method provided the sickness is not that very critical.

2.7 An Expert Systems in Business Applications

Business applications of expert systems are continuing to increase in number and diversity. Jay Liebowitz (2005) used the Business Protocol Expert System, an International Business Manners Advisor that describes an international business protocol expert system which is quite novel as an application. This mini-case study

could benefit a variety of educators/trainers by allowing themselves and their students to become more familiar with international customs and cross-cultural differences; presenting an interactive program that could be used in the information systems course as a way to internationalize the course; and helping American students in international business courses to become better aware of their foreign colleagues and their customs.

Stromquist and Tatham (1992) developed an expert system for environmental impact assessment, known as the EIA system. This system provides advice for hydropower development and river regulation projects. It is based on a method used for assessing the impact that hydropower development and river regulation will have on the environment, called the Environmental Impact Assessment (EIA) . Knowledge relating to the entire idea is required with this method to enable a stepwise approach to be adopted for the assessment. Since people in developing countries lack knowledge about the impact a project will have on the environment, as well as expertise and resources, an expert system should be invaluable to assist the end users in their decision-making regarding the impact hydropower development and river regulation projects will have.

Liebowitz (1991) MCI's product pricing system is an expert system tool, built to assist sales representatives in developing a price estimate for a potential customer. The system is available to all sales representatives and support personnel companywide. The system takes a minimum amount of user input, and based on the data, prompts the user for additional information. Once the system's inquiries have been satisfied, it generates a price estimate. The estimate can be given to a customer as a stand-alone document, or as an inclusion in a proposal. One of the strongest advantages of the pricing system is its ease of use and accuracy. Prices are generated using the most current product tariffs, accessible through feeds from corporate databases. The pricing system's accuracy, combined with on-line information, makes it more robust than other simplistic pricing. The system includes functions to price-specific product offerings, feature configurations, international and extended call pricing, discounts, and dedicated access pricing.

According to Zarri (1991) PECUNIA is an expert consultation system which gives advice on a personal investment portfolio. The system has been in use since 1987 at Banca San Paolo. PECUNIA knows about 20 different classes of financial products. Its main function is to rate a product according to a user profile built through interaction with the user by means of simple question answering. Reasons for suggesting a product or excluding it are explicitly maintained by the system and the user an freely browse through them. Moreover wean this general knowledge and bank specific heuristic knowledge.

The idea stemmed from the observation that a number of financial products were almost completely ignored in several branches, while the same products were regularly handled in other branches, even when the investors shared the same kind of requirements and constraints. A careful analysis revealed that the real motivation for these apparently different suggestions was the experience the operator had with some products, while he did not even really know the characteristics of other products. Therefore, one of the leading motivations for the development of PECUNIA was the need to improve the average skills of officers in decentralized branches. A second related point was the need to provide a reasonable substitute to the portfolio advisory officer even when one existed. PECUNIA was not expected to give in-depth analysis of the stock market, rather indications about classes of financial products in a broad sense. Stocks are covered as a particular subset of these classes, but the system does not give detailed suggestions about specific stocks. By contrast, the scope of PECUNIA is broad, and its architecture makes it easier to add new classes of products should they become available.

Jay Liebowitz (1991) developed the application, California Travel Expense Claim System (CALTREC), that prompts the user for information about expenses incurred on state business and produces an appropriate Travel Expense Claim document based on the information collected and state of California rules governing reimbursement of expenses. CALTREC is somewhat similar to early fielded expert systems in that to make the system usable, a great deal of work outside the scope of what would normally be considered knowledge engineering was required. First, the user audience consists of typical IBM mainframe commercial data processing users who are

accustomed to being led through an application without having to know special commands or refer to extensive documentation.

Expert System for Claims Authorization and Processing (ESCAPE) is used in the validation process for incoming warranty program checks at the Ford Motor Company Baur and Pigford (1990). The system helps Ford dealers determine if a given vehicle is covered under warranty for the work proposed. The system checks each incoming claim and attaches an error code to any that are not valid. It verifies that the vehicle type, production date, mileage, part and labor costs, and other data are appropriate for the warranty coverage indicated by the submitting dealer.

According to Osborn (1990) an Expert system as Bank Expert (BERT) assists bank examiners in evaluating the financial condition of banks. The Office of the Comptroller of the Currency (COC), is responsible for evaluating the financial condition of over 4,400 nationally chartered banks. The COC currently has 2,800 bank examiners that analyze banking data, prepare bank status reports, and conduct on-site inspections at troubled banks. BERT downloads all the data from COC's Amdahl mainframe onto the examiners' PC and then begins analyzing the data. The system considers 2,000 decisions and reduces them to five overall conclusions that are presented with narrative comment. The analysis takes about six minutes per bank. In tests, its conclusions matched those of the field testers 90 to 95 percent of the time. The system was implemented using GURU.

Holmes (1989), developed an expert system called Computer-Assisted Real Estate Market Analyst (CARMA), assists in the evaluation of the real estate market. The system is rule-based, uses a backward-chaining strategy, and consists of ten different rule modules. The system was implemented using EXSYS and Lotus 1-2-3. CARMA asks questions related to the area under consideration, such as population and employment trends, household incomes, and housing demands. It then uses Lotus to calculate financial ratios to aid in producing its overall evaluation of the real estate market.

Behan and Joe (1987) used an expert system, English Language-Oriented Indexing System for EDGAR (ELOISE) to assists personnel at the U.S. Securities and Exchange

Commission (SEC) with detecting unusual security transactions. EDGAR consists of a storage system for SEC filings that are received directly from filling companies. ELOISE analyzes the SEC filing documents using natural language processing techniques to detect the presence of certain predefined patterns and concepts. The system was developed using KEE and runs on a Symbolics LISP machine. It was developed at Arthur Andersen and Co.

2.8   SUMMARY OF THE CHAPTER

In this chapter, past literatures on expert system that are related to the study are reviewed. Also necessary Islamic publications and Hadiths related to the study are equally reviewed so as to justify the study and most importantly since the proposed system is knowledge-driven. Necessary quotation from the holy Quran and hadiths are also cited.

CHAPTER 3

METHODOLOGY

This chapter describe the methodology in developing Web based Expert System for Islamic Inheritance laws development that is adapted from expert system development life Cycle (Durkin, 1994) and has been used as a backbone. Basically, this methodology has five phases, where each of these phases, has its own tasks and procedures to be followed in order to develop an Expert System for Islamic Inheritance Laws as shown in Figure 3.1. These phases are:

a) Problem Assessment

b) Knowledge Acquisition

c) Knowledge Representation
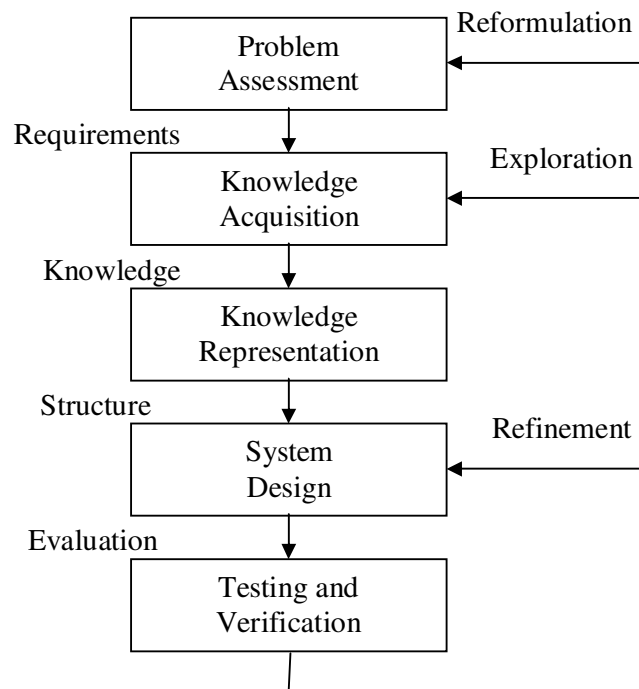
d) System Design

e) Testing and verification

Figure 3.1: ES Development Life Cycle, Durkin (1994)

3.1 Problem Assessment

During the problem assessment phase, the studies are conducted to determine and define the overall objectives of the projects. A clear definition of the problem simplifies the remaining tasks and helps generate a productive program. We need to specify the important features and scope of the project and identify the sources of knowledge including the domain experts and from other sources of knowledge such as books, annual report, Internet and others. This phase had been covered in detail Chapter 1. The current E-faraid is to be improved by adding rule based component with explanation facility to trace decisions recommended.

3.2 Knowledge Acquisition

In knowledge acquisition phase, the knowledge will be acquired, organized and studied to gather the body of knowledge in the problem of interest that can be encoded into the expert systems. The main objective of this phase is acquire Knowledge from human expert to guide the system development effort. The cycle of Knowledge Acquisition is shown in Figure 3.2.

Data, Problems, Question

| Domain Expert (Sheikh) Ahmad Adnan Bin Fadzil | → | Knowledge Engineer | → | Knowledge Base |

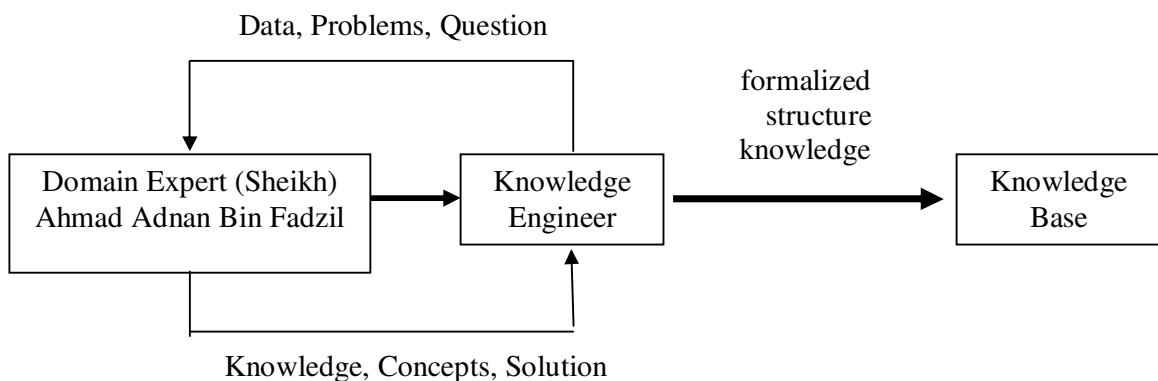formalized structure knowledge

Knowledge, Concepts, Solution

Figure 3:2 The Cycle of Knowledge Acquisition

Domain expert will provide the answer to every question asked by the knowledge engineer and knowledge that gained from the domain expert will be transferred into the expert system. Finally, the system will provide the results to the user.

The most common knowledge elicitations techniques in this process that had been used today in designing the expert system is the interview method.

For this project, the interview session is with one of the expert that had an experience in Islamic inheritance laws by the name Syeikh Ahmad Adnan Bin Fadzil. He conducted courses on faraid and also wrote a book titled by the name "Asas-Asas Memahami IImu Faraid". He is qualified to be an expert in this study. The interview session was about The Rules Of Inheritance, Sura Al-Nisa (Al-Quran) and some of doctrines in Islam, and how to identify the rules of wealth distribution stated in the Quran correctly.

3.3 Knowledge Representation

For the web expert system for Inheritance in Islam, this phase include the process of interpreting and analyzing the knowledge. These two processes provide the guidance in designing the new technique for collecting the additional knowledge from the human expert and other sources. This phase is covered in detail in Chapter 4 .

3.4 System Design

During the design phase, the overall structure and organization of the system's knowledge are defined. In this phase also, an initial prototype system to inheritance in Islam, is built. The method for processing the knowledge that will be use in the system and software tools that can represent and reason the system knowledge was chosen.

3.5 Testing and Verification

Testing and verification phase is a continuous process though out the projects. We can modify the systems along the process as we want in order to make it up to–date and current. The new technology also can be added to the system and directly to the knowledge base. The system is validated by the domain expert in order to ensure all the information about the Islamic inheritance laws is correct and accurate. The prototype and the rules, were examined by the system.

3.6 SUMMARY OF THE CHAPTER

This chapter defines clearly how the set objectives in the study are to be achieved. The discussion in the chapter is primarily centered on the system development approach used, the steps include problem assessment, knowledge acquisition, knowledge representation, system design and testing.
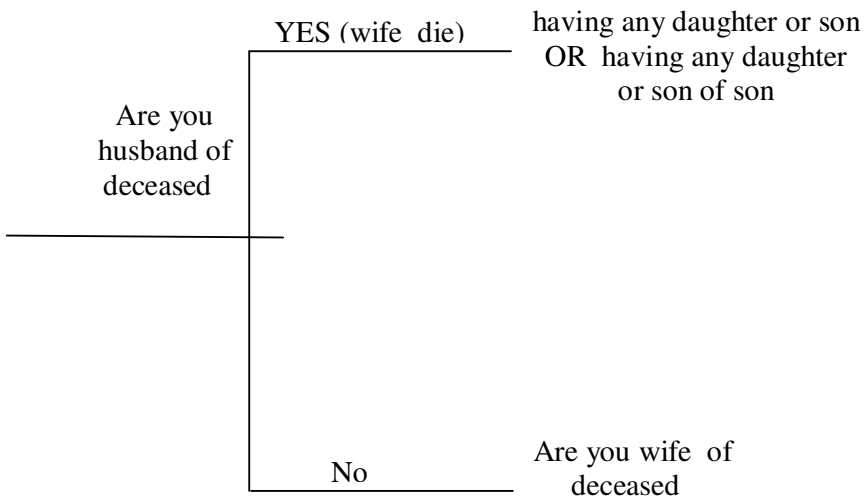
CHAPTER 4

SYSTEM DESIGN AND DEVELOPMENT

This chapter discusses about the system design and development of web based Expert system for i-Faraid, which include decision tree, decision table, interpretation the knowledge representation in production rules, inference engine, and also architecture. In System Analysis section, the context diagram, system flowchart and data flow diagram are presented. In the other section, which is System Design, database schema and system module are described. The last section is the system architecture, which discusses about the system requirements for this system which , knowledge base, working memory and inference engine.

4.1 Decision Tree

Decision Tree is graphical representation of a problem search space. The tree is composed of nodes and arcs linking related to the nodes. Each node represents decision issues and each arcs represent possible values for each issue. It provides an easy-to-follow graphical representation of the approach used in problem solving. Figure 4.1 illustrates the decision tree for heirs entitled to receive faraid portion and value of proportion.

```
                              having any daughter or son
          YES (wife  die)     OR  having any daughter
                                      or son of son
Are you
husband of
deceased


                                Are you wife  of
              No                   deceased
```

Figure 4.1: Decision Tree for heirs entitled to receive faraid portion

For Husband and Wife
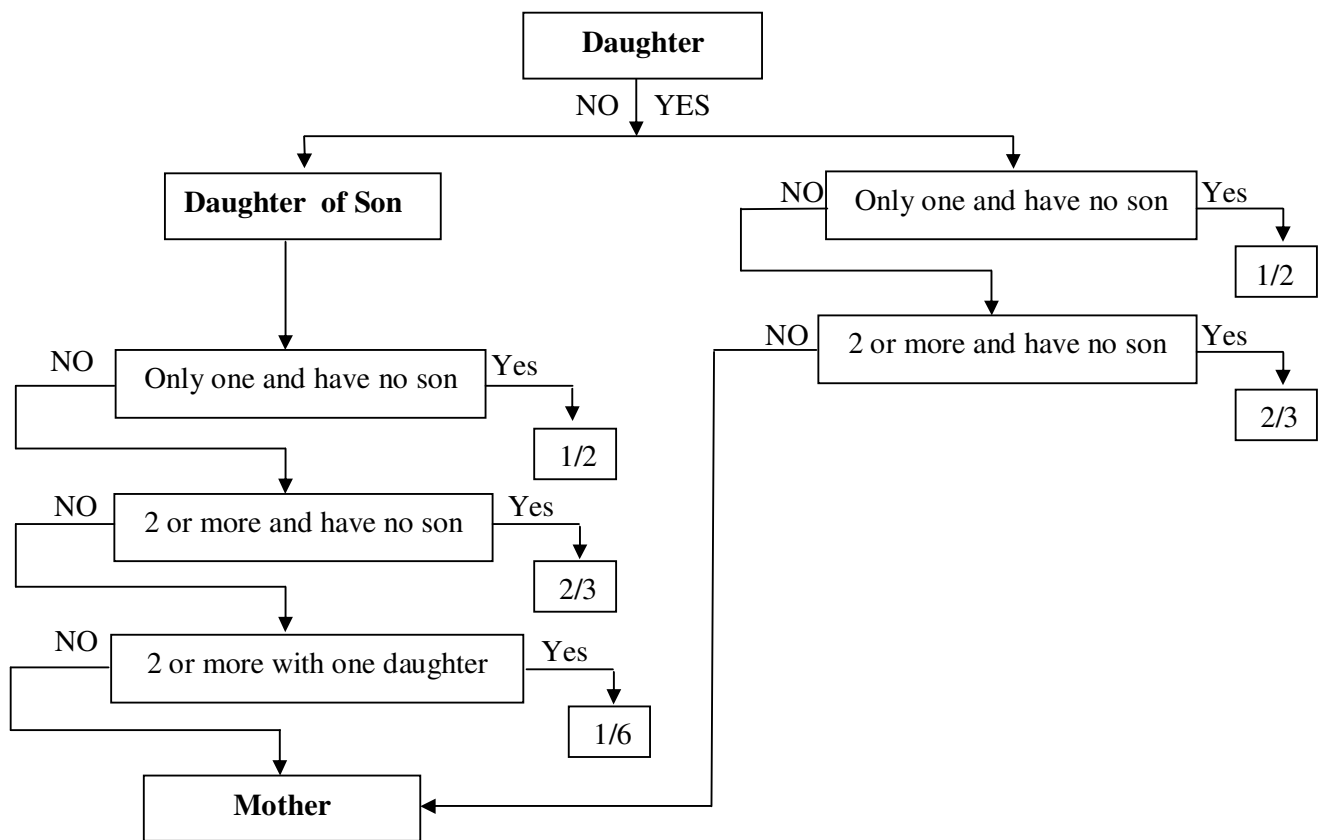
Figure 4.2: Decision Tree for heirs entitled to receive faraid portion
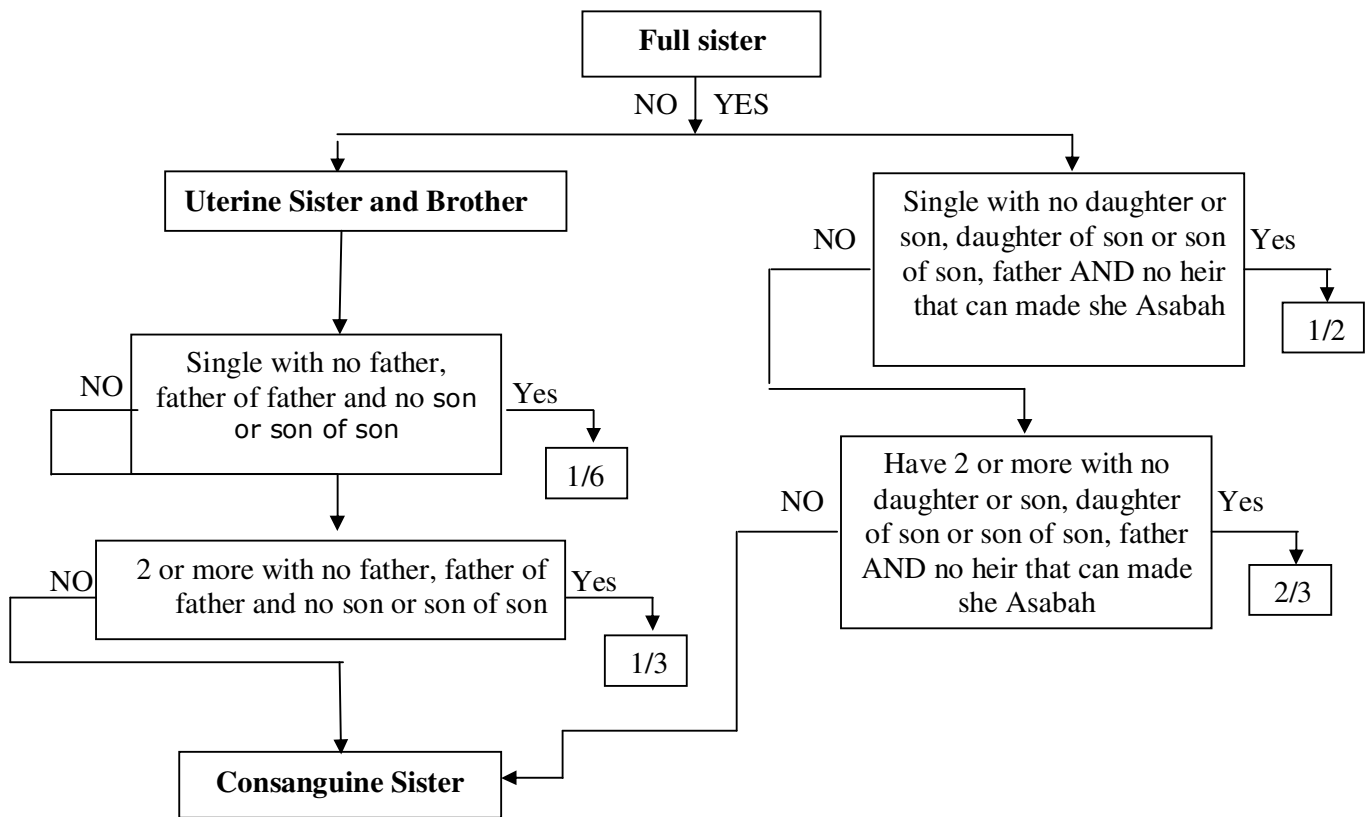
For Daughter and Daughter of Son
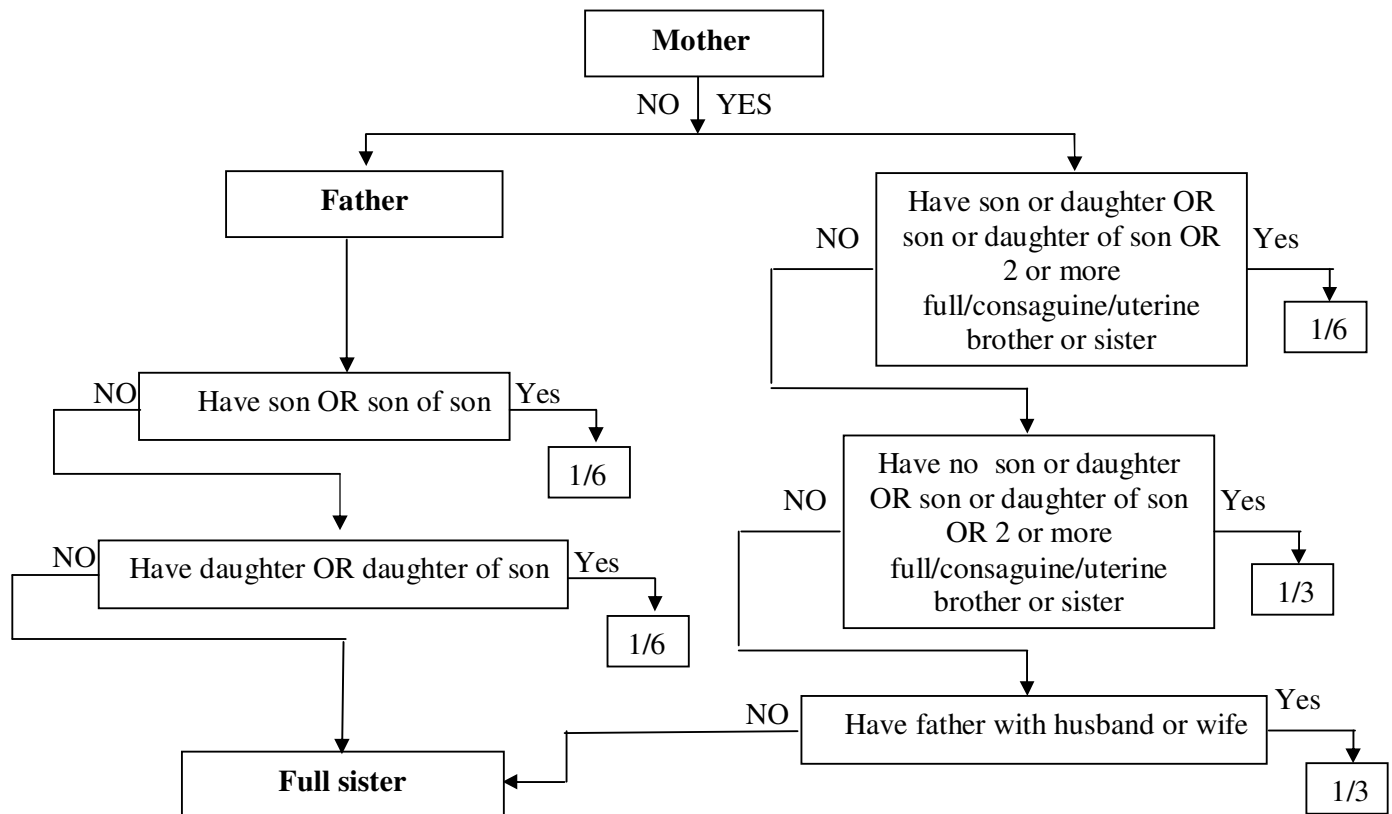
Figure 4.3: Decision Tree for heirs entitled to receive faraid portion

For Mother and Father

Figure 4.4: Decision Tree for heirs entitled to receive faraid portion

For Full sister and Uterine Sister and Brother
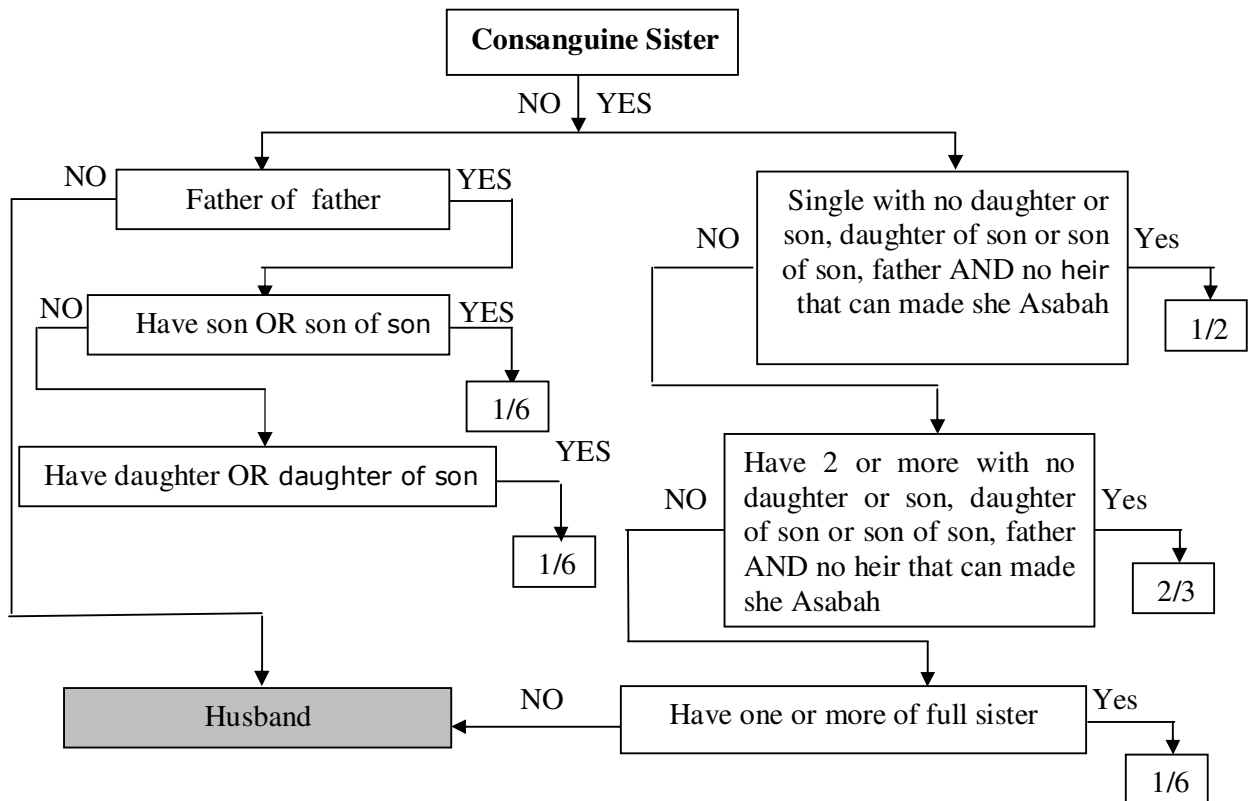
Figure 4.5: Decision Tree for heirs entitled to receive faraid portion
For Consanguine Sister and Father of father

4.2 Decision Table

Decision table is one of the knowledge representation techniques. Each table consists
of a series of decision factors, which labels columns and represent precondition

needed to reach a conclusion, which is represented in another column. Decision factor values are placed in rows, which lead to specific conclusion. It also provides an easy – to- fill-out form that the expert can use to provide the decision making knowledge **.**

Table 4.1: Heirs entitled to receive faraid portion according to the rule (1/2)

Heirs entitled to receive	Portion
Husband Not having any daughter or son OR Not having any daughter or son of son.	**Half (1/2)**
Daughter Only one AND have no son.	
Daughter of son Only one AND have no son.	
Full sister Full Sister Single with no daughter or son, daughter of son or son of son, father AND no heir that can made she Asabah.	
Consanguine Sister Single with no daughter or son, daughter of son or son of son, father AND no heir that can made she Asabah**.**	

Table 4.2: Heirs entitled to receive faraid portion according to the rule (1/3)

Heirs entitled to receive	Portion
Mother Have no son or daughter OR son or daughter of son OR 2 or more full/consaguine/uterine brother or sister	
Mother Have father with husband or wife	**Third 1/3**
Uterine Sister and Brother One or more with no father, father of father and no son or son of son	

Table 4. 3 : Heirs entitled to receive faraid portion according to the rule (1/4)

Heirs entitled to receive	Portion
Husband Having daughter or son OR Having daughter or son of son	
Wife Not having any daughter or son OR Not having any daughter or son of son	**Fourth 1/4**

Table 4. 4 : Heirs entitled to receive faraid portion according to the rule (2/3)

Heirs entitled to receive	Portion
Daughter 2 or more AND have no son	
Daughter of Son 2 or more AND have no son	
Full Sister Have 2 or more with no daughter or son, daughter of son or son of son, father AND no heir that can made she Asabah	**Two-Thirds (2/3)**
Consanguine Sister Have 2 or more with no daughter or son, daughter of son or son of son, father AND no heir that can made she Asabah	

Table 4. 5: Heirs entitled to receive faraid portion according to the rule (1/6)

Heirs entitled to receive	Portion
Daughter of Son 2 or more with one daughter	
Mother Have son or daughter OR son or daughter of son OR 2 or more full/consaguine/uterine brother or sister	
Father Have son OR son of son Have daughter OR daughter of son	**Sixth (1/6)**
Father of father Have son OR son of son Have daughter OR daughter	

Table 4. 6: Heirs entitled to receive faraid portion according to the rule (1/8)

Heirs entitled to receive	portion
Wife Having daughter or son OR Having daughter or son of son	**Eighth (1/8)**

4.3 Production Rules

Knowledge representation is carried out by developing production rules, commonly known as rules. Rules represent the major elements of a modular knowledge representation scheme, especially when use interpreting the Knowledge. For this phase, the interview transcript is reviewed in order to get the key pieces of knowledge. From that transcript also, the concepts, objects, rules, and heuristics is identified. To make the interpretation of the knowledge become clearer, all the knowledge is converted into production rules. This is because the production rules can describe how to solve the problem . The rules structure logically connects one or more antecedents also called premises contained in the IF part, to one or more consequents also called conclusions contained in the THEN part . In general, a rule can have multiple premises joined with OR statements(disjunctions),by representing the rules in the form of conditions . Below are the rules of the system translated from the decision trees and decision tables.

Table 4.7: Production Rules of System

IF Husband   Not having any daughter or son or Not having any daughter or son of son   **THEN** portion is **(1/2)**   **OR** having daughter or son or having daughter or son of son   **THEN** portion is **(1/4)**
IF Wife   Not having any daughter or son or Not having any daughter or son of son   **THEN** portion is **(1/4)**   **OR** Wife having daughter or son or having daughter or son of son   **THEN** portion is **(1/8)**
IF Daughter   have only one and have no son   **THEN** portion is **(1/2)**   **OR**   have 2 or more and have no son   **THEN** portion is **(2/3)**

IF Daughter of son	
have only one and have no son	
TEHEN portion is **(1/2)**	
OR having 2 or more and have no son	
THEN portion is **(2/3)**	
OR having 2 or more with one daughter	
THEN portion is **(1/6)**	

IF Mother
Have son or daughter OR son or daughter of son OR 2 or more full/consaguine/uterine   brother or sister
THEN portion is **(1/6)**
OR Have no son or daughter OR son or daughter of son OR 2 or more full/consaguine/uterine brother or sister
THEN portion is **(1/3)**
OR Have father with husband or wife
THEN portion is **(1/3)**

IF Father
have son or son of son
THEN portion is **(1/6)**
OR have daughter or daughter of son
THEN portion is **(1/6)**

IF Full sister
Single with no daughter or son, daughter of son or son of son, father AND no heir that can made she Asabah
THEN portion is **(1/2)**
OR Have 2 or more with no daughter or son, daughter of son or son of son, father AND no heir that can made she Asabah
THEN portion is **(2/3)**

IF Uterine Sister and Brother
Single with no fahter, father of father and no son or son of son
THEN   portion is **(1/6)**
OR   2 or more with no father, father of father and no son or son of son
THEN portion is **(1/3)**

IF consanguine Sister

Single with no daughter or son, daughter of son or son of son,

father AND no heir that can made she Asabah

THEN portion is **(1/2)**

OR Have 2 or more with no daughter or son, daughter of son or son of son, father AND no heir

that can made she Asabah

THEN portion is **(2/3)**

OR Have one or more of full sister

THEM portion is **(1/6)**

IF Father of Father

Have son OR son of son

THEN portion is **(1/6)**

OR Have daughter OR daughter of son

THEN portion is (1/6)

The relatives node, and those who deserve the value is of the heirs from the family members. The structure of cognitive maps hierarchy is as shown in Figure 4.6.
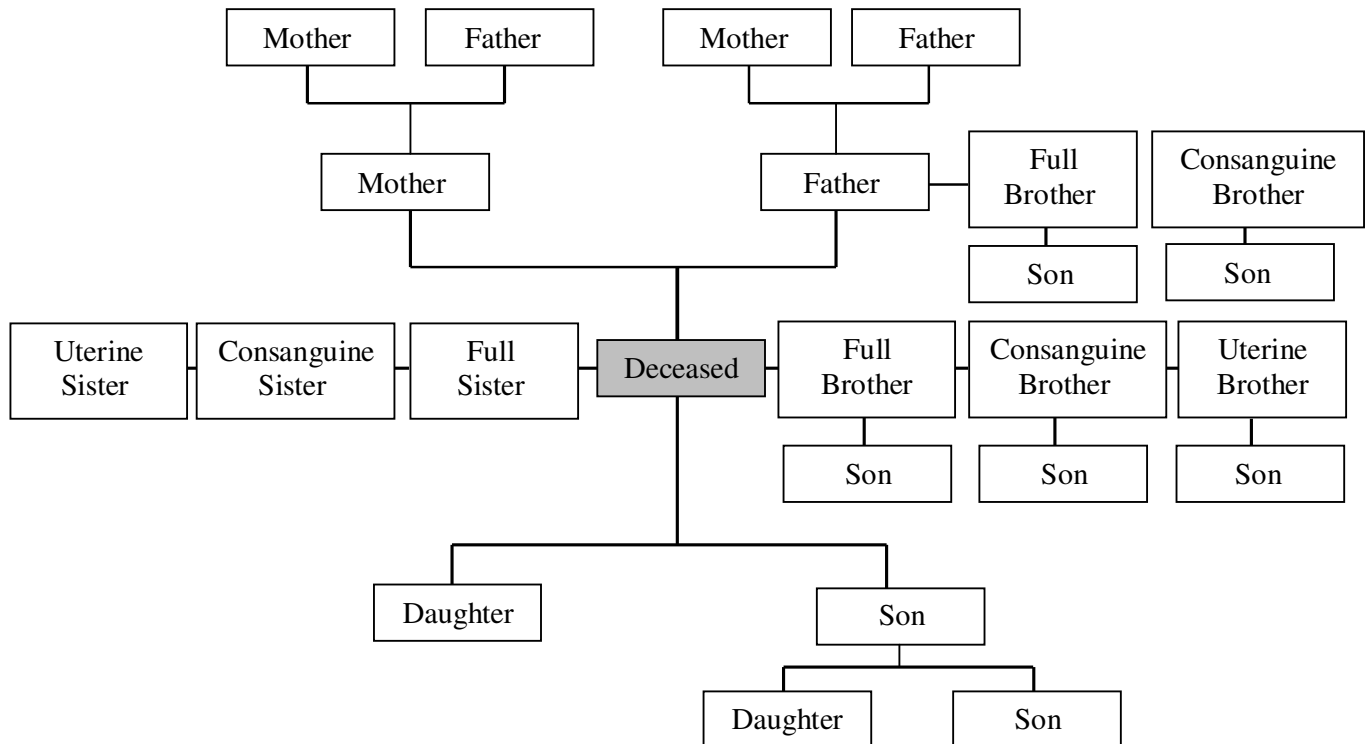

**Figure 4.6: Cognitive Heir is based on 25 heirs
entitled to receive faraid portion.**

4.4 Inference Network

Inference network provides graphical representation of the system's rules, with the antecedent and consequences of the rules drawn as nods and their supporting draw as link. Figure 4.7 and Figure 4.8 shows the inference network for heirs entitled to receive faraid portion according to the rules.
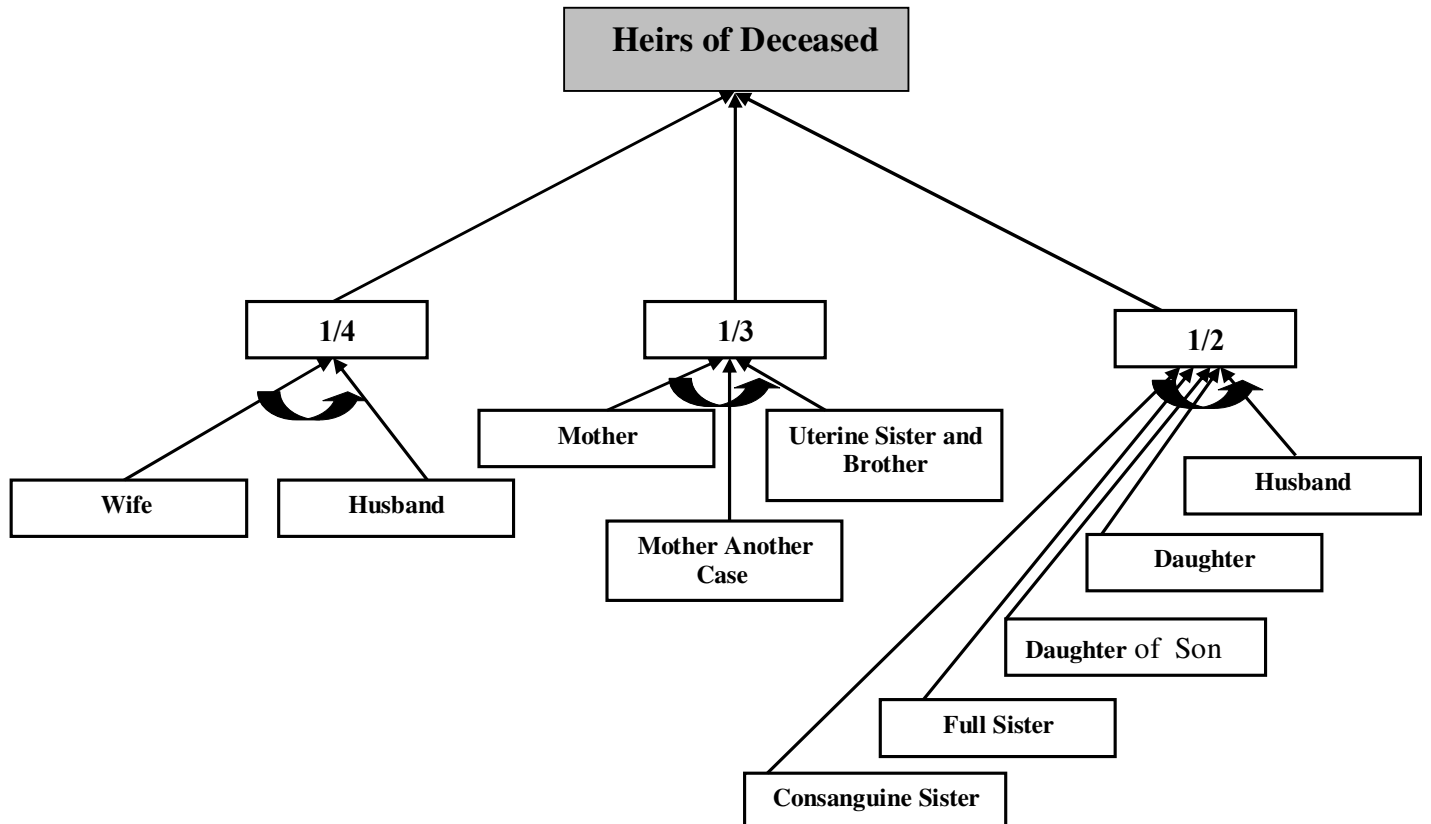

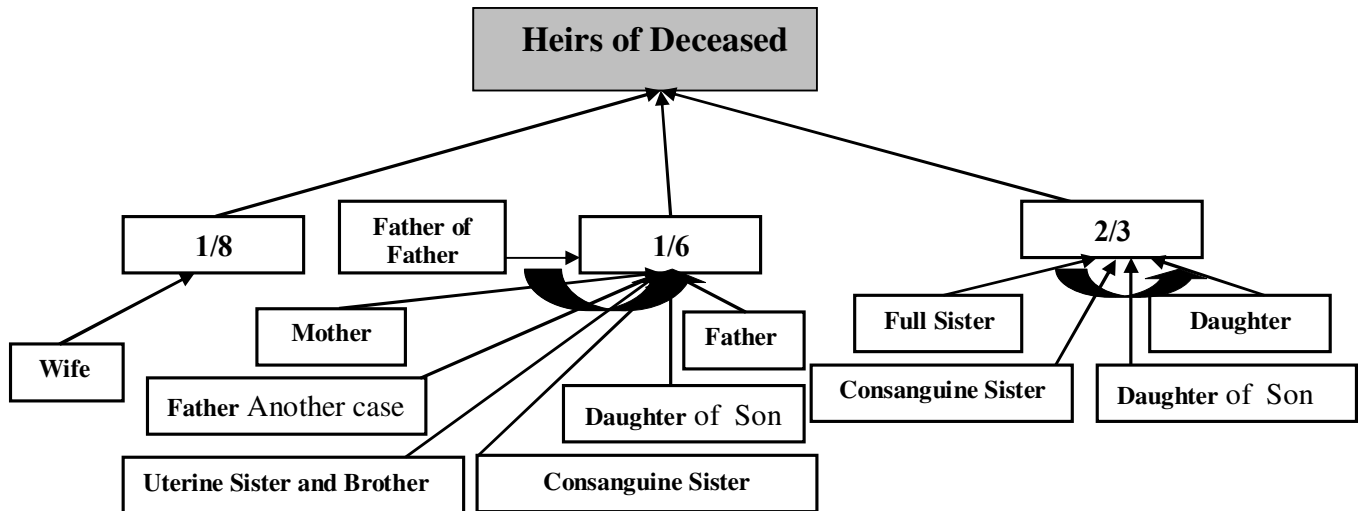**Figure 4.7: Inference engine for heirs entitled to receive faraid portion according to the rules (1/2,1/3,1/4)**

**Figure 4.8: Inference engine for heirs entitled to receive faraid portion
according to the rules (1/8,1/6,2/3)**

4.5 System Analysis

Systems analysis   dealing with analysis of sets of interacting entities,   and the interactions within the system, where the system analysis describe   the Context Diagram , System Flowchart and Data Flow Diagram .

4.5.1 Context Diagram

User will input leave value and answer all question given by the system. All the information keyed in by user will be stored in database. The system then will give the portion result for any user wanted to know his portion of the leave based on the user's input. The Administrator can update the data in data base and do some changes to the data.
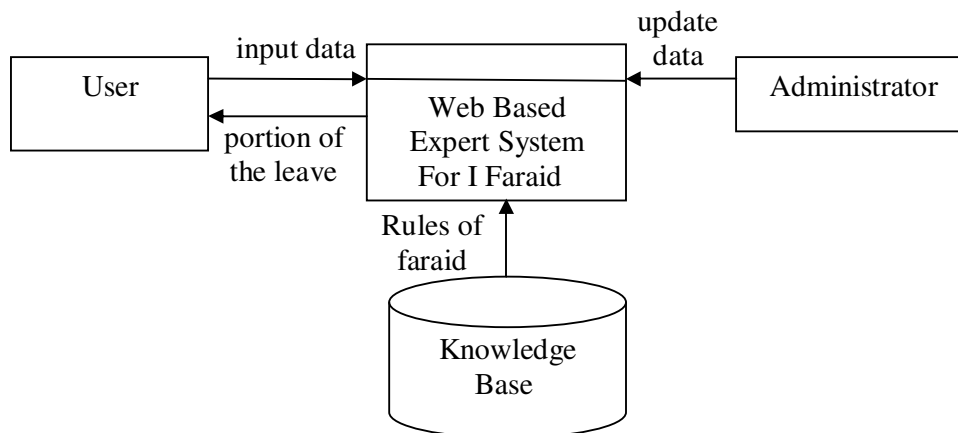

Figure 4.9 Context Diagram

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4.5.2 System Flowchart

Figure 4.10 shows the flowchart of the system. The diagram shows the main module of the system; Faraid in Islam module. When a user wants to have a consultation, the user should enter leave value of deceased. The system will directly ask questions depending on his relation with the deceased. After determining the relationship, the system will ask another questions about the rules that relates with the relationship. At the end of the consultation, the system will conclude and give the result to the user (portion of the leave). The system will also explain how the portion of the leave is calculated.
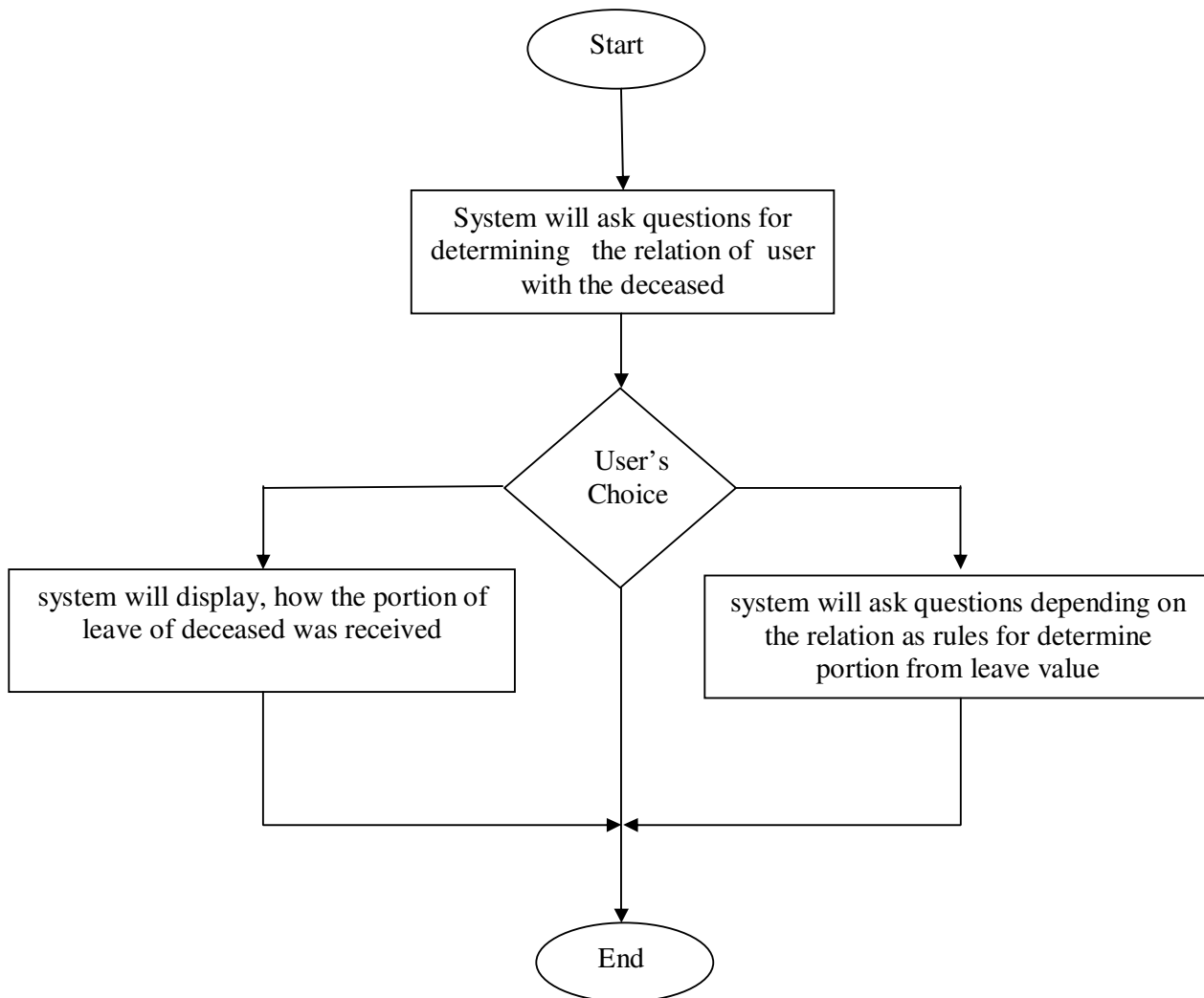

Figure 4.10 Context Diagram Flow Chart of System

4.6 System Design

This section describe all the tables for data base that was included in the system also for system module, the interface and user manual in the system.

4.6.1 Database Schema

Database Schema defines the database structure in term of table, attribute, data type and size. The following (Table 4.8 – 4.9) shows the database structure in this system.

Table 4.8: Data Structure of Admin Table

Field	Field Description	Type of Data	Size
Adminuser	name of admin	Varchar	255
Pass	Password of admin	Varchar	255

Table 4.9: Data Structure the Questions of Relationship And Portion Received

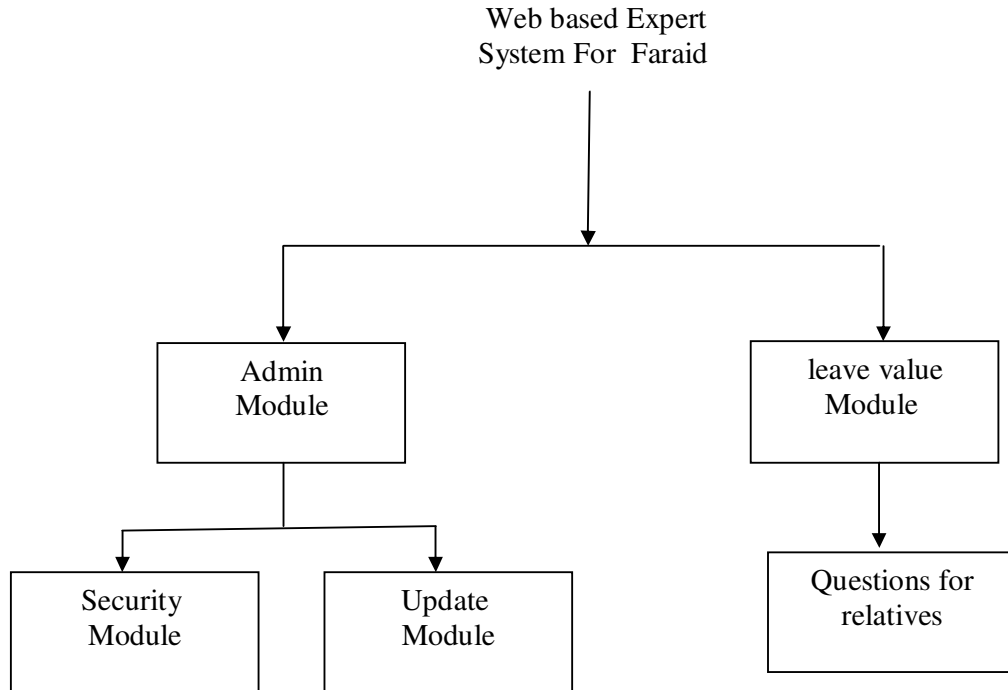| Field	Field Description	Type of Data	Size
Relation 1	Determine the relationship with Deceased	Varchar	255
Relation 2	more details for relationship	Varchar	255
Value	Portion Received	Varchar	255
ID	Number of rules	Int	11

4.6.2 System Module

Figure 4.11 System Module

As shown in Figure 4.11, the system has modules and sub modules

- **Admin Module**

The Admin Module is designed for authorized user to add, delete and update the Relative, Rule and Portion for heirs entitled to receive faraid portion.

- Leave value Module

In Leave value Module, the types of questions can be divided into 2 that are general question for determine the relationship with the Deceased, and specific questions about that relation.

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4.6.3 The interface

Web based Expert
System For Faraid

Maim Menu

Administrator

Faraid System

Login

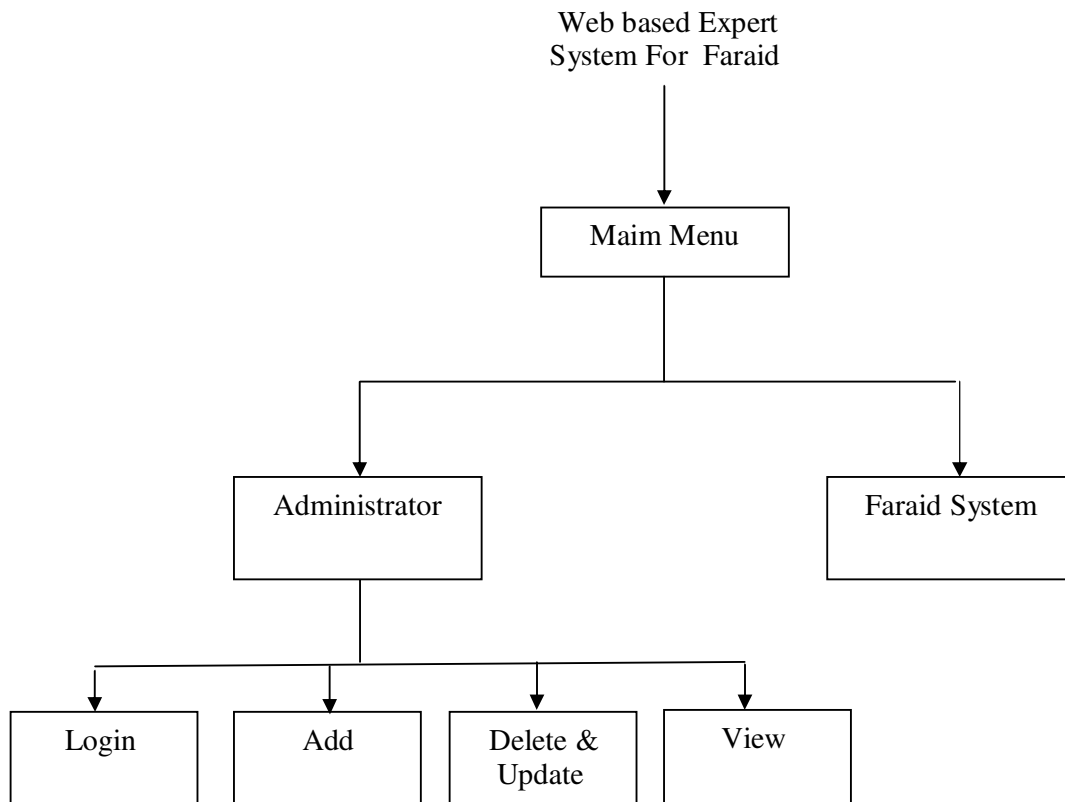Add

Delete &
Update

View

Figure 4.12 Interface Design

Figure 4.12 shows the structure of the user interface in web based Expert System for Faraid. The Main Menu has 2 sub-menus: Administrator, Faraid system. The Administrator Menue has 4 sub-menus: login Menu, Add menu, Delete And Update Menu, and View menu .

4.6.4 The Main Menu

Figure 4.13 The Main Menu

Figure 4.13 and 4.14 shows the Main Menu of Web Based Expert System for Faraid in Islam . It contains 2 sub menu, Administrator, Faraid System, and from this menu the user will enter leave value.

4.6.5 The Menu for Questions of relative

Figure 4.14 shows the system will ask the user to determine the relation with the inheritor

Figure 4.14 Questions to determine the kinship relevance

4.6.6 The Menu for more questions for the relative

Figure 4.15 shows after determining the relationship with inheritor, the system will ask more detail questions to determine the value of the heirs depending on that relationship it was chosen.

Figure 4.15: More questions for the relative

4.6.7 The Result for Portion received and Leave made by the system

Figure 4.16 shows the result for portion received and leave, where the value is divided depending on the relationship with the inheritor and the value of portion of the heirs according to the rules of Faraid.

Figure 4.16 The result for portion received and leave

4.6.8 The Explanation After The Result

Figure 4.17 shows after the result for portion received and leave, the System will give the user explanations how the result was obtained, it means result for reason. Characteristics of an expert system in this study is an enhancement for E-faraid (http://maths.usm.my/faraid/msl/default.html).

Figure 4.17 The explanation after the result

4.6.9 The Admin Module

Figure 4.18 shows the admin menu. The administrators are required to enter their login and password.
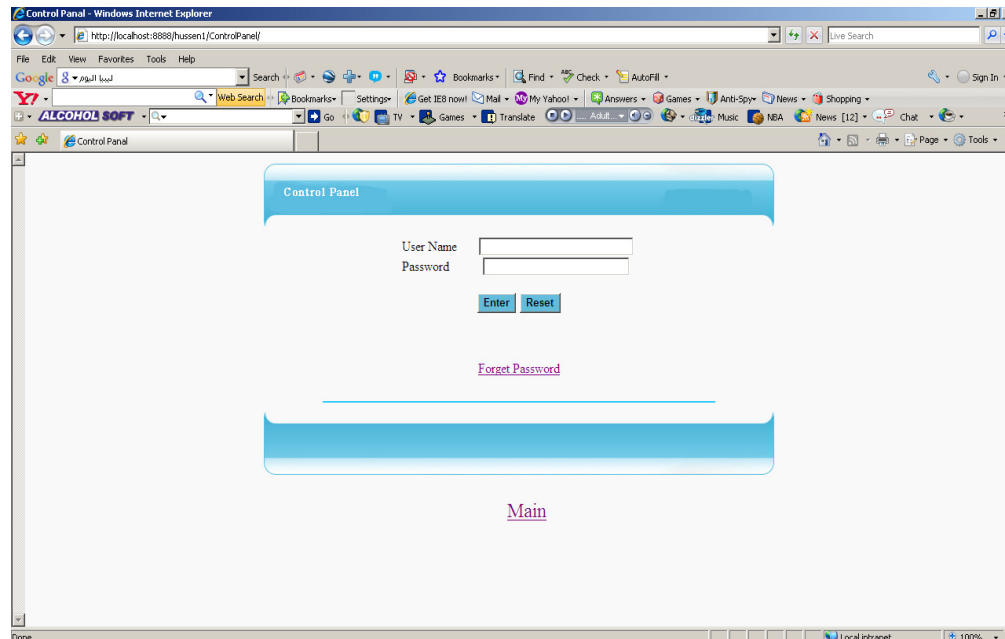

Figure 4.18 The Admin Menu

Figure 4.18 shows the admin menu. Admin person are allowed to make changes to the system in order to ensure the system is up-to-date.

4.7 System Architecture

Web based Expert System for Faraid is a web-based expert system that is located in the server and can be accessed through the world wide web. The system is implemented using Java Server Pages (JSP) application program interface (APIs) to develop Web applications. JavaServer Pages (JSP) technology enables Web developers and designers to rapidly develop and easily maintain, information-rich, dynamic Web pages that leverage existing business systems. As part of the Java technology family, JSP technology enables rapid development of Web-based applications that are platform independent. JSP technology separates the user interface from content generation, enabling designers to change the overall page layout without altering the

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underlying dynamic content. Web Based Expert System for Faraid contains 3 main components : Knowledge base, Working Memory and Inference Engine (Figure 4.19).
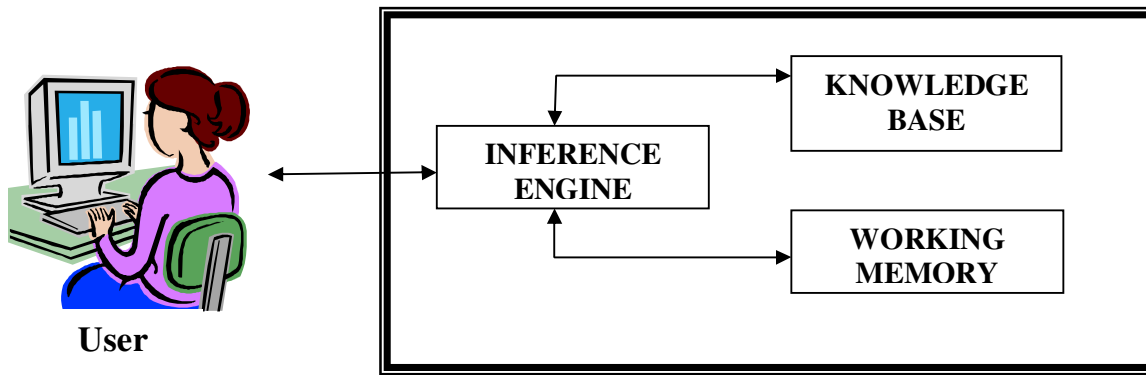

Figure 4.19 Expert System Problem Solving, Durkin, J. (1994)

4.7.1 Knowledge Base

Knowledge base is the important part in developing the expert system. Knowledge base contains every thing necessary for understanding, formulation and solving the problem in the system. The most popular approach to representing domain knowledge is using production rules. All the knowledge will be represented in different ways in the table of the data base**.**

4.7.2 Working memory

Working memory contains facts about problem that are discovered during the consultation with the expert system. All the information on the current problem will be located in the working memory. The system will match this information with knowledge contained in the knowledge base to infer new facts. The system reaches some conclusion that is also entered into the working memory.

4.7.3 Inference Engine

The inference engine will generate the consultation result. It works with facts contained in the working memory and the domain knowledge base to derive new information. It will match the facts to draw conclusion about the problem.

4.8 Testing and Verification by Domain Expert

In order to check the testing and verification   of our system we met the domain expert (Syeikh Ahmad Adnan Bin Fadzil) . He entered a lot of scenario tests to the web based expert system. Among these are :

a) For deceased person who is has husband ,wife ,daughter .

b) For deceased person who is has daughter of son, mother, father .

c) For deceased person who is has full sister, uterine sister and brother , congaing sister.

All these scenarios were tested and gave accurate results based on rules from the Holy Quran and domain expert.

With these successful testing of these scenarios, included inside the system the domain expert was satisfied and appreciated the flexibility of the knowledge base and advised to add more rules of faraid to the prototype .

4.9   SUMMARY OF THE CHAPTER

This chapter discusses the design and analysis of the system, all possible instances of inheritance according to Islamic rules are clearly defined using the decision trees, decision tables and productions rules. In addition to this, the chapter also contains the samples of the developed prototypes and functional analysis of the system using flow chart and data flow diagrams.

CHPTER 5

CONCLUSION AND DISCUSSION

The expert system that has been developed as a result of our research work can be used online. Any Muslim, worldwide can easily compute his or her portion of the wealth left behind by the decease according to the Rules of Faraid in Islam . The website can provide the user to allocate the wealth to all the users and to those, who have rights or entitled to receive their portion from the wealth. When any user answers the question on his relation to the System. The web based expert system for Islamic Inheritance Laws is considered useful for any Muslim in this world and Success in Design. Such a system leads to call for wider use of expert systems in the field of Islamic Jurisprudence. In this chapter, the limitation of the prototype and recommendation for future works for the system presented as prototype.

The contributions of this study are:

- Achieving, the first objective of this study by identifying the rules of sharing wealth of Muslim deceased.

  Domain expert was interviewed to capture the knowledge of a reputable Islamic scholar and also from other Islamic publications and most especially the Quran as stated in chapter four.

- Achieving the second objective, the captured rules was implemented and a web based expert system was developed and the identified rules serve as the knowledge as shown in the prototype in chapter four.

5.1 Limitation

In this study the limitation of the prototype developed such as:

- This prototype only covers sizeable portion of faraid rules.

- It can only assess, when the user is online.

- The processing speed for this system can be slow depending on the number of user using the system and bandwidth

- 'Why' facility for each question asked is not included in the system.

5.2 Recommendation

Below are the recommendation for the future works :

- subsequent web based designer could add more relevant questions to the knowledge base to make it more robust and extensiveness.

- the system can be adapted to other branches of Islam such as Zakat, and recurring phenomenon to use an expert systems in field of Islam , more work is needed in this direction
- Have multiple experts as domain expert to get more knowledge of experts regarding all the rules for faraid in four schools of thought (*Almathaheb*).
- The 'Why facility can be added in the future for every question asked.

REFRENCES

Acquire.com,(2005). Acquire Intelligence: Expert System. Retrieved 20 Septemper,2005, from http://www.aiinc.ca/information/es.shtml.

Ahmad, H. B. D. L. T. J. R. (2008). Online Islamic Medication Expert Systems (OIMES). IEEE.

Awad, E. M. (1996). Building expert systems. West Publishing Company.
Beanlands, G. A. (1994). The Application of Expert Systems to Environmental Impact Assessment. Annotated Bibliography. (GEBEC Consultants, Halifax).

Behan, J. (1987). Overview of Financial Applications of Expert Systems, Proceedings of IEEE Computer Society, WESTEX-87: Proceedings-Western Conference on Expert Systems, Anaheim, CA, pp. 223-229.

Cantu-Ortiz. (1991). Operational expert system applications in Mexico –Francisco, J. Cant-Ort (editor), Pergamon Press, publisher: Butterworth-Heinemann

Durkin, J. (1998). Certainty Therory.(1st E.) Expert System: Design and Development.(pp.350-353). United States of America: Macmillan Publishing Company.

Durkin, J. (1994). Expert Systems: Design and Development.(p.28). United States of America: Macmillan Publishing Company

Donald A. Waterman (1986). A guide to Expert Systems, United States of America: Addison-Wesley Longman Publishing Co., Inc

Engelmore. (1993). Introduction Expert Systems and Artificial Intelligence Retrieved May 6, 2005, from http://www.wtec.org/loyola/kb/c1_s1.htm

Finn, G. A. (1989). Applications of expert systems in the process industry. In: G.G. Patry and D Chapman eds..Dynamic Modeling and Expert Systems in Wastewater Engineering. Lewis Publishers, Inc. Chelsea. MI.Chapter 6, pp. 167-192.

Giarratano, J.C & Riley, G. D (2005). Expert System Life Cycle. (4th Ed.) Expert Systems: principles and programming.(pp.338-345). Canada Thomson Course Technology .

Holmes, W. T. M. E. W. (1989). The computer-assisted real estate market analyst: A knowledge-based real estate market analyst, Proc. of the 1989 Conference of the Northeast Decision Sciences Institute, .

Jackson, p. (1998). Expert System. (3th Ed). Intruduction to Expert Systems (pp.3-7). United States of America: Addison Wesley Logman .

Jackson, P. (1999). Introduction to Expert Systems, Addison Wesley England.

Khan, M. M. A. (20c 00). Islamic law of Inheritance. Aligarh Muslim University, Aligarh .

Liebowitz, J. (1991). Operational expert system applications in the United States. Oxford, U.K.: Pergamon.

Liebowitz, J. (2005). Journal of Information Systems Education ,Professor of Management Science   George Washington University Washington.

Luger, (2002). Intruduction to Artificial Intelligence (4th Ed), Artificial Intelligence structure and strategies for complex problem solving,United states of America . Addisons Wesley . pp.5-8

Marican, P. (2004). Islamic Inheritance Laws in Malaysia, Malayan Law Journal: Sdn Bhd (76125-H) T1-6, Jaya 33, 3 Jalan Semangat, Seksyen 13   46100 Petaling Jaya, Selangor Darul Ehsan.

Mertens, S., Rosu, M., & Erdani, Y (2004). An Intelligent Dialogue for Online Rule Based Expert Systems .

Noran. (2000). A Course Advisor Expert System . Retrieved May 5,2005, from http://www.cit.gu.edu.au/nora

Osborn, P. A. W. Z. (1990). Building expert systems from the ground up, AI Expert, vol. 5, no. 5, pp. 28-35.

Pigford, B. (1990). Expert Systems for Business concepts and Applications, Boston: Boyd & Fraser Pub. Co.

Shinghal, Y. S. A. R. (1991). Operational expert system applications in Canada : Butterworth-Heinemann Newton, MA, USA

Stromquist, L. T., S. (1992). in Stromquist (Ed.) Environmental, Development, and Environmental Impact Assessment: Notes on Applied Research. Department of Physical Geography, Uppsala University, UNGI Nr 82.

Zarri, G. P. (1991). Operational expert system applications in Europe Oxford, U.K.: Pergamon.

APPENDIX

DATA FLOW DIAGRAM

1.0 Data Flow Diagram

Data Flow Diagram (DFD) is a means of representing a system at any level of details with a graphic network of symbols showing data flows, data stores, data processes and data sources/destination. The purpose of DFD is to provide a semantic bridge between users and system developers. The goal of DFD is to have a commonly understood model a system. For this system, the DFD is focused in the system analysis process model phase. Figure 1 will show the flow of data in level 0.
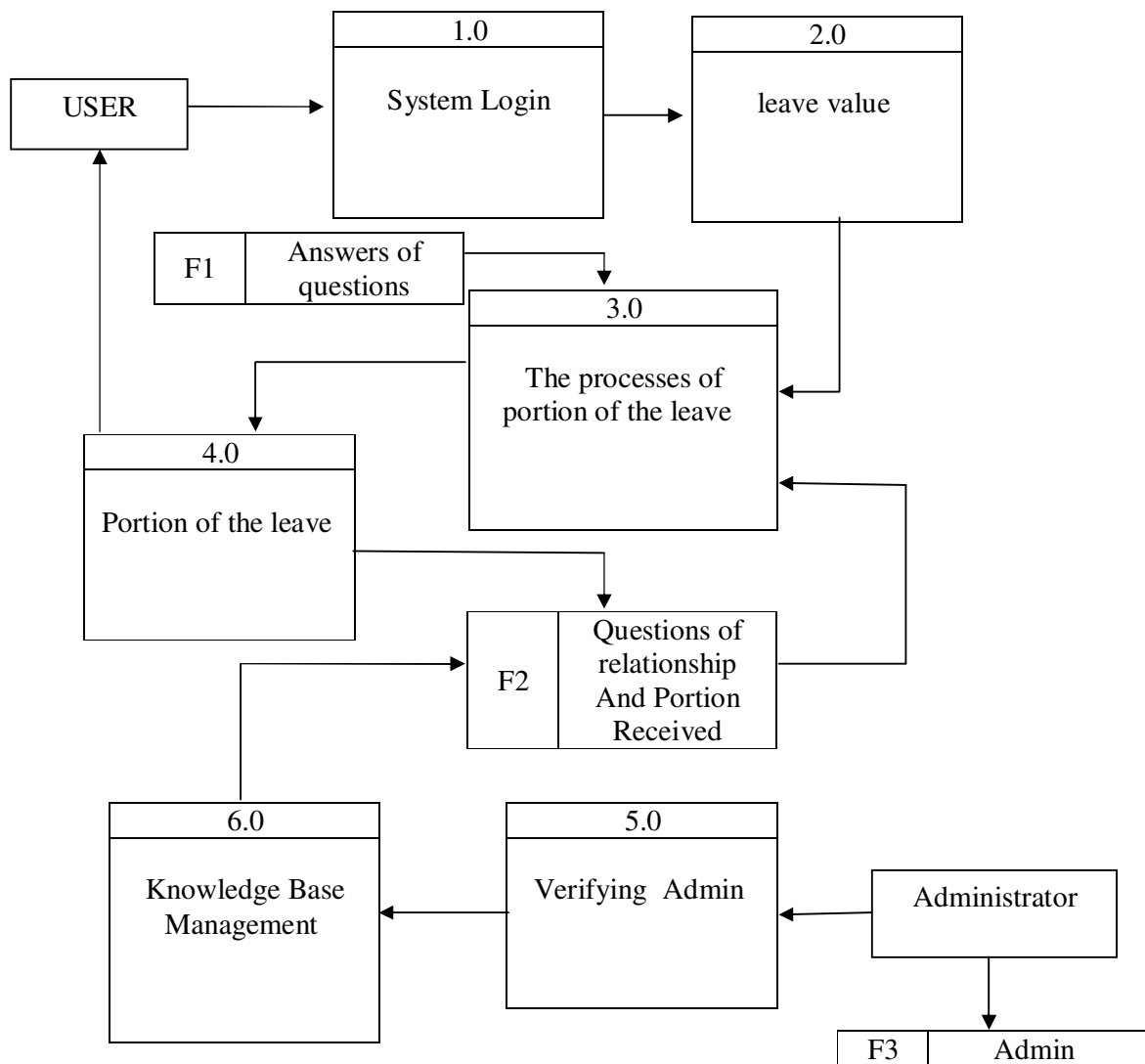
Figure 1: Data Flow Diagram Level 0

Figure 1 shows there are 6 main processes that involved in the system. There are System Login, Enter leave value, The processes of portion of the leave , Portion of leave, Verifying Admin, Knowledge Base Management. The process of portion of the leave, which is the process 3.0, is the core in the system because it will represent the portion of leave for everyone has relation   with the Deceased.
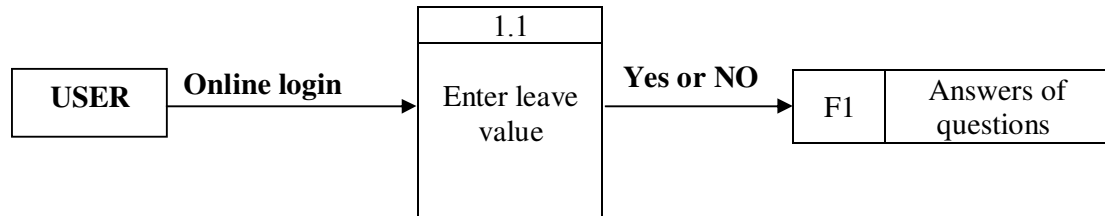

Figure 2:The DFD level 1 for System Login process

Figure 2 illustrated the sub process for process 1.0, which is System Login process. User will enter leave value in the main page to use the system.
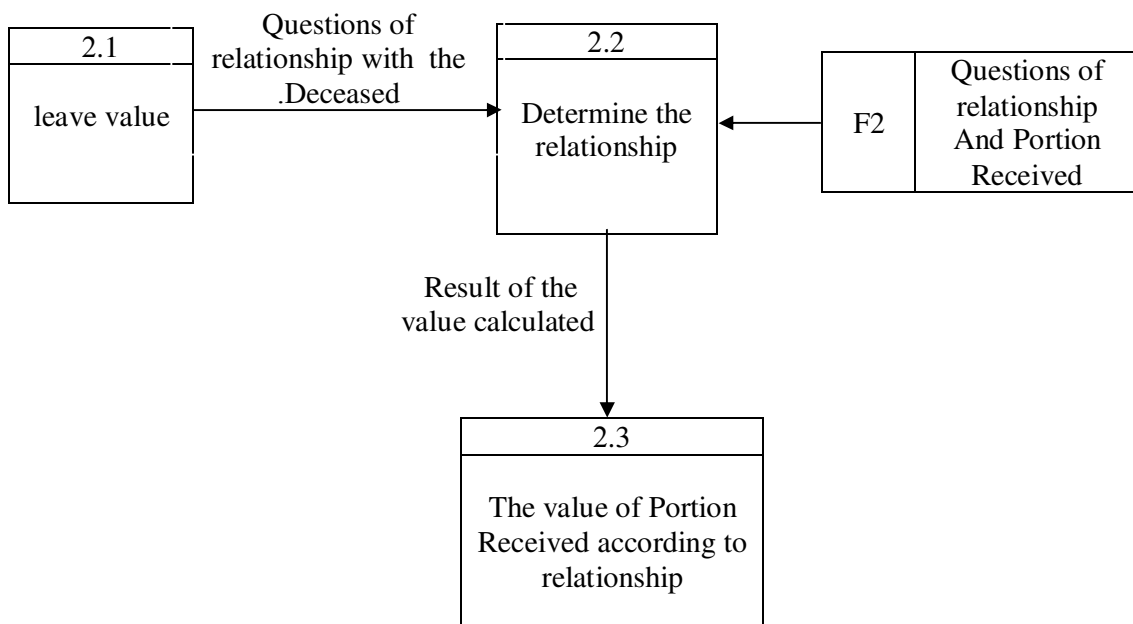

Figure 3: The DFD level 1 for Leave Value process

Figure 3 illustrated the level for leave value. After the system login, the System requests from the user to enter the value of leave. Then the system will ask questions to the user to determine the relationship with the Deceased. Those questions within the contents of the file which is consider the knowledge base of the system.
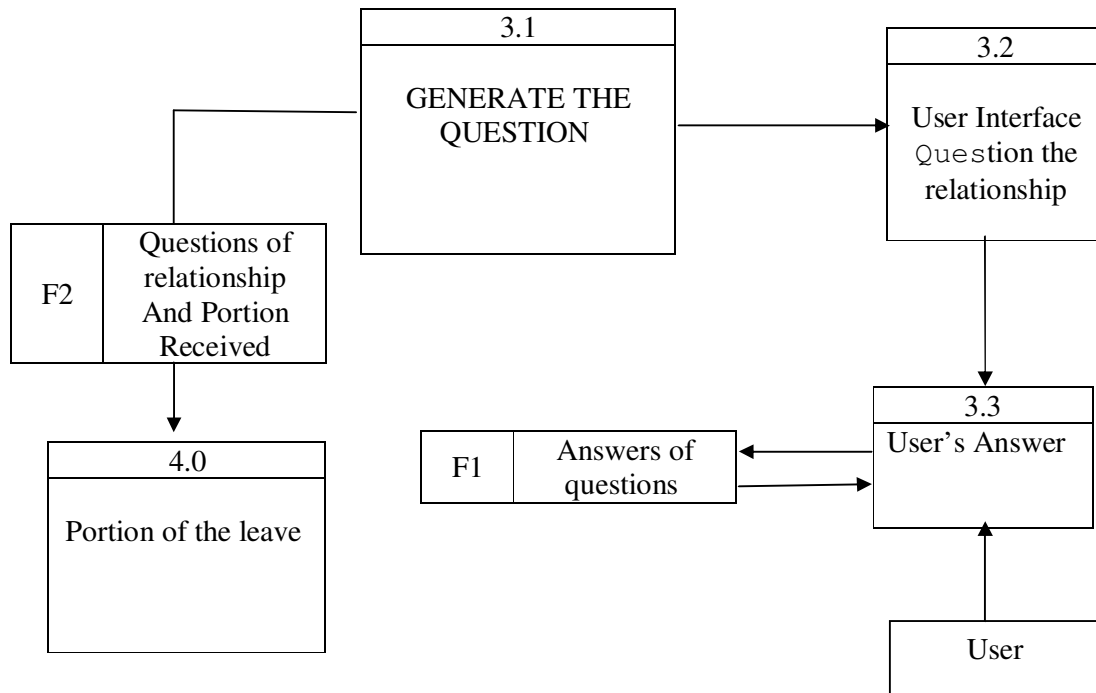
3.1
GENERATE THE QUESTION

3.2
User Interface Question the relationship

F2	Questions of relationship And Portion Received

4.0
Portion of the leave

F1	Answers of questions

3.3
User's Answer

User

Figure 4: The DFD the of processes of portion of the leave

Figure 4 illustrated the DFD level 1 for processes of portion of the leave. where it involves 4 main processes. Generate the question, user interface question the relationship, user's answer, portion of the leave, After the checking processes, system will generate questions which need to be answered by the user. The entire answered will be located into one table in the data base. after getting all the answer from user, system will conclude and display the result to the user (portion of the leave).
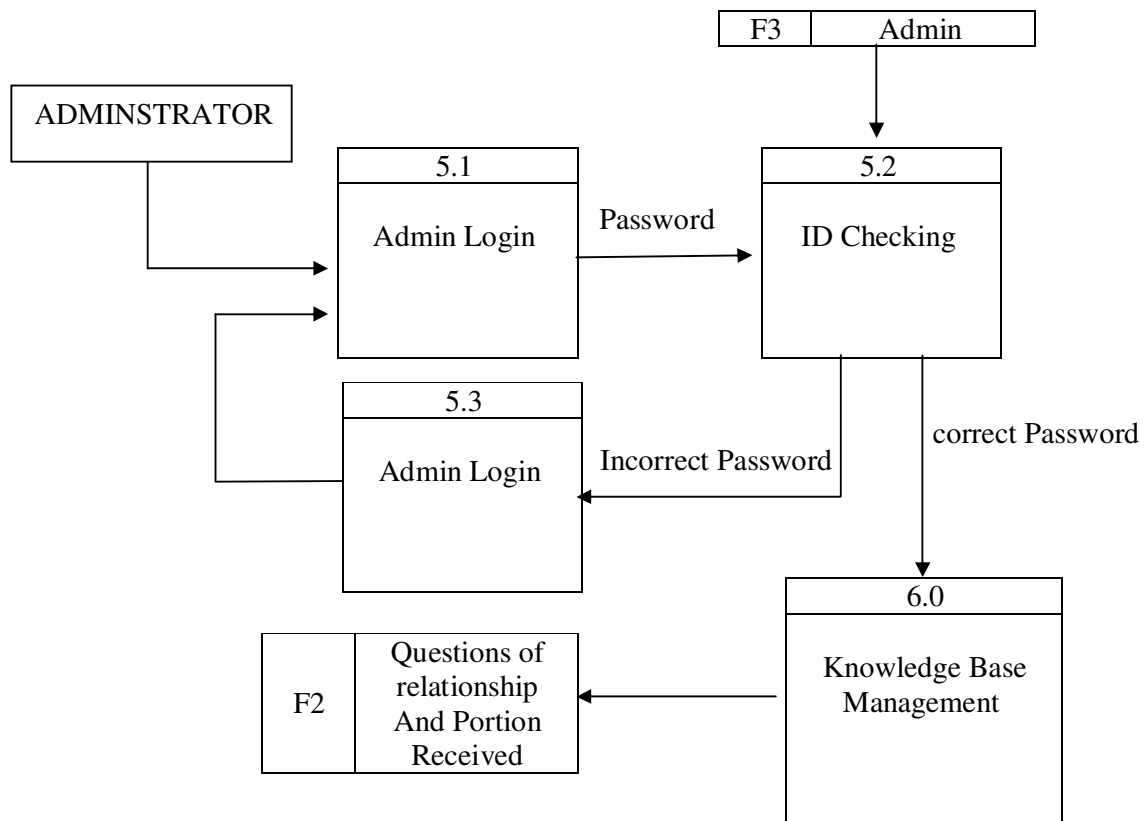
Figure 5: The DFD level 1 for Administrator Verification

Figure 5 is the DFD Level 1 for Admin Verification process. It involves 4 main processes; Admin Login, ID checking, Back to Main Menu and Knowledge base Management. Admin will login the system using their password. System will check the main ID and if the ID is correct, it will allow the admin person to enter the knowledge Base Management where admin can do some changes to the data base, such as adding, updating and deleting the Questions of relationship and Portion Received. If the ID entered is incorrect, it will return back to the main menu, where the admin to enter their password once again.