

DEVELOPMENT OF INTELLIGENT CHATBOT FOR FARAI DH SOLUTION



UNIVERSITI TEKNIKAL MALAYSIA MELAKA

BORANG PENGESAHAN STATUS TESIS[^]

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DEVELOPMENT OF INTELLIGENT CHATBOT FOR FARAIDH SOLUTION

MOHAMMAD AKLIF BIN MOHAMMAD SAINI



This report is submitted in partial fulfillment of the requirements for the Bachelor of Computer Science (Artificial Intelligence) With Honors.

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2018

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I hereby declare that this project report entitled
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SUPERVISOR : _____ Date : _____
DR. ABDUL SYUKOR BIN MOHAMAD JAYA

DEDICATION

بسم الله الرحمن الرحيم

Assalamualaikum WBT

First of all, I would like to express my gratitude to Allah SWT because He has given me the strength of being able to finish my Final Year Project (FYP). Without the guidance from Him, it should not have been my strength to complete my project, especially regarding the branch of knowledge in Islam, which are Faraidh. Also thanks to my parents, Norain binti Abdullah and Mohammad Saini bin Suhaibe for giving me the moral support by advising me to continue this project and spiritual support by always praying to me from the beginning I was born until today and the future. Next, thank you also to my supervisor, Dr. Abdul Syukor bin Mohamad Jaya for giving me the guidance for almost one year without expecting any rewards. Hopefully, all the guidance that you have given to me becomes the jariah that will always continue its reward until the end of the day.

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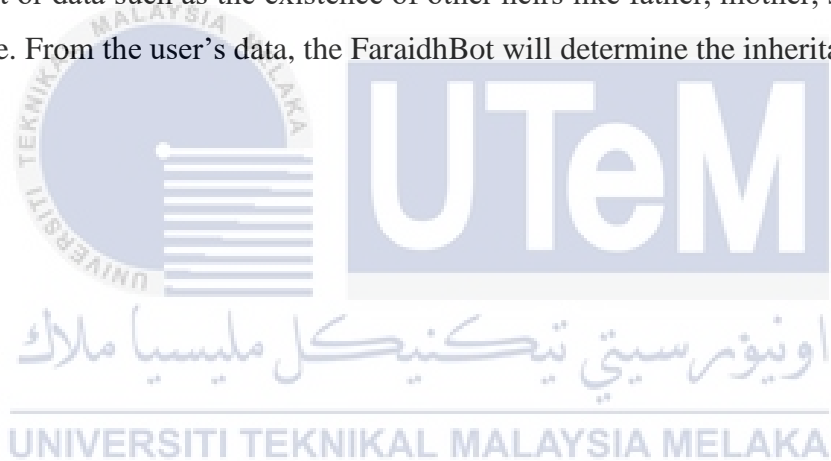
ACKNOWLEDGEMENT

ALLAH SWT is the best planner. Although there are problem at the beginning of this project, He give me strength to finish this Final Year Project. My supervisor, Dr Abdul Syukor bin Mohammad Jaya is the person that I really thankful in giving the encouragement to do this project.. Deepest appreciation to Universiti Teknikal Malaysia Melaka, UTeM for giving me the chance to run this Final Year Project.



ABSTRACT

FaraidhBot is an intelligent conversational agent also known as chatbot that works to solve the problems related to inheritance distribution. FaraidhBot are capable to reply and answer queries from users such as “Apakah definisi faraidh?”. “Siapakah yang layak mendapat harta pusaka?” and many more. Besides that, it also can make reasoning to determine the inheritance part of each heirs based on the Quran and Hadith. The reasoning also called production rules is actually a knowledge representation in the development of this chatbot. In addition, decision tree also used for the knowledge representation. FaraidhBot using data-driven or forward-chaining approach to make reasoning. Meaning that the FaraidhBot require the user’s input or data such as the existence of other heirs like father, mother, sons, daughter and many more. From the user’s data, the FaraidhBot will determine the inheritance part.



ABSTRAK

FaraidhBot adalah sebuah agen perbualan pintar atau lebih dikenali sebagai *chatbot* yang berfungsi untuk menyelesaikan masalah pembahagian harta pusaka. FaraidhBot berkeupayaan untuk menjawab soalan-soalan berkaitan faraidh seperti “apakah definisi faraidh?”, “siapakah yang layak mendapat harta pusaka?” dan banyak lagi. Selain itu, ia juga dapat membuat *reasoning* untuk menentukan bahagian seseorang berdasarkan al-Quran dan as-Sunnah. *Reasoning* juga disebut sebagai *production rules* sebenarnya adalah perwakilan kepada ilmu (*knowledge representation*) dalam pembangunan *chatbot*. Tambahan pula, *decision tree* juga digunakan sebagai *knowledge representation*. FaraidhBot menggunakan pendekatan *data-driven* atau *forward-chaining* untuk membuat *reasoning*. Maksudnya, ia memerlukan input daripada pengguna seperti kewujudan ahli waris yang masih hidup seperti ayah, ibu, anak lelaki, anak perempuan dan banyak lagi. Selepas itu, FaraidhBot akan menentukan bahagian harta pusaka berdasarkan input daripada pengguna tadi.

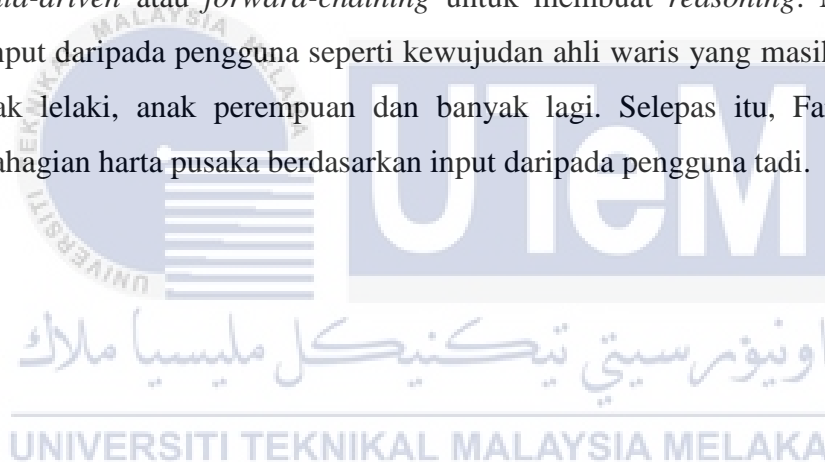


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CHAPTER 1: INTRODUCTION

1.1 Introduction

Distribution of Inheritance is one of the most important elements of economic development. If this distribution not performed in the correct format and the prescribed procedure, the property may not be distributed or handed over to the appropriate party properly. Failure to claim the property may result the property being froze. The estate is more to be define as something that left by the deceased from the property that he or she owns during his or her life and the property will be given to the heirs after his or her death.

Faraidh is one of the most important branches of knowledge in the Islamic Law. Our prophet, Muhammad (PBUH) emphasized this knowledge more the any other knowledge in Islam. Rasulullah SAW said that narrated from Abdullah bin Amru al-Asr which means “There are three knowledge, besides the advantages. That is the sentence of the law (in the Quran), the Authentic Sunnah that are narrated from the Messenger of Allah and distribute a fair inheritance.” (Narrated by Abu Daud and Hakim). The purpose of the Faraidh is to identify the heir to the deceased, to determine the beneficiary of the deceased’s benefactor, to identify the proportion of beneficiaries entitled to the deceased’s estate and to determine the proportion of heirs with mathematical calculation methods (Hilmi Hariz, 2013).

Day by day, Faraidh becomes a forgotten knowledge. A hadith of prophet Muhammad (PBUH) says that, “Learn Faraidh and teach to others. Because is indeed a part of a big

knowledge. But unfortunately, Faraidh is a forgotten knowledge and it is the first knowledge to be deprived of my people” (Narrated by al-Hakim and al-Baihaqi). According to Ghazali Ibrahim, 2015, surely, what Rasulullah SAW says is true. By understanding Faraidh, we will encouraged to know other knowledge such as syarak, nasab, mathematics and other. At the same time, Faraidh is a knowledge forgotten by most Muslims.

In this project, FaraidhBot is developed as the conversational bot agent for the role of interacting with users for Faraidh solutions. FaraidhBot will be using Artificial Intelligence Markup Language (AIML) to develop its knowledge base. AIML is an XML derived language which user in case-based reasoning and textual pattern matching algorithms. AIML was developed by Dr. Richard Wallace and the Alicebot open source and can be quickly adapted to new knowledge domains. Many conversation bots used AIML to develop their agents that communicate with users is natural language.



1.2 Problem Statement

When it comes to death in a family, there will be many things that need to be dealt with and not to missed as well as problems that will be faced especially to Muslims family and a small number of non-Muslims family. The problems are in terms of the distribution of inheritance to the decedent’s heir. Islam has established that every heir will acquire some property from the decedent according to the calculations mentioned in the Holy Quran and Authentic Hadith of Rasulullah SAW. This division of property is called Faraidh.

Quarrels between family members especially in Muslims family often occur due the property struggle. Each of the family members want to defend the right of justice in the division of the inheritance. Berita Harian (March 2016) reported that over RM60 billions property that have been frozen. This is because, lack of knowledge about Faraidh among Muslims because most Muslims nowadays think that Faraidh is not important and only focuses on worship. In addition, Minister of Education, Science and Technological Research Dato’ Sri Michael Manyin at that time said that from the statistic it is obvious that Malaysians are more inclined

to read light material while citizens from developed countries like the United States of America (USA) read heavy materials like books. On 20 September 2000, Berita Harian (Edisi Utara) has shown that too many cases of inheritance division have yet to be resolved. Northern Territory Property Distribution Unit received 61,035 applications for claims for property. Until July 2000, the northern state of the country recorded 61,035 cases of inheritance. This has proven that Malaysians are not well exposed about Faraidh.

Besides that, lack of knowledge regarding that management of distribution of inheritance, causing the heirs do not know how to begin the process of claiming and distributing inheritance (Md Azmi & Sabit Mohammad, 2011; Wan Hassan, Alias, Muslim, Yunus & Umar, 2014). This is because, Malaysian Muslims are given less exposure and awareness of the process and is not given specific guidelines specifically in the claim of inheritance (Abdul Rashid & Yaakub, 2010; Noordin, Shuib, Zainol & Mohamed Adil, 2012; Noraini Noordin, Shuib, Zainol & Mohamed Adil, 2013). There is a suggestions for developing Faraidh education at the primary, secondary and high levels of education because today, the primary and secondary education focuses only on the fundamental aspects of the religion and does not expose much about Faraidh (Alma'mun, 2010; Noraini et al., 2013; Shafie et al., 2014). So, as a solution, FaraidhBot is introduced to replace as the alternative way for the Faraidh solution.



1.3 Project Objectives

- i. To understand the significant elements, the inheritance part of each heir and the calculation methods in Faraidh knowledge.
- ii. To develop an interactive knowledge-based system which are called FaraidhBot for Faraidh's solution by using data-driven approach.
- iii. To verify the system developed using the dataset of inheritance-related cases and individuals who are experts in Faraidh solution.

1.4 Project Scope

This project scope are divided into three parts, which are domain, target users and language that I used in the development of this chatbot. Firstly, the domain is related to Faraidh, which are the knowledge of the distribution of inheritance to heirs with a certain rules of calculation. Second, the target user is of course to Malaysian Muslims users because the knowledge of Faraidh is in Islamic Law. Lastly, Malay language is used for this chatbot because the target user is for Malaysian and mostly Muslims in Malaysia are Malays and the language of daily conversations using Bahasa Malaysia.

1.5 Project Significant

Development of intelligent chatbot is one of the platforms for Malaysia Muslims especially those who are not in the field of religion to increase their understanding regarding the fundamentals of Faraidh. This chatbot enables to ease the users in terms of obtaining the authentic information related to Faraidh such as verses of Quran and hadith of Rasulullah SAW. FaraidhBot is an expert system (ES) which it is one of the categories of knowledge-based system. ES is the initial categories of knowledge-based system the most famous. Faraidh is the knowledge that require an expert to solve if there is any problem regarding it. With FaraidhBot, it can replace Faradih experts when the expert is not available and when the intelligent agent are required for decision making and problem solving.

1.6 Summary

This project report is organized in the following orders:

Chapter 1 : Introduction

This chapter introduces the background of Faraidh, the problems faced by Malaysian Muslims regarding faraidh, the proposed solution and the objectives of his project

Chapter 2 : Literature Review and Project Methodology

This chapter reviews the literatures on Faraidh and the proposed solution which are the conversational bot and its related fields. Also explain about the project methodology and using the intelligent development model while conducting this project.

Chapter 3 : Analysis

This chapter explain more details about the knowledge acquisition process which include the steps to acquire knowledge and mention about the existing techniques of knowledge acquisition

Chapter 4 : Design

This chapter explains about the knowledge representation used, which are production rules and decision tree and gives example on how the knowledge representation works. Also explain the user interface design.

Chapter 5 : Implementation

This chapter explains step-by-step on how to setup the environment for developing the FaraidhBot.

Chapter 6 : Testing

This chapter illustrates the users' feedback in graphical method after they experience the FaraidhBot.

Chapter 7 : Conclusion

This chapter explains the strength and weakness of FaraidhBot and also explains the project contribution.

CHAPTER 2: LITERATURE REVIEW AND PROJECT METHODOLOGY

2.1 Introduction

This chapter discusses related topics in the project such as the Islamic Law of Inheritance which are Faraidh and the elements to understand Faraidh thoroughly, conversational agent also known as chatbot, techniques in artificial intelligence in the development of intelligent conversational bot which are the knowledge-based system. The aim of this project is to develop an intelligent conversational agent named FaraidhBot to provide consistent and helpful assistance to give explanations about Faraidh.

2.2 Facts and Findings

2.2.1 Faraidh

The word 'Faraidh' is an Arabic word. It is a plural word and its root word is 'Faridhah'. In the term of language, 'Faridhah' means something that are already fixed. In Islamic term, it means something that has been determined to the heir about their part of inheritance that has been determined by Allah SWT. Therefore, faraidh is the knowledge of distribution of inheritance to each heirs by using the calculation method that has been determined. To gain a complete understanding about Faraidh, we need to know all the significant elements in Faraidh

which are the definition of Faraidh, its purpose, its role to the whole nation especially to Muslims, the law of Faraidh, the source of Faraidh law, the importance and advantage of Faraidh, things that must be fulfilled before the inheritance process is done, the reasons for inheritance, terms to get the inheritance part, thing that are prohibited from getting a legacy, the calculation method of Faraidh and many more.

2.2.1.1 Significant Elements in Faraidh

The main purpose of the knowledge of Faraidh is to give a certain share to the heirs who are entitled to the property of the deceased. Faraidh has four important roles which are to identify the heir to the deceased, to determine the heirs that are deserve the inheritance of the deceased, to identify the beneficiary's share of the deceased's estate and to calculate the beneficiary part with the calculation method that has been determined.

There are two divisions of law related to Faraidh, which are the implementation of Faraidh in our life and the learning process of Faraidh. Firstly, it is compulsory to any heirs to implement Faraidh law if there is any death in their family. While, for any of them that do not want to implement the Faraidh law and determine the part of inheritance by their own mind and lust, then, Hell is their place in the Hereafter. In accordance with the word of Allah SWT in surah An-Nisa', verse 13 and 14, which means:

“There are limits set by Allah, and whoever obeys Allah and His Messenger will be admitted by Him to gardens (in Paradise) under which rivers flow, abiding eternally therein; and that is the great attainment. And whoever disobeys Allah and His Messenger and transgresses His limits, He will put him into the Fire to abide eternally therein, and he will have a humiliating punishment” (Surah An-Nisa': 13 – 14)

Secondly, the learning process of Faraidh is Fardhu Kifayah to all Muslims. It is not obligatory for all Muslims to learn it. When a person has learnt the Faraidh, it becomes Sunnah for the other. The sources of law Faraidh necessarily from the Quran and Hadith. Nearly all the laws of division are summarized in the surah of An-Nisa'.

2.2.1.2 Inheritance Parts

Before we are going to know, what is the inheritance part for each beneficiaries, we must know who is the beneficiaries. A total of 25 people have the right to inherit the property of the deceased according to the provision of the Quran. Table 2.1 below shows the eligible beneficiaries in order:

MALE HEIRS	FEMALE HEIRS
Sons	Daughter
Grandsons from sons	Granddaughter from sons
Father	Mother
Grandfather from the father side	Grandmother from the father side
Male siblings with same parents	Grandmother from the mother side
Male siblings with same father	Female siblings with same parents
Male siblings with same mother	Female siblings with same father
Nephews from male siblings with same parents	Female siblings with same mother
Nephew from male siblings with same father	Wife or wives
Uncles from father side (same parents)	Master to slave
Uncles from father side (same father)	
Cousins from father side (same parents with father)	
Cousins from father side (same father with father)	
Husband	
Master to slave	

Table 2.1 Eligible Beneficiaries in Order

If all of the heirs who are entitled to receive the inheritance are gathered, then the closest heir to the deceased are:

- i. Sons
- ii. Daughters
- iii. Mother
- iv. Father
- v. Husband or wife

The basic division of each inheritance is $\frac{1}{2}$, $\frac{1}{4}$, $\frac{1}{8}$, $\frac{2}{3}$, $\frac{1}{3}$, and $\frac{1}{6}$. Below are the division according to the members entitled to inheritance:

- i. Husband
 - a. $\frac{1}{2}$ if the deceased does not have a daughter, son, granddaughter of a son or grandson of a son.
 - b. $\frac{1}{4}$ if the deceased have a daughter, son, granddaughter of a son or grandson of a son.
- ii. Wife
 - a. $\frac{1}{4}$ if the deceased does not have a daughter, son, granddaughter of a son or grandson of a son.
 - b. $\frac{1}{8}$ if the deceased have a daughter, son, granddaughter of a son or grandson of a son.
- iii. Father
 - a. $\frac{1}{6}$ if the deceased have a son or grandson of a son.
 - b. $\frac{1}{6} + \text{balance}$ if the deceased does not have a son and grandson of a son and have a daughter or granddaughter of a son.
 - c. **Balance** if the deceased does not have a daughter, son, granddaughter of a son or grandson of a son.
- iv. Mother
 - a. $\frac{1}{6}$ if the deceased have children or 2 or more children except their sons. (Son are not involved in this situation).
 - b. $\frac{1}{3}$ if the deceased does not have children or does not have 2 or more children except their sons.

- c. **1/3 from the balance** if the deceased only have a mother, father and husband or wife.
- d. **1/3 + radd** if the deceased have :-
 - i. Only one mother or
 - ii. Mother and husband or wife or
 - iii. Mother and one female sibling with the same parents or
 - iv. Mother and one female sibling with same father only or
 - v. Mother and one female sibling with same mother only or
 - vi. Mother and one male sibling with same mother only.
- v. Grandfather from father side
 - a. **1/6** if the deceased have a son or grandson of a son.
 - b. **1/6 + balance** if the deceased does not have a son and grandson of a son and have daughter or granddaughter of a son.
 - c. **Balance** if the deceased does not have a daughter, son, granddaughter of a son or grandson of a son.
- vi. Grandmother from father side
 - a. **1/6** if the deceased does not have a mother of father
- vii. Grandmother from mother side
 - a. **1/6** if the deceased does not have a mother.
- viii. Daughter
 - a. **1/2** if she is alone and the deceased does not have a son
 - b. **2/3** if the total of daughter is 2 or more and the deceased does not have sons.
- ix. Granddaughter
 - a. **1/2** if she is alone and the deceased does not have grandsons, sons, and daughter.
 - b. **2/3** if the total of granddaughter is 2 or more and the deceased does not have grandsons, sons and daughter.
 - c. **1/6** does not care the total number of them either it is one or more, if the deceased have only one daughter and does not have sons and grandsons
- x. Female sibling with same parents
 - a. **1/2** if she alone and the deceased does not have male siblings with same parents.
 - b. **2/3** if the total of them is 2 or more and the deceased does not have male siblings with same parents.

- xi. Female sibling with same father
 - a. $\frac{1}{2}$ if she is alone and does not have male siblings with same father, male siblings with same parents and female siblings with same parents.
 - b. $\frac{2}{3}$ if total of them is 2 or more and does not have male siblings with same father, male siblings with same parents and female siblings with same parents.
 - c. $\frac{1}{6}$ does not care if the total of them is 1 or more, if the deceased have only one female sibling with same parents and does not have male siblings with same father and male siblings with same parents.
- xii. Male siblings with same mother
 - a. $\frac{1}{6}$ if he is alone.
 - b. $\frac{1}{3}$ of the total of them is 2 or more either it is a male or female.
- xiii. Female siblings with same mother
 - a. $\frac{1}{6}$ if she is alone.
 - b. $\frac{1}{3}$ if the total of them is 2 or more either it is a male or female.

2.2.2 Artificial Intelligence

The word “artificial” comes from Latin “art” and “fex”, which means “skill” and “to make” respectively. “Artificial” is the combination between these two words meanings an entity that is not naturally made but it has been made by human. The word “intelligence” also comes from Latin word, “intelligo”, which means “I understand”. In English, the word “intelligence” is the capability to understand. Intelligence consists of learning, improving and applying problem-solving methods. By combining these two words between “artificial” and “intelligence” meaning that intelligence demonstrated by machines. Artificial Intelligence (AI) is one of the areas in computer science. It can be defined as the creation of intelligent computers or machines that can think and act like humans. AI has been embed into many systems such as computers, video games, robots, machines as well as conversational agent, chatbots. AI is going to impact many field such as healthcare, engineering, business, marketing and many more.

According to Rich and Knight, the AI system can be specified and classified into different types of task based on the artificial intelligence techniques that have been implemented to the machines or computers. There are three types of task in an artificial intelligence system, which are mundane tasks, formal tasks and expert task.

Mundane task can be said to be a typical or less challenging task that a machine or computer needs to do. In other hand, mundane task is for system for everyday use. As an analogy, humans learn mundane tasks since their birth. At the beginning of the age, babies learn perception which are visualizing the environment and try to speak for the first word. After learning to speak, humans will learn to understand the conversation and also learned the correct grammar and learning the second language. Same as mundane task in artificial intelligence which are perception, natural language processing, common sense, reasoning, planning and the other is robotics.

Formal task are more focus on a big and complicated domain for problem solving. It will become more difficult and takes time to solve the problem without the intervention of artificial intelligence. Formal task focus on calculations in mathematics such as algebra, geometry, theorem proving, integral calculus, logic and many more. Besides calculations, formal task also often deal with handling simple formal games such as chess, checkers and backgammon.

Expert task always deal with a specific knowledge and requires expert's decision or conclusion on a specific domain. Without the presence of an expert, this expert task or system are capable to solve the user's problem immediately as the expert is with the user at this time. An expert task consist of engineering, fault finding, manufacturing, monitoring, scientific analysis, financial analysis, medical diagnosis as well as faraidh.

2.2.2.1 Knowledge-Based System

Knowledge-Based System (KBS) is a computer system that reasons knowledge from data, information and from that knowledge itself to solve complex problems. KBS is one of the

categories in artificial intelligence system. KBS was developed by a group of artificial intelligence researchers. At the beginning of knowledge-based system were expert system. In fact, the term of knowledge-based system often used equally with expert system. There are many categories of knowledge-based system, which are :

- i. Expert systems
- ii. CASE-based systems
- iii. Intelligent tutoring systems
- iv. Linked systems
- v. Database in conjunction with an intelligent user interface

In the knowledge-based system architecture, we need to understand the domain more deeply and can classified the domain's knowledge into what types of knowledge. There are several types of knowledge, which are commonsense knowledge, heuristic knowledge, domain knowledge, metaknowledge, explicit knowledge, tacit knowledge. Below are the description of each knowledge:

TYPES OF KNOWLEDGE	DESCRIPTION
Commonsense knowledge	General knowledge about a domain that an average person is expected to know
Heuristic knowledge	A specific rule of thumb or argument derived from experience
Domain knowledge	Valid knowledge for a specified domain. Specialists and experts develop their own domain knowledge and use it for problem solving
Metaknowledge	Can be defined as knowledge about knowledge
Explicit knowledge	Can be easily expressed in words or numbers and shared in the form of data, scientific formula, product specifications, manuals and universal principles. It is more formal and systematic
Tacit knowledge	Knowledge stores in subconscious mind of experts and not easy to document. It is highly personal and hard to formalize and hence difficult to represent formally in systems. Subjective insights, intuitions, emotions, mental models, values and actions are examples of tacit knowledge

Table 2.2 Types of Knowledge

Basically, knowledge consists of three components which are facts, rules and heuristics. Facts and rules are grouped into one knowledge which are declarative knowledge while heuristics is procedural knowledge. Facts serves as a sets of raw observation, alphabets, symbols or statement (Arvind & Srinivas, 2010). For example, faraidh is the division of property of a deceased and does not leave a will before his death. While, rules include conditions and actions. Example of rules, if the deceased (a wife) does not have any children or grandchildren, then the husband will get half of his wife properties. And heuristics is more to problem solving based on the similar situation. Heuristic represent the problem-solving experience within the knowledge-based.

2.2.2.1.1 Expert System

Expert system (ES) is the first invention in knowledge-based system and it also the most popular. ES are able to solve complex problem despite the absence of experts. According to Arvind and Srinivas, ES are very useful when there is no experts available at that time and at that place, when the expertise is to be stored for future use or when expertise is to be cloned or multiple and when more than one expert's knowledge has to be grouped on one platform.

2.2.2.2 Data-Driven / Forward-Chaining Approach

Data-driven or forward chaining is the inference engine that processes the knowledge for the problem solving and decisions making. In the knowledge base, there are working memory that stores the rules and facts. Collection of inputs and data from the users will trigger the rules and then perform their action by making a decision or displaying the problem-solving answer. It is also called data-directed inference because it triggered by the input(data) from the user.

2.2.3 Conversational Agent (Chatbot)

Chatbot application and its technology has been through an advancement and improvement drastically since the first chatbot created in 1966. Yet, the idea or reason and added value that conversational agent offer has not been clearly specified. In order to develop a conversational agent that serves a meaningful experience, the perceptions of people towards this technology and what benefits are there for chatbots based on user demands must be understood. As a result, chances for the chatbots to improve its meaningful experiences is by improving the efficiency of administrative tasks (Jennifer, 2017). Meaning that chatbots must have a specific domain where it can add a meaningful purpose. In this technological

advancement era, majority of the conversational agents were developed based on selected domain such as healthcare, education, e-business and ergonomics.

The earliest and famous conversational agent was Eliza. Weizenbaum, the developer of Eliza designed the Eliza to play the role of a psychotherapist to a patient. At that time, Eliza was considered a breakthrough in AI because human are able to communicate with computer using natural language. It has also undergone the Turing Test, but unfortunately it does not pass the Turing Test. Nevertheless, patients can still be persuaded by Eliza to continue the conversation. Figure 2.3 shows a sample dialogue of Eliza (1966).

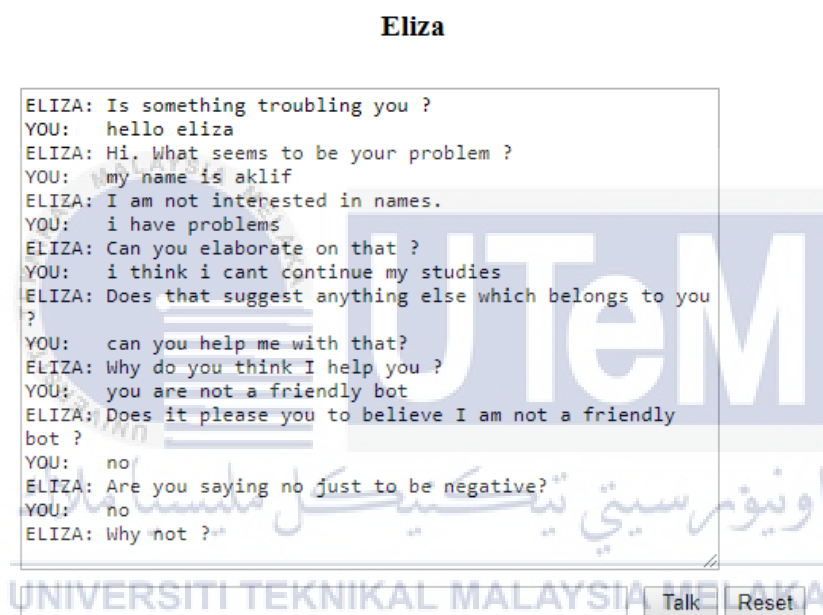


Figure 2.1 Sample Dialogue Between Eliza and User as the Patient

Eliza are capable to rephrasing the patient's statements as a questions and the patient will continue to communicate with Eliza until the patient will likely to open up his or her personal problems. According to Saygin et. at., 2003, Weizenbaum was shocked that his conversational bot able to deceive normal people into believing it. Colby, 1966 said that, there were suggestions went as far to replace psychotherapists with suck kind of programs so that the therapy become cheap and could be done on a larger scale.

Eliza's success in AI and chatbot to help people in terms of psychology have inspired a psychiatrist named Kenneth Mark Colby. He wrote his own program to simulate a person with paranoid schizophrenia. Kenneth's program called PARRY has a personality and emotional state such as fear, anger and mistrust which would determine its responses to the interviewer. Figure 2.4 shows the conversation between PARRY and a human psychiatrist where it answered well and attempted to introduce its own topic.

Network Working Group
Request for Comments: 439
NIC: 13771

V. Cerf
SU-ERL
21 January 1973

PARRY Encounters the DOCTOR

The session recorded below actually happened on 18 September 1972 and is herewith reproduced for your entertainment.

Good Evening.

Tell me your problems. Please terminate input with a period or a question mark.

*People get on my nerves sometimes.

I am not sure I understand you fully.

*You should pay more attention.

Suppose you should pay more attention.

*You're entitled to your own opinion.

Figure 2.2 Conversations Between Human and PARRY (Kenneth, 1981)

In 1973, PARRY and Eliza were put into a conversation for demonstration. Figure 2.5 shows the conversation logs of Eliza and PARRY in September 1972.

ELIZA: Good Evening.

ELIZA: Tell me your problems. Please terminate input with a period or a question mark.

PARRY: People get on my nerves sometimes.

ELIZA: I am not sure I understand you fully.

PARRY: You should pay more attention.

ELIZA: Suppose you should pay more attention.

PARRY: You're entitled to your own opinion.

ELIZA: What makes you think I am entitled to my own opinion?

PARRY: It bothers me just to be around people in general.

ELIZA: Please go on.

PARRY: I went to the track at Bay Meadows a while back.

<p>ELIZA: What does that suggest to you?</p> <p>PARRY: I went to the races.</p> <p>ELIZA: What else would you like to discuss?</p> <p>PARRY: Horseracing interests me.</p> <p>ELIZA: Why do you say that just now?</p> <p>PARRY: There's a lot of crooked gambling going on there.</p> <p>ELIZA: I am not sure I understand you fully,</p> <p>PARRY: It's clear to me if not to you.</p> <p>ELIZA: Do you think its likely that not to I?</p> <p>PARRY: I went to the races.</p> <p>ELIZA: Please go on.</p> <p>PARRY: I gamble on horses.</p> <p>ELIZA: What does that suggest to you?</p> <p>PARRY: I went to the races.</p> <p>ELIZA: What else would you like to discuss?</p> <p>...conversation continues</p>

Figure 2.3 Conversations Between Eliza and PARRY (Cherf, 1973)

In 1990, Dr. Hugh Loebner took the initiative to benefit the AI exploration and conduct the Turing Test by introducing Loebner Prize Competition. The competition was held every year and grant a gold medal and \$100,000 as the grand prize for the competition which able to respond indistinguishably from a human being. Since the initiation of Loebner Prize Competition, many chatbot developers attracted to the competition and encourage to the development of conversational bots to wins the prize every year.

The famous conversational bot Artificial Linguistic Internet Computer Entity (ALICE) was developed by Dr. Richard Wallace and won the Loebner Prize Competition in 2000, 2001 and 2004. ALICE was built using the Artificial Intelligence Markup Language (AIML) which are the derivatives of Extensible Markup Language (XML). AIML also created by Dr. Richard Wallace. ALICE uses simple stimulus-response techniques to return matching response to the user, similar to those used by Eliza but it has more categories of knowledge compare to Eliza.

The latest chatbot that won the Loebner Prize Competition 3 times in a row in 2016, 2017 and 2018 is Mitsuku. Mitsuku was created from AIML technology by Steve Worswick. Mitsuku is accessible as a flash game on Mousebreaker Games and on Kik Messenger under the username “Pandorabots”, and was accessible on Skype under the same name, but it was removed by its developer.

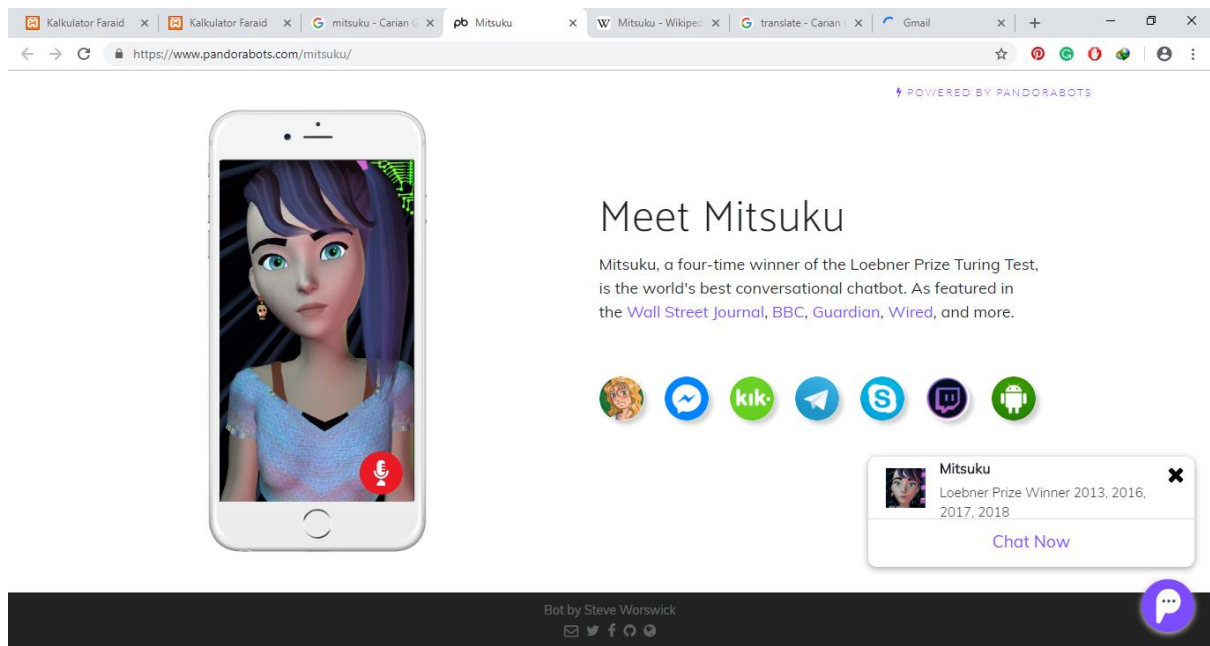


Figure 2.4 Mitsuku Homepage Interface

Mitsuku is a chatbot who claims to be from Leeds, England and an 18-year-old female chatbot. It consists of all of ALICE's AIML files, with many extensions from user-generated conversations, and is always a work in progress. Steve claims Mitsuku started to learn from human-generated conversation since 2005. Her intelligence includes the capability to identify the characteristics of a specific object. For instance, if someone asks "Do you eat house?", Mitsuku looks up the characteristics for "house". Finds the value "made_from" is set to "brick" and replies "no", as house cannot be eaten.

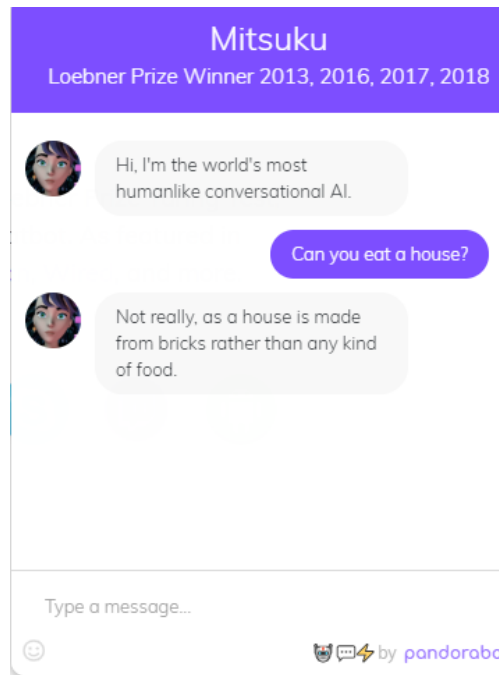


Figure 2.5 Mitsuku Chat Interface

Mitsuku also can do magic tricks and play games with the user if the user demand for it. In 2015, the average conversation between Mitsuku and users are exceeded quarter of a million times daily. Fast Company expressed Mitsuku as really extraordinary and announced Mitsuku the victor over Siri in a chatbot smackdown. A blog post for the Guardian on loneliness explored the role chatbots like Mitsuku and Microsoft's Xiaolce play as allies, rather than mere conversational agent or assistant, in people's emotional lives.

2.2.4 Existing System

2.2.4.1 Kalkulator Faraid

Kalkulator Faraidh is a web-based Faraid computational system that was developed in 2015 by the Faculty of Technology and Information Science, Universiti Kebangsaan Malaysia. The system also has a little explanation of Faraidh's fundamental and understanding but does not explain the whole of the Faraidh knowledge.

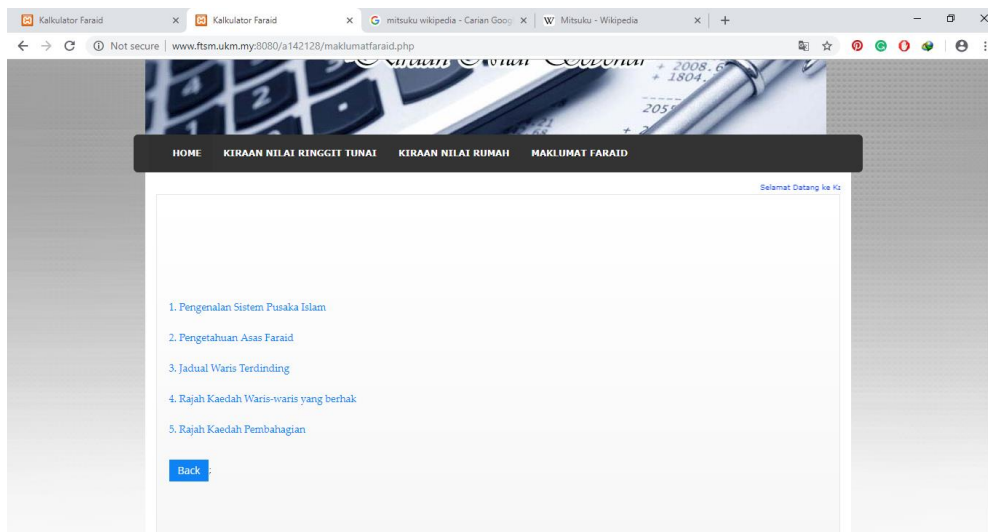


Figure 2.6 Kalkulator Faraid Homepage

Relationship	Input
Ibu :	<input type="radio"/> <input type="radio"/>
Bapa :	<input type="radio"/> <input type="radio"/>
Suami :	<input type="radio"/> <input type="radio"/>
Isteri :	1 <input type="radio"/> 2 <input type="radio"/> 3 <input type="radio"/> 4 <input type="radio"/>
Anak Lelaki :	Ada <input type="radio"/> Tiada <input type="radio"/>
Anak perempuan :	Ada <input type="radio"/> Tiada <input type="radio"/>
Nenek Sebelah Ibu :	<input type="radio"/> <input type="radio"/>
Nenek Sebelah Bapa :	<input type="radio"/> <input type="radio"/>
Datuk Sebelah Bapa :	<input type="radio"/> <input type="radio"/>
Cucu Lelaki Anak Lelaki :	Ada <input type="radio"/> Tiada <input type="radio"/>
Cucu Perempuan Anak Lelaki :	Ada <input type="radio"/> Tiada <input type="radio"/>

Figure 2.7 Kalkulator Faraid Calculation Page

The screenshot shows a web browser window with the URL www.ftsm.ukm.my/8080/a142128/nilaitunai.php. The page is titled "Kalkulator Faraid" and displays the following data:

Anak perempuan :		Cucu Perempuan Anak Lelaki :	
Ada * Tiada		Ada * Tiada	

Buttons: **Calculate** (highlighted), **Reset**

HARGA TUNAI

Ibu :	1666.6666666667	Nenek Sebelah Ibu :	TIADA
Bapa :	1666.6666666667	Nenek Sebelah Bapa :	TIADA
Suami :	2500	Datuk Sebelah Bapa :	TIADA
Isteri :	TIADA		
Anak Lelaki :	5000	Cucu Lelaki Anak Lelaki :	TIADA
Anak perempuan :	3333.3333333333	Cucu Perempuan Anak Lelaki :	TIADA

Buttons: **Back**, **Cetak**

© COPYRIGHT 2015 KALKULATOR FARAIID UKM

Figure 2.8 Kalkulator Faraid Calculation result

2.2.4.2 FaST Guide

FaST Guide is a mobile application that are available in Google Play Store and App Store for only RM3.50. This application was published by As-Salihin Trustee Berhad company. As-Salihin Trustee Berhad is an estate planner company located in Petaling Jaya, Selangor. FaST Guide functions like a calculator and will output in a fraction and percentage of distribution of heirs, amount of each heir based on value of an estate and pie chart for the result.



Figure 2.9 FaST Guide Interface

as-Salihin
TRUSTEE BERHAD

Tap below

Single/Divorced/Widowed

Parent

☐ Father ☐ Mother

Siblings

Brother(s) 0 Sister(s) 0

Children

Son(s) 2 Daughter(s) 2

Son's Son 0 Son's Daughter 0 Daughter's Son 0 Daughter's Daughter 0

Reset Get Result

Figure 2.10 FaST Guide Input Heir Interface

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

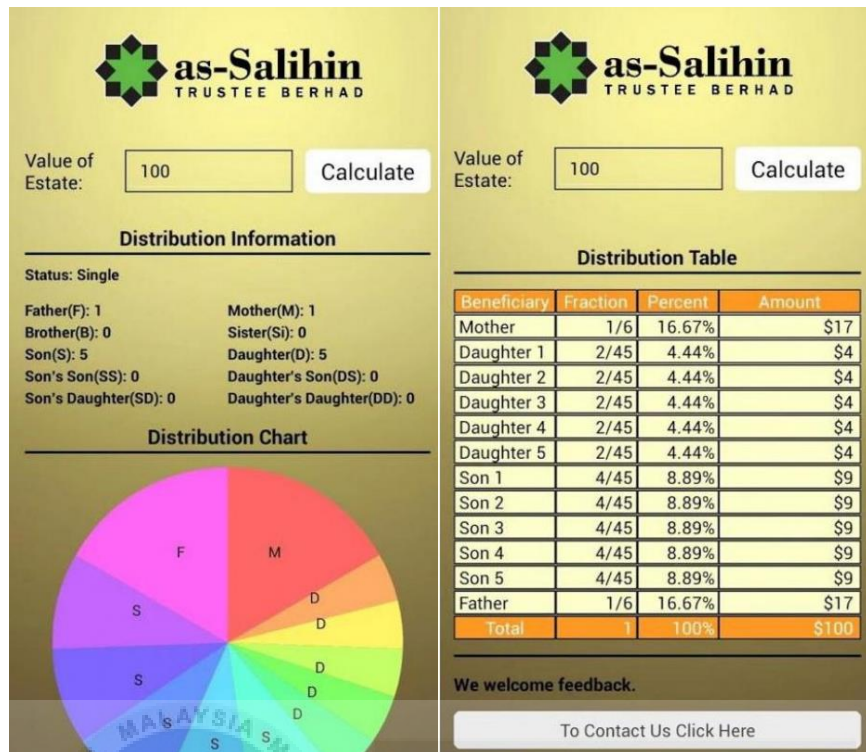


Figure 2.11 FaST Guide Sample Result Interface

2.3 Project Methodology

This project is based on qualitative because this project would not be able to quantify in numerical data as in quantitative project. Qualitative project involves inductive data analysis and data interpretation from the researcher. For conversational agent project, there are many of them was conducted in qualitative method because Turing test which are popular among researchers in this field is also based on qualitative assessment (Browne 1991).

2.3.1 System Development Lifecycle Model

In order to build FaraidhBot, to assure a speedy development, the intelligent system development model is used. The fundamental activities to develop a knowledge-based system based on this model are:

- i. Knowledge acquisition
- ii. Feasible requirement
- iii. Strategy selection and overall design of knowledge-based system
- iv. Ontology selection and knowledge representation
- v. System development and implementation
- vi. Testing, implementation and training

All of these 6 actions are divided into four phases, which are:

- i. Analysis
- ii. Design
- iii. Detailed design
- iv. Implementation

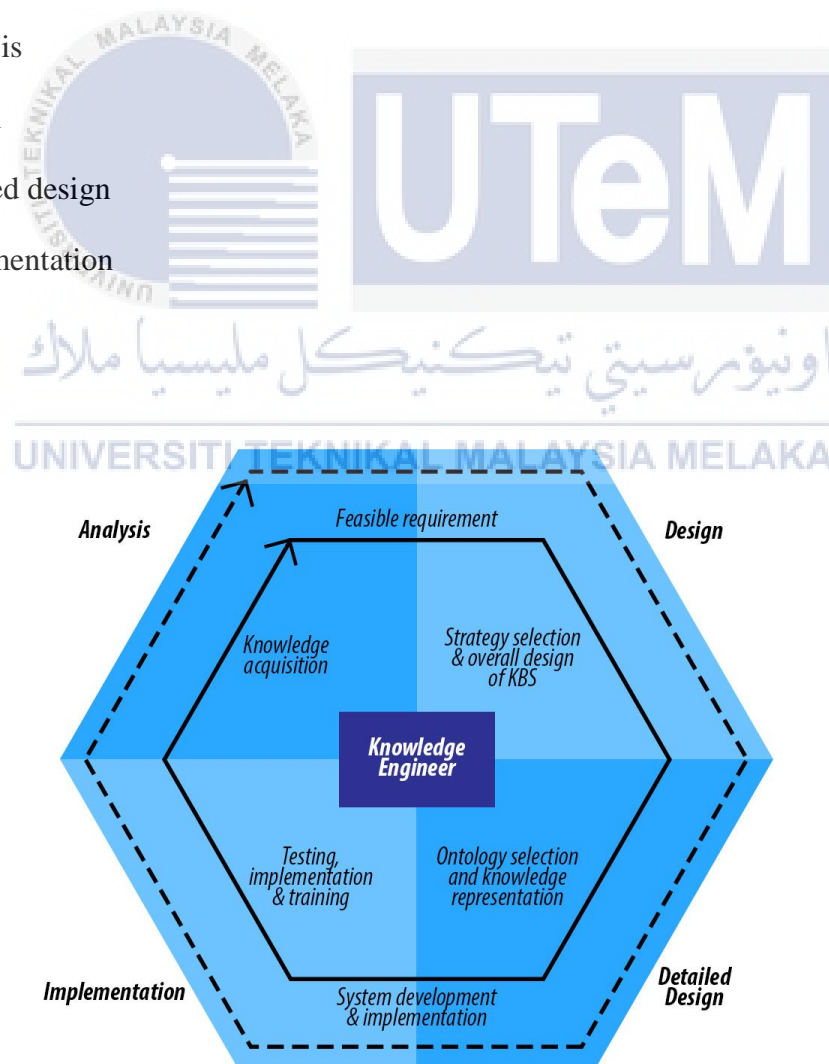


Figure 2.12 Intelligent Development Model

By referring to Figure 2.12, during the initial development round, the knowledge engineer initiate to figure out the situation and problems, and list down the requirements by visiting experts and users. After analyzing the feasible requirements, the full design and prototype of the system is prepared. The first prototype is implemented and tested. Testing the prototype regularly will lead to identify more hidden requirement. With these additional hidden requirements and the problems raised by the users and experts, another round starts, by including the additional hidden requirements collection, design and development. There may be multiple rounds until the desired level of quality or of users' satisfaction is achieved.

2.4 Project Requirement

2.4.1 Software Requirement

No	Software	Function
1.	Microsoft Office Windows 10	As server
2.	Apache Web Server	As web server
3.	Google Chrome	As web client
4.	MySQL	Database management system
5.	Microsoft Word 2016	Project documentation
6.	Notepad++	To edit AIML files
7.	WampServer	Installer for latest releases of Apache, MySQL, and PHP
8.	Hypertext Preprocessor	Programming language of the system
9.	Adobe Photoshop CC 2019	Image editor for the system
10.	PhpMyAdmin	Administration tool for MySQL Database System

Table 2.3 Software Requirement**2.4.2 Hardware Requirement**

No	Software	Function
1.	Laptop	Workstation
2.	Modem	Internet purposes
3.	Google Drive	Cloud

Table 2.4 Hardware Requirement**2.5 Project Schedule and Milestone**

Due Date	Activity	Note/Action
PSM 1		
3 – 11 January 2018	Proposal PSM : Discussion	Deliverable
18 – 22 February 2018	Proposal presentation and submission via PSM Online System	Proposal Presentation
25 February 2018 – 10 March 2018	Chapter 1 : Introduction	Deliverable
11 March 2018 – 6 April 2018	Chapter 2 : Literature Review	Progress Presentation
8 – 30 April 2018	Chapter 3 : Analysis	-Deliverable -Knowledge Acquisition -Elicitation of feasible requirement

1 – 19 May 2018	Project Demo PSM 1 Report	
20 – 25 May 2018	Final Presentation and Project Demo PSM 1	
PSM 2		
3 September 2018 – 28 September 2018	Chapter 4 : Design	-Strategy selection and overall design of knowledge- based system
1 October 2018 – 12 October 2018	Chapter 5 : Implementation	-Ontology selection and knowledge representation -System development and implementation
15 October 2018 – 2 November 2018	Chapter 6 : Testing	-Testing, implementation and training
12 November 2018 – 30 November 2018	Chapter 7 : Conclusion	
3 – 7 December 2018	Project Demo PSM2 Draft Report	
10 – 14 December 2018	Final Presentation and Project Demo	

Table 2.5 Project Milestone

2.6 Summary

This chapter covered literature review and project methodology of the development of FaraidhBot. There various chatbot with various domain but there is no chatbot that functions

to calculate about faraidh distribution. Mostly web-based application and mobile application such as Kalkulator Faraid and FaST Guide respectively, only function as a faraidh calculator but not in conversational style. Further chapter will cover about the overview of the knowledge acquisition in analysis phase.



CHAPTER 3: ANALYSIS

3.1 Introduction

This chapter discusses about the analysis about the knowledge acquisition and the overall design of the FaraidhBot on the strategy selection of the techniques of knowledge acquisition, which are the objective is to understand the real-world problems and user's needs. Then, this chapter will discusses more specific on the analysis phase based on Figure 2.12 in the previous chapter which is the intelligent system development model, which the activity in analysis phase is knowledge acquisition. In order to develop an expert system that focuses on a specific domain, there are several things that need to be prepared such as knowledge engineer, domain expert, knowledge elicitation and step of knowledge acquisition.

3.2 Problem Analysis

In order to develop a conversational agent that gives a meaningful experience, first, we must understand the user's perception and expectation towards this technology. According to comScore, a mobile measurement company, half of the digital media in the United States of America allocate most of their time in social and chatting applications. Besides that, chatbots are available on mobile devices and expect a bigger accessibility to this technology. Although chatbots are easy to access in our mobile devices, but the values are not clearly defined as well as the intention and use for these chatbots. Chatbots provide an assistant to the users in terms of common tasks such as administrative needs and information seeking. Developing trust

between human and AI is crucial for building a healthy relationship. Present the human-like behaviors is important for the chatbot for relationship building.

3.3 Requirement Analysis

3.3.1 Data Requirement (Knowledge Acquisition)

Knowledge can be obtained from variety of sources such as printed material like books and documents, the internet, media, reports and experts. The process of knowledge acquisition will involve several things such as the knowledge engineer, domain experts, the knowledge elicitation and the several steps to obtain the knowledge.

3.3.1.1 Knowledge Engineer

This is the individual who is responsible for the analysis, design and development of the conversational agent or chatbot. In short, knowledge engineer interprets knowledge into computer systems in order to solve complicated problems normally involving a high level of human expertise. It also organize knowledge and information from the domain experts on how the system to make a decision.

3.3.1.2 Domain Expert

Experts are those people in the field who are consulted when a problems regarding to that domain. They use their knowledge to make decisions, know when exceptions are to be made and explain their decisions. Experts play a key role in making decisions. The abilities to communicate and explain are valuable when it comes to developing a knowledge-based system as the quality depends upon the successful and proper documentation provided by the experts in the knowledge base of the system.

The knowledge acquisition process emphasizes capturing experts' thoughts and experiences. Typical fact-finding methods may be helpful here to some extent. However, more

important are specific knowledge acquisition methods such as elicitation, collection, analysis, modelling and validation of knowledge.

3.3.2 Functional Requirement (Techniques in Knowledge Acquisition)

There are several techniques to acquire a domain knowledge. For example, by reviewing the literature, interview and protocol analysis, surveys and questionnaires, observation, diagram-based techniques, generating prototypes and concept sorting. Before that, we must know how to acquire the knowledge in accordance with the prescribed steps. Generally, the following steps are carried out for knowledge acquisition:

Step 1 : Find suitable experts and a knowledge engineer.

The expert that the knowledge engineer refer to is the authorized officers at the Universiti Teknikal Malaysia Melaka (UTeM) Islamic Center and some books related to Faraidh which are “Pembahagian Harta Pusaka dan Kepentingan Wasiat” and “Fajar Faraidh” that have been authored by Ustaz Ghazali Ibrahim and Hilmi Hariz respectively which both are experts in faraidh. These are the main sources of FaraidhBot. The knowledge representation, system architecture and inference engine designed by the knowledge engineer.

Step 2 : Proper homework and planning.

The knowledge engineer are responsible to acquire the knowledge from variety of sources. Knowledge engineer often refer to Faraidh-related books “Pembahagian Harta Pusaka dan Kepentingan Wasiat” by Ghazali Ibrahim and “Faraj Faraidh” by Hilmi Hariz. Knowledge engineer must understand the background information, any available knowledge and problem of the domain to prepare for the knowledge acquisition process.

Step 3 : Interpreting and understanding the knowledge provided by the experts.

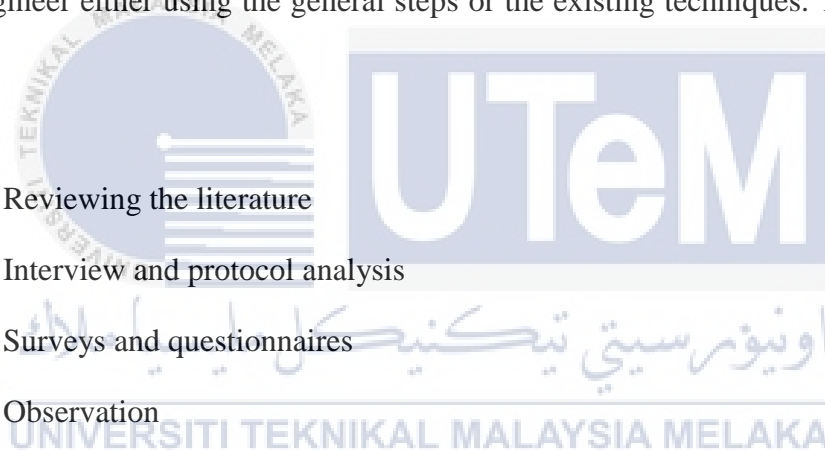
The knowledge-based system represents the understanding of the knowledge engineer, not the experts. So, it is crucial for the knowledge engineer to have a complete understanding

about the experts' knowledge before implementing it to the knowledge base. Interpreting the knowledge accurately will ease the reasoning process.

Step 4 : Representing the knowledge provided by the experts.

Once the knowledge acquisition started, knowledge engineer must jot down the knowledge into a temporary knowledge representation scheme. The temporary knowledge representation scheme may be will be permanently used into the knowledge-based system. But, the knowledge acquired also may be represented into many different ways.

The above steps are the general and basic to steps for the knowledge acquisition. There are several techniques of knowledge acquisition that already exist. So, it depends on the knowledge engineer either using the general steps or the existing techniques. The techniques are as follow:

- 
- i. Reviewing the literature
 - ii. Interview and protocol analysis
 - iii. Surveys and questionnaires
 - iv. Observation
 - v. Diagram-based techniques
 - vi. Generating prototypes
 - vii. Concept sorting

These knowledge acquisition techniques must be chosen correctly according to the type of knowledge and its nature. Before we go any further on how to classify faraidh knowledge according to its nature, a little bit of explanation on tacit and explicit knowledge. Tacit knowledge is a knowledge that acquire unconsciously (unconscious knowledge) which are usually embedded in human mind. While, explicit knowledge is the opposite (conscious knowledge). Explicit knowledge is easy to transfer and extract compared to tacit knowledge. The difference between explicit and tacit knowledge as shown in Table 3.1.


TACIT KNOWLEDGE <ul style="list-style-type: none"> • Personal • Context-specific • Difficult to transfer, encode, and explain • Mostly stored unconsciously 	Unconscious Knowledge 	Tacit knowledge	Ability to interpret, perceive, communicate, ect.
		Implicit knowledge	Knowledge about strategies, malfunctions, policies, systems etc.
EXPLICIT KNOWLEDGE <ul style="list-style-type: none"> • Packaged • Easy to transfer, encode and explain • Mostly stored consciously 	Conscious Knowledge	Explicit non-codified knowledge	Knowledge about instructions, procedures, history of processes etc.
		Explicit codified knowledge	Documentation, report, books, directories etc.

Table 3.1 Difference between Tacit and Explicit Knowledge

Different techniques to acquire knowledge are used depends on the type and nature of the knowledge. Below are the overview on how to choose the best knowledge acquisition techniques depending on the type and nature of the knowledge.

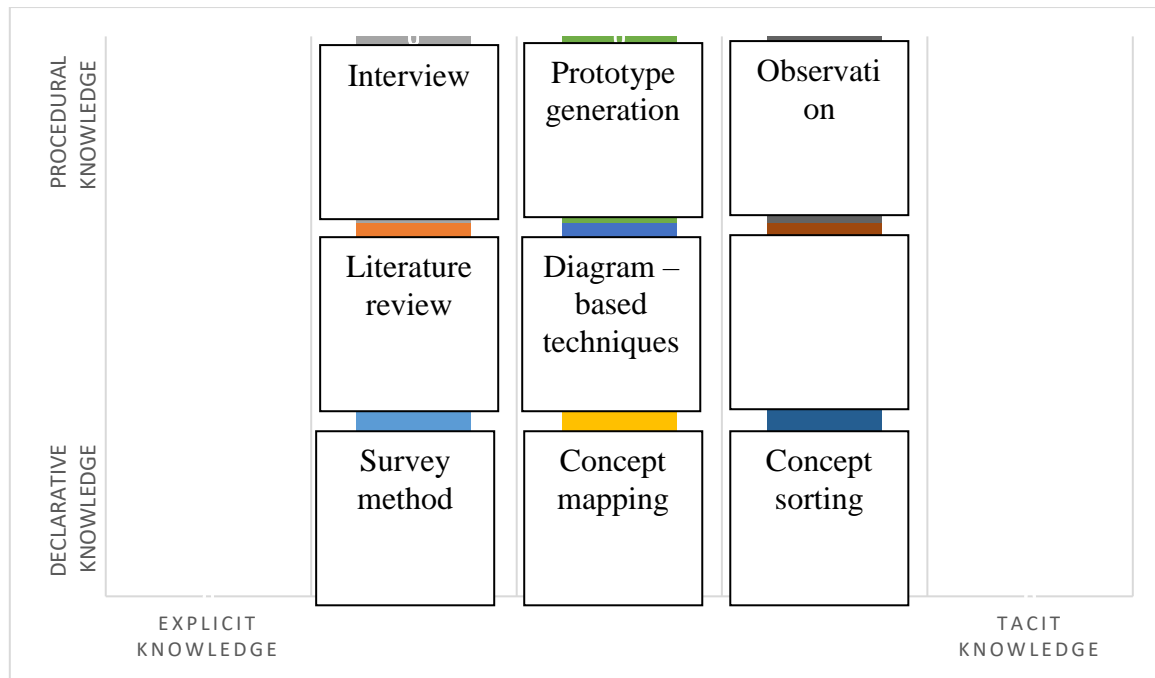


Figure 3.1 Knowledge acquisition techniques for different types of knowledge

Faraidh refer to a specific area of knowledge in Islamic law. Meaning that it is a domain knowledge. Faraidh consists both component of knowledge which are declarative and procedural knowledge. Facts in faraidh are the significant elements in faraidh such as the definition, purpose, the eligible beneficiaries of the inheritance and the rules of faraidh is the inheritance part of each heirs that already mentioned in the Holy Quran. While, the procedural knowledge of faraidh is the intellectual skills from experts to make decisions that determines the inheritance part of each heirs. By referring Figure 3.1, faraidh is between declarative and procedural knowledge. Meaning, the technique that will be used either by reviewing the literature or by using diagram-based technique.

In terms of tacit and explicit knowledge, faraidh also is between conscious and unconscious knowledge. By referring Table 3.1, faraidh is more to tacit and explicit codified knowledge. This is because the main source of faraidh is the al-Quran and as-Sunnah which both are a type of documentation or books but the difference to other books, Quran and Hadith are authentic and persistent sources and cannot be changed. In order to make a decision on the inheritance part, an expert is required to interpret, perceive, communicate and consult to the

client. In Figure 3.1, we can choose the knowledge acquisition techniques between explicit knowledge and tacit knowledge which are prototype generation, diagram-based and concept mapping. So, the intersection between knowledge component (declarative and procedural) and type of knowledge according to its nature (explicit and tacit) is diagram-based techniques. So, in this project I will use the diagram-based techniques in the process of knowledge acquisition.

3.3.3 Non-functional Requirement

The FaraidhBot will response the best answer as long as the pattern and template are state in the category. This chatbot will have weaknesses in responding a message to user, chatbot able to give a response to a query only. This is because the system cannot trace more than one pattern but this chatbot are capable to carry a long conversation.

3.4 Summary

Chapter 3 cover the analysis of the project on create ways to solve the problem that area state in chapter 1. Overall, the development of chatbot will use AIML for the knowledge base and create the categories that consists of pattern (the question the user asks the FaraidhBot) and template (the answers the FaraidhBot provide). Next chapter will cover the design of the chatbot and technique use to create a chatbot. Also, will explain about diagram-based system in order to develop this system.

CHAPTER 4: DESIGN

4.1 Introduction

This chapter explains the design of FaraidhBot using AIML and how the knowledge is represented. The knowledge representation that are used to develop this chatbot is production rule and decision tree. Decision tree is the diagram-based techniques in knowledge acquisition that already explained in the previous chapter.

4.2 High-Level Design

4.2.1 Knowledge Representation of FaraidhBot

Knowledge representation methods are focused to assemble knowledge in convenient format, which allows the use of a knowledge-based system, to store and maintain knowledge in a form as close to the knowledge given by an expert and to present knowledge in such way that they can be altered, which are addition of rules and facts. There are many types of knowledge representation methods, which are decision tree, semantic networks, production rules, frames, scripts, hybrid structures and semantic web structures.

4.2.1.1 Production Rules (Reasoning)

The selected method of knowledge representation for FaraidhBot is production rules. The general format of the rule is as follows :

If <conditions>, then <actions>

Rules are straightforward and easy to alter, understand and implement. Rules of FaraidhBot are design based on the inheritance part that stated in the Holy Quran. The inheritance part mentioned in Chapter 2. The example of rules for the FaraidhBot are as follows:

Heirs	Inheritance Part Based on Quran	Production Rules
Husband	1/2 if the deceased does not have children or grandchildren	IF the deceased is a wife AND does not have children OR does not have grandchildren THEN husband will get $\frac{1}{2}$ of the property
Husband	1/4 if the deceased have children or grandchildren	IF the deceased is a wife AND have children OR have grandchildren THEN husband will get $\frac{1}{4}$ of the property
Wife	1/4 if the deceased does not have children or grandchildren	IF deceased is a husband AND does not have children OR does not have grandchildren THEN wife will get $\frac{1}{4}$ of the property
Wife	1/8 if the deceased have children or grandchildren	IF deceased if a husband AND have children

		OR have grandchildren THEN wife will get 1/8 of the property
Father	1/6 if the deceased have a son or grandson	IF deceased have a son OR have grandson THEN father will get 1/6 of the property
Father	1/6 + balance if the deceased does not have son or grandson and have daughter or granddaughter	IF deceased does not have son OR does not have grandson AND have daughter OR have granddaughter THEN father will get 1/6 + balance of the property
Father	Balance if the deceased does not have children and grandchildren	IF deceased does not have children AND does not have grandchildren THEN father will get balance of the property

Table 4.1 Example of Inheritance Part Converted to Production Rules

4.2.1.2 Diagram-Based Technique

In order to easily understand about the distribution of inheritance among the heirs, an overview of the beneficiaries heirs along with its inheritance part are illustrated. Figure 4.1 below are the illustration of faraidh that are often used by the experts to explain to their client about the distribution of inheritance.

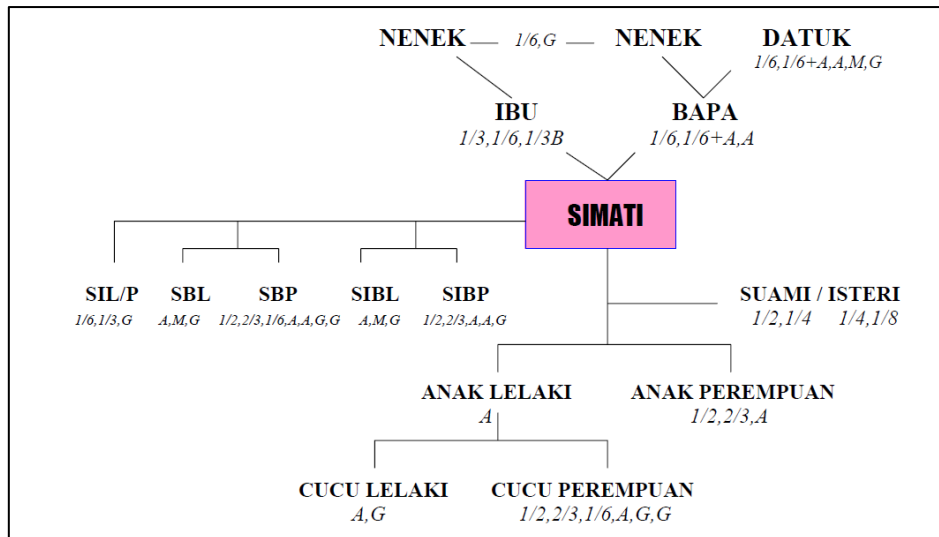


Figure 4.1 Diagram for the Beneficiaries Heirs and Its Inheritance Part

It is difficult to translate the above diagram into AIML code because it can only be understood by the experts. So, to make it easier to understand by the knowledge engineer, which are me, and implement it into the system using the AIML code, I am using decision tree to illustrate the inheritance part to the existing heirs. The decision tree are made by referring to the production rules. Below are some of the example of decision tree.

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Production rule 1 :

<p>IF the deceased is a wife</p> <p>AND does not have children</p> <p>OR does not have grandchildren</p> <p>THEN husband will get $\frac{1}{2}$ of the property</p>	<p>IF the deceased is a wife</p> <p>AND have children</p> <p>OR have grandchildren</p> <p>THEN husband will get $\frac{1}{4}$ of the property</p>
--	--

Table 4.2 Production Rules 1

Decision tree 1 :

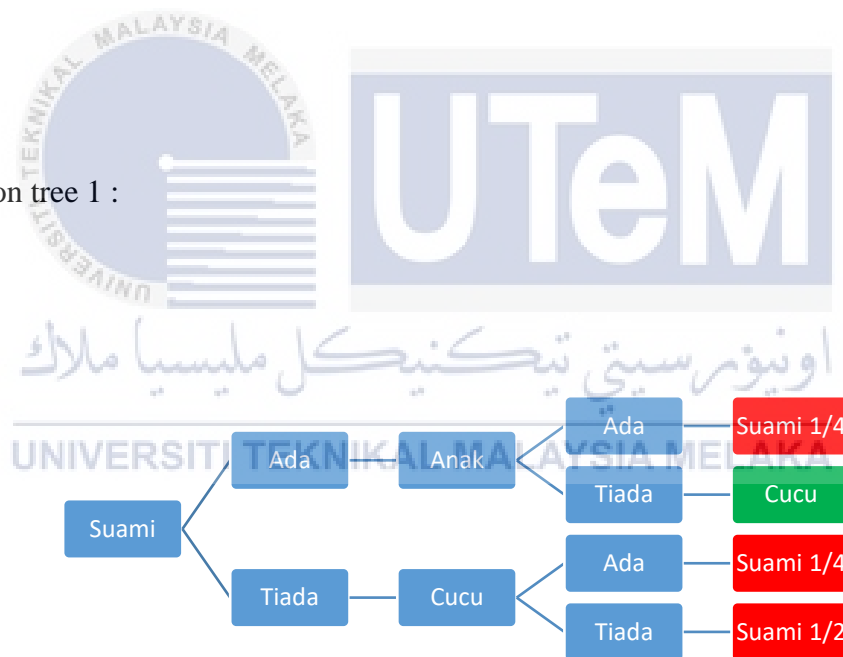


Figure 4.2 Decision Tree 1

Production rule 2 :

IF deceased have a son	IF deceased does not	IF deceased does not
OR have grandson	have children	have son
THEN father will get 1/6 of the property	AND does not have	OR does not have
	grandchildren	grandson
	THEN father will get	AND have daughter
	balance of the property	OR have granddaughter
		THEN father will get 1/6 + balance of the property

Table 4.3 Production Rules 2

Decision tree 2 :

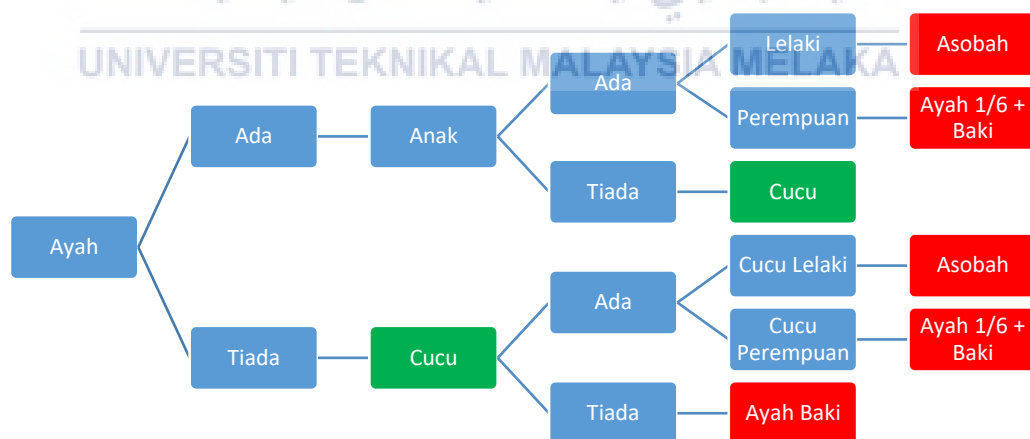


Figure 4.3 Decision Tree 2

Production rule 3 :

IF the deceased have a son	IF the deceased does not have son	IF the deceased does not have children
OR grandson	AND does not have grandson	AND does not have grandchildren
THEN grandfather will get 1/6	AND have daughter OR have granddaughter THEN grandfather will get 1/6 + balance	THEN grandfather will get balance

Table 4.4 Production Rule 3

Decision tree 3 :

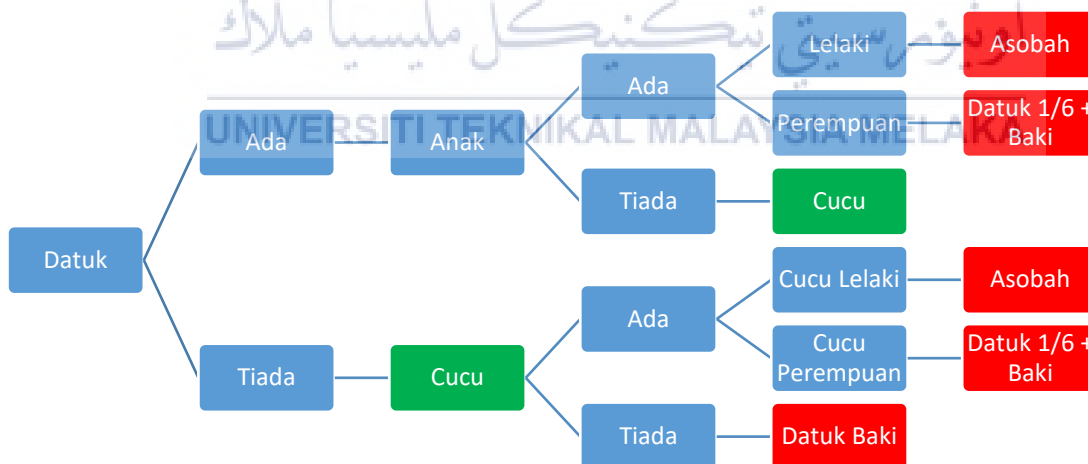


Figure 4.4 Decision Tree 3

4.2.2 System Architecture for FaraidhBot

FaraidhBot works using the client-server concept, just like any other web-based application. The AIML interpreter and FaraidhBot user interface are hosted at Pandorabot.com and the database to store the knowledge base is in the AIML categories. When the user ask any questions to FaraidhBot, the question will be processed by AIML interpreter by referring to the knowledge base. The knowledge engineer can constantly maintain the knowledge base by adding the knowledge in AIML file format. Figure 4.1 below shows the overview of the system architecture.

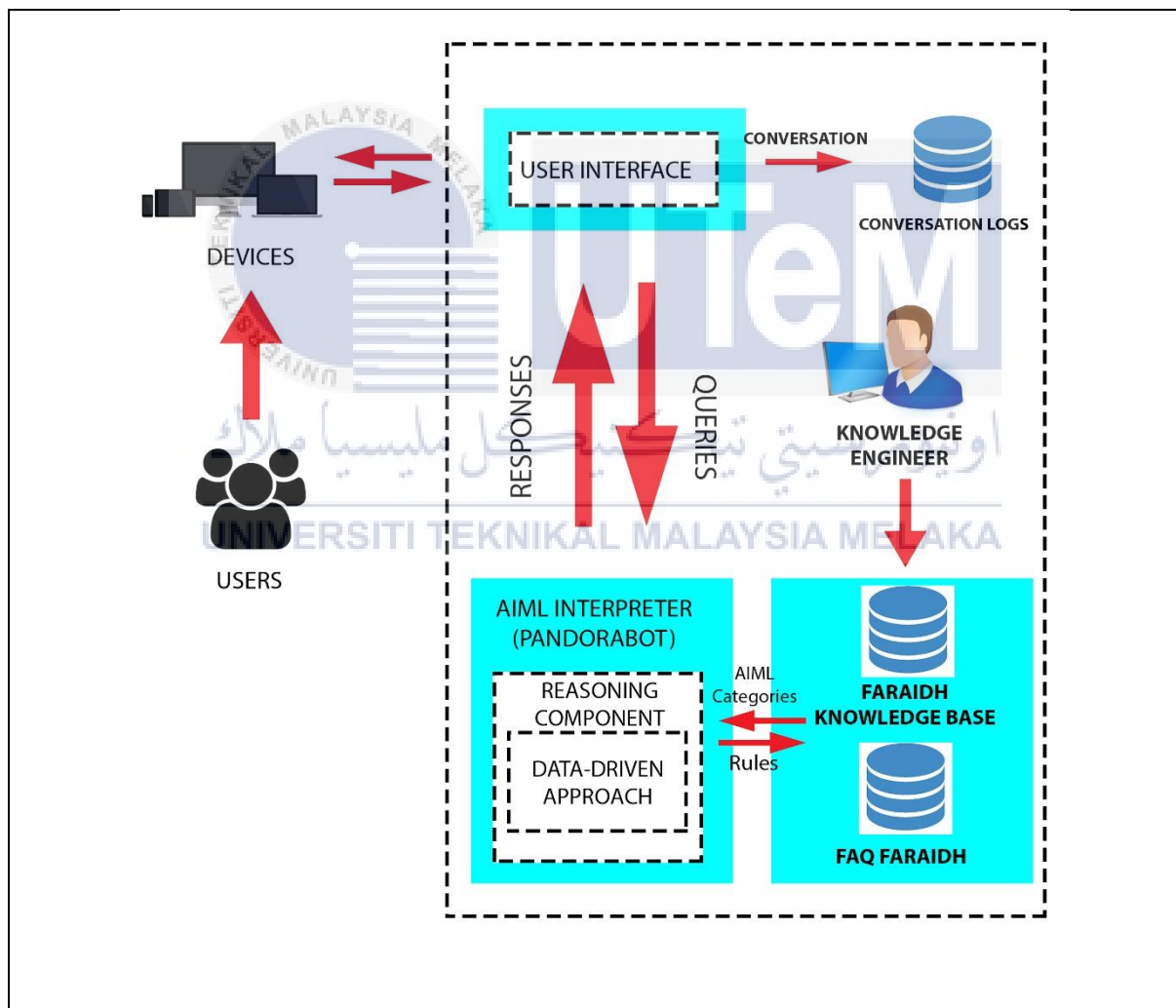


Figure 4.5 FaraidhBot's System Architecture

4.2.3 User Interface Design for FaraidhBot

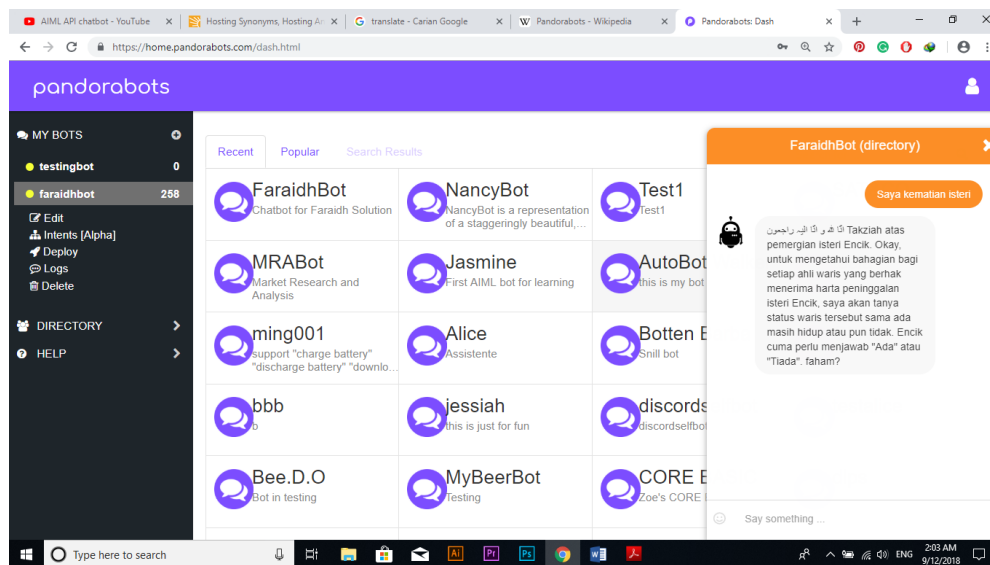


Figure 4.6 Pandorobot API User Interface

4.3 Summary

This chapter gives the overview of the system architecture, knowledge representation and the user interface design. Knowledge representation used in this chatbot development is production rules also known as reasoning which are the if <condition>, then <condition> rules and decision tree on how to represent the Faraidhbot to make a decision to the user about the inheritance part. By analyzing the knowledge representation and construct the production rules and decision tree, supposedly the knowledge engineer will have a better and complete understanding about the domain knowledge. After that, that knowledge engineer are ready to implement the knowledge into the system. The following chapter will explain on how to implement the knowledge-based system.

CHAPTER 5: IMPLEMENTATION

5.1 Introduction

This chapter explains the implementation of FaraidhBot prototype. Based on the FaraidhBot's system architecture that have been reviewed in the previous chapter, FaraidhBot will be developed according to the system architecture which includes chat interface, knowledge base and AIML interpreter. In order to start the development of FaraidhBot, the environment needs to be setup locally and the relevant software needs to be installed. The knowledge base of FaraidhBot can be built up by using the AIML interpreter and also in other way can be built by using text editor such as Notepad++.

5.2 Software Development Environment Setup

FaraidhBot is a web-based conversational bot using Pandorabot, Inc. online Application Programming Interface (API). Pandorabot is an artificial intelligence company that a web service for developing and launching chatbots. Pandorabot is the earliest and biggest chatbot hosting services in the world. Pandorabot compatible with the development of the Artificial Intelligence Markup Language (AIML).

5.2.1 Signing Up in pandorabots.com

In order to use the Pandorabot API, we need to sign up to the website at <https://home.pandorabots.com/home.html>.

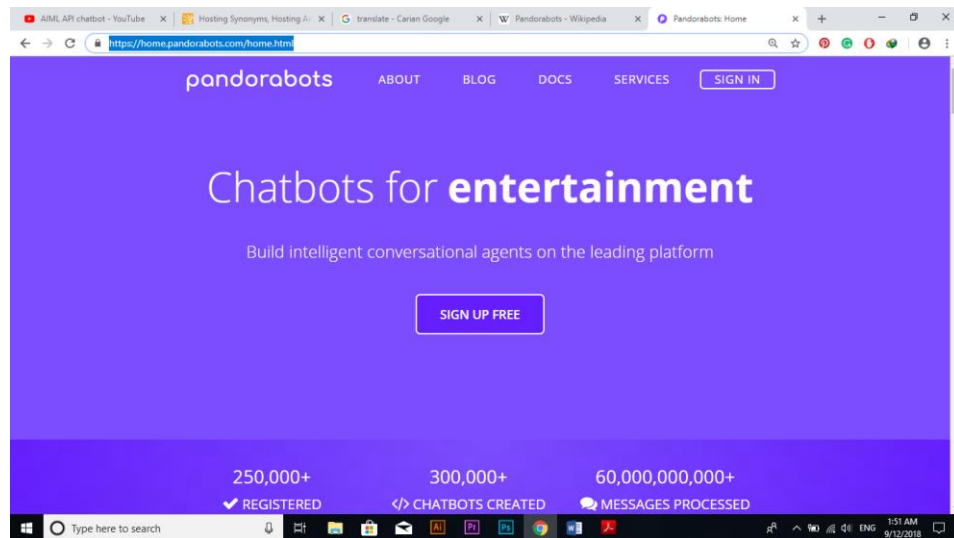


Figure 5.1 Home page of pandorabots.com

Click the “SIGN UP FREE” button for the registration.

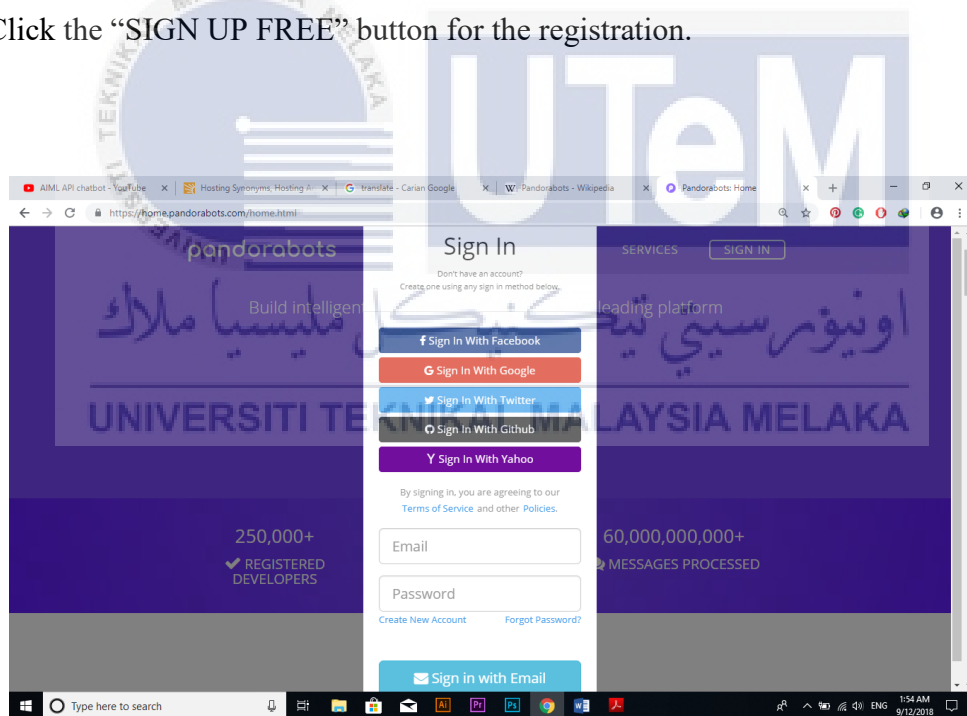


Figure 5.2 Sign Up Form

The sign up form will pop-up after clicking the “SIGN UP FREE” button. There are many ways to sign up whether to sign up with Facebook, Google, Twitter, Github or Yahoo.

Also can sign up by clicking on the “Create New Account”. Then, fill up your details such as email and password. In this case, I just sign up a new account with my Google account.

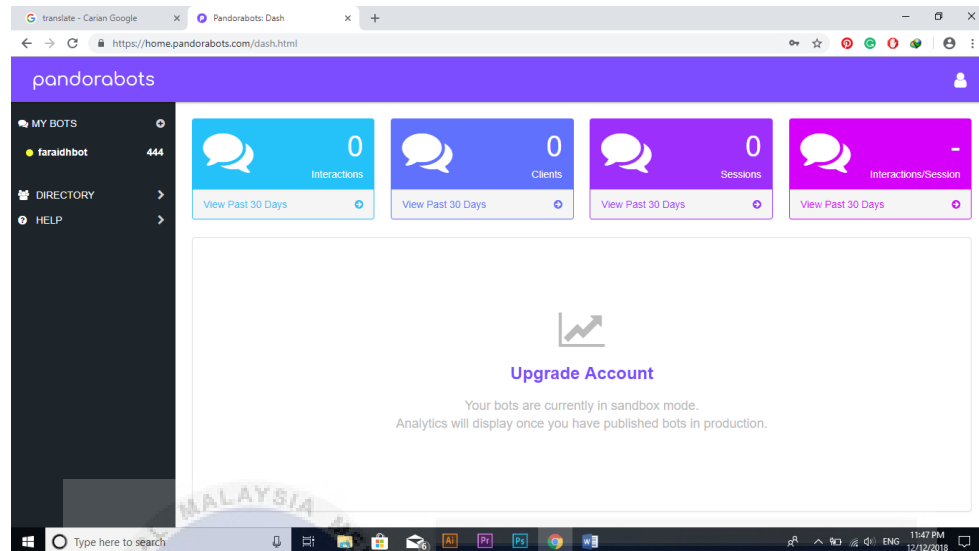


Figure 5.3 Pandorabot Home Page

To create a new bot, you need to click the plus icon on the upper left besides “MY BOTS” of the Pandorabot Home Page.

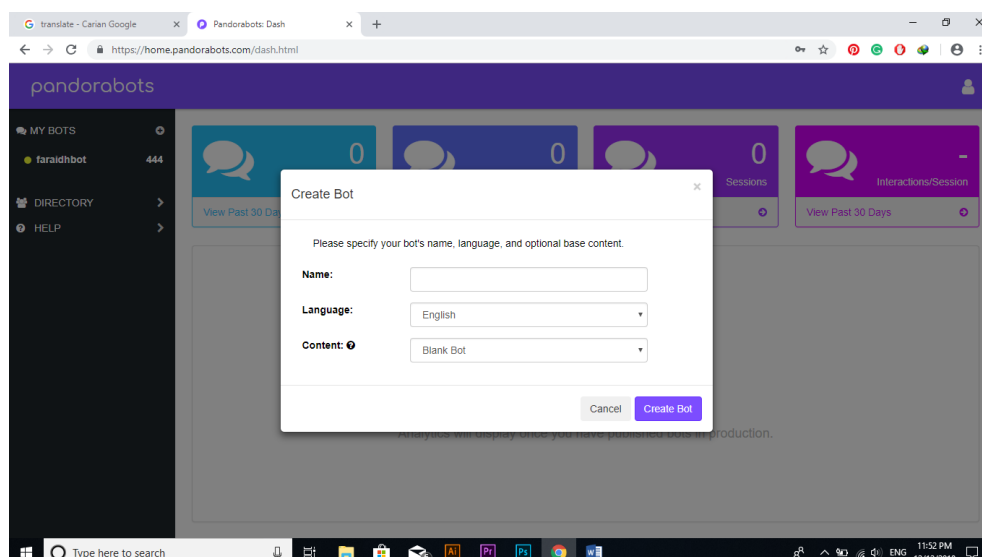


Figure 5.4 Creating New Bot in Pandorabot

Then, a dialog box of “Create Bot” will pop-up. Fill up the bot’s name, language and content. Then, click “Create Bot” button.



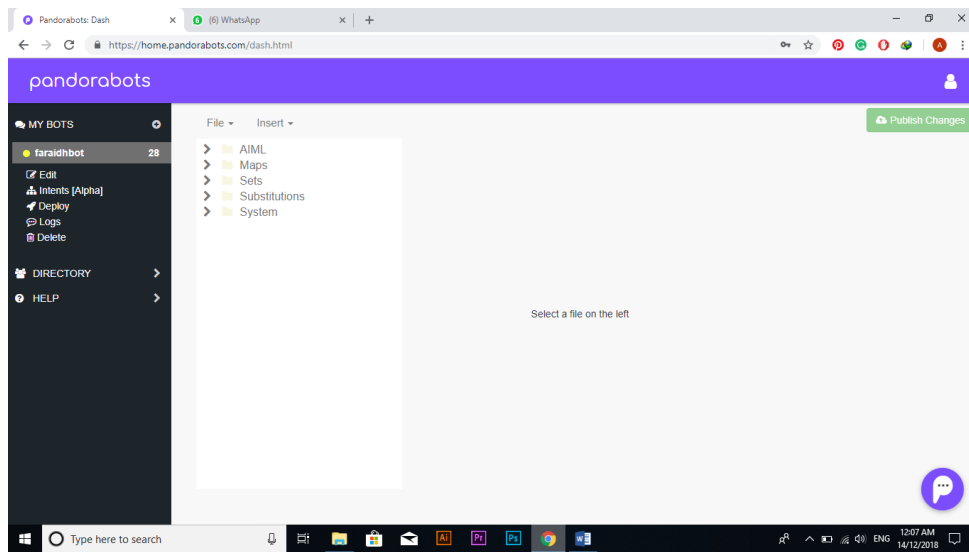


Figure 5.5 FaraidhBot Editing Workstation

In order to create the knowledge base, we need create the AIML file by click on the “File” dropdown button > New > AIML. Then, a dialog box will pop up to rename the file. After that, click “Create File” button.

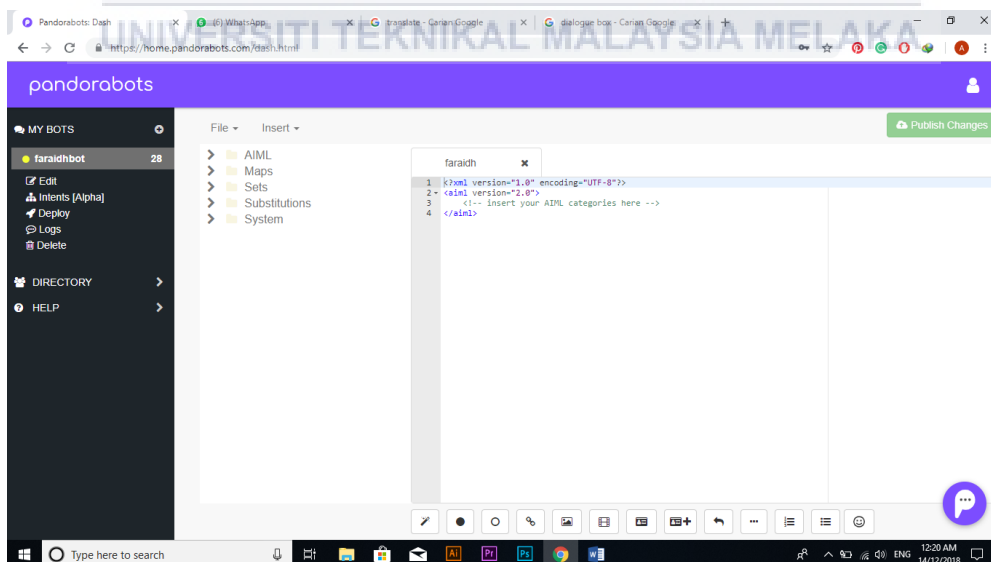


Figure 5.6 FaraidhBot AIML File

After creating the AIML file, it will show up the AIML file for adding the knowledge base using AIML code.

5.3 Summary

This chapter covered the implementation of FaraidhBot using Pandorabots internal bot directory. Development environment are crucial to ensure the system can work smoothly. For FaraidhBot, the knowledge base plays the important role to decide the intelligence of the chatbot. Therefore, a sufficient knowledge must be added to ensure most of the queries can be answered. FaraidhBot's user interface is designed totally by the pandorabot API. After the system has been implemented completely, it will be tested by the expert and non-expert. The result and analysis will be explained in the next chapter.



CHAPTER 6: TESTING

6.1 Introduction

This chapter describes about the testing phase of FaraidhBot. Total of 13 respondents that consists of expert and non-experts are experienced using the FaraidhBot. After they tested the FaraidhBot, surveys regarding their experience using the FaraidhBot are distributed via google form. The test result and analysis will be described further in this chapter.

6.2 Test Plan

This project collected qualitative methods from 13 respondents. The respondents are categorize into two groups based on their level of knowledge regarding faraidh, which are group of expert and non-expert. In the non-expert group consists of people who know about faraidh and people who do not know anything about faraidh :

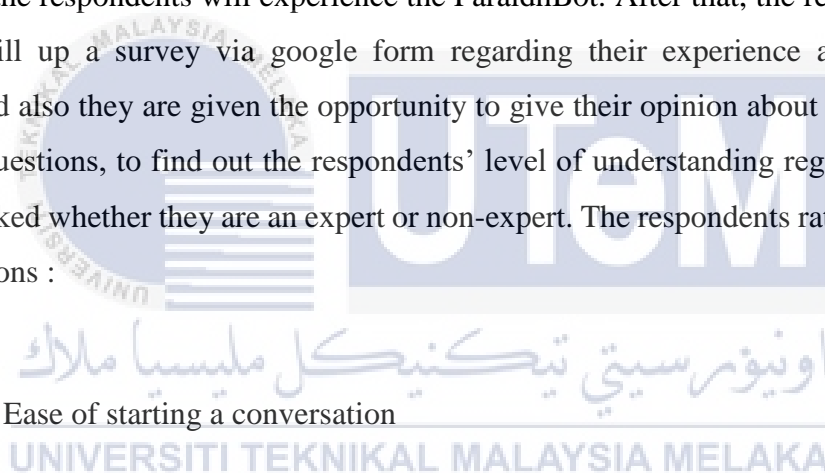
- i. **People who are expert in faraid** – This group is a group who studies faraidh and work also related to faraidh.
- ii. **People who know a little bit about faraidh** – usually this group are those who study in the field of Islamic law but not specifically in faraidh.
- iii. **People who do not know anything about faraidh** – this group consists of people who do not know and do not study nor work in the field of faraidh.

6.2.1 Test Organization

FaraidhBot is a type of knowledge-based system. To be specific, it is an expert system. Where it require many roles in the development of the system such as knowledge engineer and knowledge expert. In this project, the knowledge engineer is Mohammad Aklif bin Mohammad Saini which me and the knowledge expert is Ahmad Zarul Zalfhan bin Shahari, Senior Executive Officer at as-Salihin Trustee Berhad Company located in Kelana Jaya, Selangor. The role of the expert in this project is to test and verify the system.

6.2.2 Test Environment

All of the respondents will experience the FaraidhBot. After that, the respondents will be asked to fill up a survey via google form regarding their experience after using the FaraidhBot and also they are given the opportunity to give their opinion about FaraidhBot. In the survey's questions, to find out the respondents' level of understanding regarding faraidh, they will be asked whether they are an expert or non-expert. The respondents rated satisfaction for four questions :

- 
- i. Ease of starting a conversation
 - ii. Accuracy of understanding your words
 - iii. Quality of results
 - iv. Relevancy of Faraidh in Chatbot
 - v. If FaraidhBot continues, will you continue to use it as faraidh solution

Each questions were structured as a 5-point satisfaction scale numbered as 1 until 5 where 1 represent not satisfied at all, slightly satisfied, moderately satisfied, very satisfied and 5 extremely satisfied.

6.2.3 Test Schedule

The duration of testing the FaraidhBot has been conducted for 1 week from 5th December until 12th December 2018.

6.3 Test Result and Analysis

6.3.1.1 Expert's Conversation Log With FaraidhBot

sessionid	time	input	ouput
70676646	2018-12-12T03:00:54Z	Saya kematian ayah	اَنَا لِّلّٰهِ وَ اَنَا اِلَيْهِ رَاجِعُونَ Takziah atas pemergian ayah Encik.Okay, untuk mengetahui bahagian bagi setiap ahli waris yang berhak menerima harta peninggalan ayah Encik, saya akan tanya status waris tersebut sama ada masih hidup atau pun tidak. Encik cuma perlu menjawab "Ada" atau "Tiada". Encik faham?
70676646	2018-12-12T03:04:20Z	fAHAM	Okay baik. Kalau macam tu Alhamdulillah. Nak tanya... Pertama sekali, nak tahu datuk Encik sebelah ayah masih ada? Maksudnya ayah Encik punya ayah.
70676646	2018-12-12T03:04:33Z	Ada	Hmm... Nenek Encik pula? Sama juga, nenek sebelah

			ayah. Ataupun ibu kepada ayah Encik.
70676646	2018-12-12T03:04:52Z	Ada	Encik ada adik beradik lelaki yang lain?
70676646	2018-12-12T03:04:58Z	Ada	Adik beradik perempuan?
70676646	2018-12-12T03:05:35Z	Ada	Encik ada berapa orang adik beradik lelaki?
70676646	2018-12-12T03:05:59Z	3	Encik ada berapa adik beradik perempuan?
70676646	2018-12-12T03:06:03Z	2	<p>Okay, secara kesimpulannya, yang hanya layak mendapat harta peninggalan ayah Encik mengikut perkiraan faraidh adalah :</p> <p>Encik sendiri sebagai anak lelaki akan mendapat asobah. Ayah sebanyak 1/6. Ibu sebanyak 1/6. Anak lelaki sebanyak asobah. Anak perempuan sebanyak Asobah dengan anak lelaki (العصبة بالغير) dengan bahagian seorang anak lelaki sama dengan bahagian dua orang anak perempuan. Boleh rujuk surah An-Nisa ayat 11.</p>

Table 6.1 Conversation Log Between Expert and FaraidhBot

6.3.1.2 Overall of Respondents' Feedback

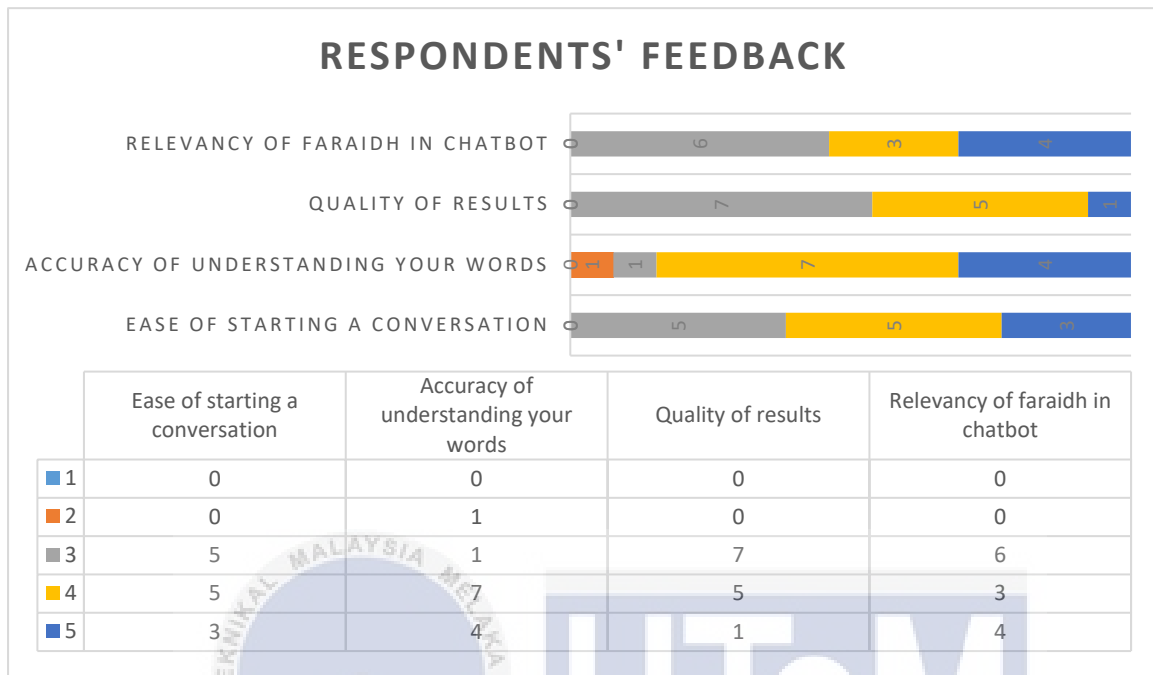


Figure 6.1 Respondents' Feedback

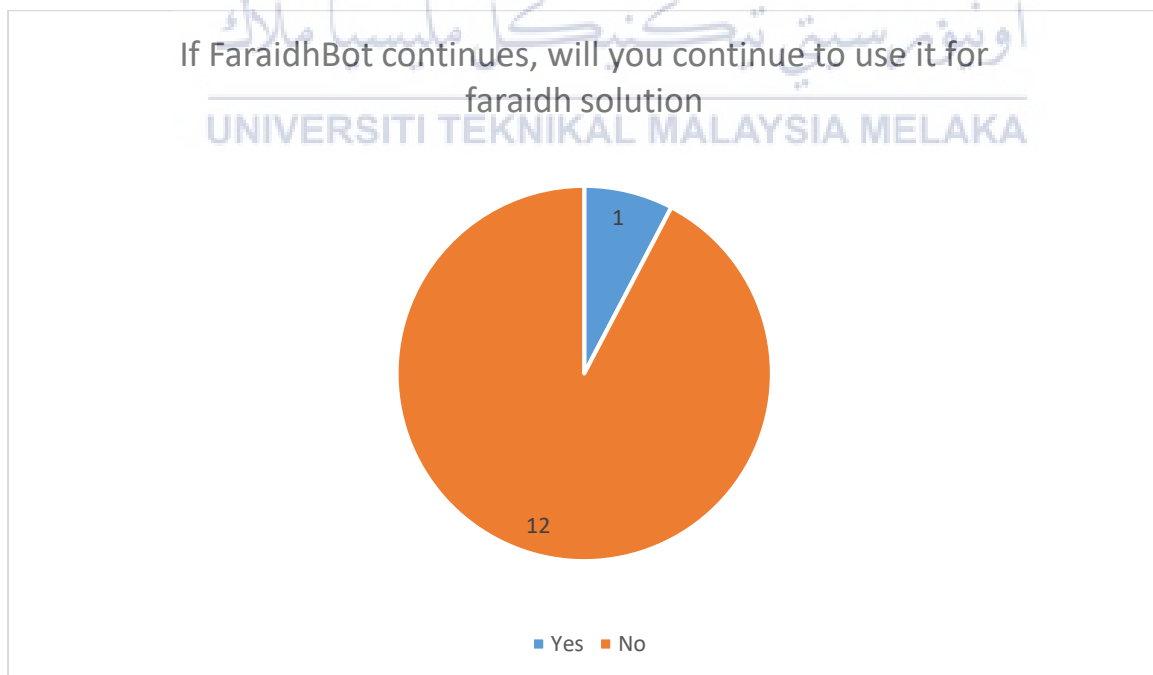


Figure 6.2 Question 5

Referring to Figure 6.1, is it the feedback of the respondents' including the expert and non-expert. Majority of the respondents rated satisfaction between 3 and 4 whether there are partially satisfied or very satisfied experiencing the FaraidhBot. Based on the first question, ease of starting conversation, some respondents with a moderate level knowledge about faraidh and respondents that do not know anything about faraidh rated extremely satisfied with the first conversation with FaraidhBot and some of them rated equally between partially and very satisfied. More surprising, the expert has rated very satisfied.

On the second question, mostly of them rated very satisfied with the FaraidhBot's accuracy in understanding the respondents' words. But, there are two respondents that partially and slightly satisfied with the understanding of FaraidhBot on their words. This is because the user input does not match with the knowledge base due to the spelling error of the respondents. As we all know that AIML using pattern matching technique to reply any queries. So, if the pattern does not match, it will display default response, which are "I do not understand your words". Besides that, it is also because of the misunderstanding of the respondents towards the FaraidhBot's words. The FaraidhBot told the respondents to reply either "exist" or "none" of the each existing heirs. But before the FaraidhBot proceed to ask existence of each heirs, the FaraidhBot asked "Do you understand?". Supposedly, the respondents should reply "Yes" or "No". If the respondents reply other than "Yes" or "No", the FaraidhBot will not understand the respondents'.

Third question is about the quality of result. Majority of the respondents rated moderately satisfied as well as the expert. According to the expert, when using an application about faraidh, usually users only want to know the exact value about their inheritance part. The result by FaraidhBot is too long to read. In the other hand, the expert credited FaraidhBot answers. Each result from the FaraidhBot has its justification and explanation from Quran, Hadith and the experts' heuristics knowledge, which it will give a better and complete understanding regarding faraidh rather than just output a total of inheritance part without any explanation.

Lastly, half of the respondents are very agree and extremely agree about the relevancy of faraidh in chatbot and also half of them are partially agree. The expert has rated partially agree because based on his experience with many clients, for now, people are tend to know only the inheritance part of each heirs. But, he cannot doubt that in the next 20 to 30 years chatbot is very useful to replace experts in a particular field including faraidh.

6.4 Summary

Testing phase was conducted in qualitative method by experiencing 13 respondents with the FaraidhBot. Then, all of the respondents will give their feedback via google form after experience the FaraidhBot. They also give their opinion towards the FaraidhBot whether it is relevant to implement in this era. According to the expert, it is not the time to make a system of faraidh in chatbot but it will benefits people in 20 to 30 year from now.



CHAPTER 7: CONCLUSION

7.1 Observation on Weakness and Strengths

FaraidhBot depends on the technology provided by pandorabot API as the interpreter to the AIML code and for the chatbot deployment. To make the chatbot available on public using supported messaging applications such as Facebook Messenger, Whatsapp Business, WeChat, Telegram or APIs, we need to upgrade our pandorabot account into the developer plan. Upgrading to developer plan will be billed monthly using our credit card. FaraidhBot only available on the internal bot directory in pandorabots.com and not available on public due to the absence of credit card for the billing process.

7.2 Propositions for Improvement

FaraidhBot can be improved in term of the knowledge management. According to Skyrme (2002), knowledge management can be defined as the explicit and systematic management of vital knowledge and its associated processes of creating, gathering, organizing, diffusion, use and exploitation, in pursuit of organizational objectives. A good management of knowledge will improve the quality of the decision from the chatbot, improving customer relationships, prevention of knowledge loss and shorter product cycles. Besides that, it also can be improved in terms of the chatbot's response. According to the expert, it is better for the chatbot to response in short and brief explanation regarding the chatbot results.

7.3 Project Contribution

The development of FaraidhBot helps Muslims to have a basic understanding regarding to faraidh. As we all know, faraidh is a very crucial knowledge in Islamic law. But, many Muslims does not have the awareness of the importance of faraidh. They just focus on worship to Allah SWT. At the end, when death occurs, faraidh is the first thing that must be resolved after the funeral. From that problem statement, I took the initiative to develop FaraidhBot. In this project, the development of FaraidhBot are focus on the knowledge representation to enable FaraidhBot to make decision or reasoning about the inheritance part.

7.4 Summary

As conclusion, FaraidhBot provide a relevant information about the knowledge of distribution of inheritance. No doubt that there are still have weaknesses on the development of the FaraidhBot, which are the knowledge management are not emphasize in this project. But, the biggest contribution from this project is the design of two types knowledge representation, which are production rules and decision tree.

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APPENDICES

Timestamp	Tahap pengetahuan anda tentang Faraid	Mudah untuk memulakan pergaulan	Ketepatan untuk memahami kata-kata anda	Kualiti jawapan yang dikeluarkan	Kerelevanan chatbot dalam bidang faraid	Sekiranya FaraidhBot ini diteruskan, adakah anda akan terus menggunakannya sebagai jalan penyelesaian untuk masalah Faraidh?
12/11/2018 11:24:50	Pakar	4	4	3	3	Tidak
12/13/2018 8:53:57	Sederhana	3	5	3	3	Ya
12/13/2018 9:00:23	Sederhana	4	4	4	5	Ya
12/13/2018 9:01:29	Sederhana	3	4	4	4	Ya
12/13/2018 9:04:24	Tidak Tahu	5	5	4	5	Ya
12/13/2018 9:18:49	Tidak Tahu	3	5	3	3	Ya
12/13/2018 9:20:50	Tidak Tahu	4	4	3	5	Ya
12/13/2018 9:30:45	Tidak Tahu	4	4	4	4	Ya
12/13/2018 9:46:20	Tidak Tahu	3	3	3	3	Ya
12/13/2018 10:31:51	Sederhana	3	2	3	3	Ya
12/13/2018 12:33:11	Sederhana	4	4	3	3	Ya
12/13/2018 15:51:06	Sederhana	5	5	4	5	Ya
12/13/2018 16:01:03	Tidak Tahu	5	4	5	4	Ya