CHAPTER 1: INTRODUCTION

1.1 Background of Study

As part of their duty to Allah, Muslims are required to seek medical help for illness. To show gratitude and respect for the body health that has been gifted to them, we need to look after our health. On top of that, Muslims see it as their duty to try to preserve life for as long as possible. In Muslim's belief, it is up to Allah to decide when He will take their life.

However, some Muslims, especially the older generation may not be willing to take western or modern medication such as pain relief as a form of sickness healing method. They believe that all pain and suffering is part of Allah's test. Thus, it should be endured rather than alleviated. In this day, there are many modern medicines, techniques, and technologies available for diagnosis and treat sicknesses that attack or suffered by human beings.

Usually, people nowadays prefer modern medication as a way to treat sicknesses. However, there are also people that choose traditional method as a way to cure their sickness. From Islamic point of view, it is a responsibility for all human beings to find the cure for the sicknesses as long as it does not use forbidden prescription or method in Islamic perspective. Islamic treatments provide no side effect since it only used water as the main ingredients and reading from Quranic verses and Hadith. Muslims believe that all sicknesses have their own cure because Allah had made the sicknesses and the cure itself as mentioned in the Hadith:

"There is no disease that Allah has created, except that He also has created its treatment." (Sahih Al-Bukhari)

The proposed Expert System (ES) for Islamic therapy is to compile the types of diseases/sicknesses with their respective symptoms. The system would be able to suggest the treatments from Qur'an and Hadith. The system will be made readily available on mobile platform. The users are expected to access the system anywhere at any time. It should be emphasized here that the most important element is the user must have confidence and faith that Allah is there to help and cure his/her sickness.

1.2 Problem Statement

In daily life, Islamic healing method has many benefits in terms of effectiveness and ease of implementation. Unfortunately, it is found that information regarding Islamic therapy is not widely exposing yet in Malaysia via mobile or Internet technologies. Most of this information are only available in books or printed media. Most Muslims prefer to use modern method of medications which are quite expensive and may not be affordable by some of them.

One solution is by developing an intelligent system that provides Muslims with the treatment for the sicknesses according to Islamic concept. Moreover, there are no expert systems for Islamic healing method being found recently. Thus, Islamic treatment should be encouraged as this method has no harm at all to the practitioners. This healing method is based on natural resources and on certain ruqyah (Quranic healing).

On January 2012 an Islamic medication method was developed in web platform. The system was developed by Shahnaz Zaida named BIMES. However the system has weakness where user needs to use internet connection in order to use the application. Besides that, the user interface of the BIMES web platform also not satisfied user.

Since the smart phone user is increased in worldwide. Author found that this is a good advantage if the BIMES system is develop for mobile application. Thus, user can

access the system anytime and anywhere without internet connections. Hopefully, the application cans benefits to all muslims.

1.3 Objectives

This project is to do extension of existing web platform BIMES. The objectives are:

- ✓ To develop an expert system on mobile platform to provide user a system that is capable to diagnose the user's sickness based on the symptoms specified
- ✓ To preserve and nurture Islamic medication system
- ✓ To make a research on applying Bayes Theorem in diagnosis process
- ✓ To make an in depth research on types of sickness, their symptoms, and their treatment from Quranic verses and Hadith

1.4 Scope of Study

This project will cover the research part and based on the findings from the research, the expert system will be developed. For the research part, the scope is divided into three main areas:

1) Research on symptoms and types of sicknesses (eye pain, fever, headache, stomachache, and toothache)
2) Research on Quranic verses and Hadith for the treatment
3) Research on implementing Bayes Theorem in diagnosis system

This system provides no risk of side effect to the treatment because there will be no usage of chemical medication. It will only use water as the main ingredients and some herbs. The treatments come with some gestures to be practiced with reading from Al-Quran and approved reading from the scholars. A programming will be made to make the system being able to diagnose.

CHAPTER 2: LITERATURE REVIEW

2.1 Bayes' Theorem

The conditional probability, P (A|B), states the probability of event A given that event B occurred. The inverse problem is to find the inverse probability, which states the probability of an earlier event given that a later one occurred. This type of probability occurs often, as in the case of medical or equipment diagnosis where symptoms appear and the problem is to find the most likely cause. [1]

The solution to this problem is Bayes' Theorem, also sometimes called Bayes' Formula, Bayes' Rule, or Bayes' Law, named after the 18th Century British clergyman and mathematician, Thomas Bayes. Bayesian theory is extensively used today in many applications. In fact, the familiar Office Assistant, and Technical Troubleshooter Help that is provided automatically in Microsoft Office and Windows use Bayesian logic to better try and help us rather than relying on simple decision trees. [1]

Bayes' Theorem is:

$$\mathbf{P(H \mid E) = P(E \mid H)\,P(H) / P(E)}$$

While Bayes' Theorem is useful in medicine, its accurate use depends on knowing many probabilities. For example, Bayes' Theorem may be used to determine the probability of a specific disease, given certain symptoms as:

$$\mathbf{P(D_i \mid E) = P(E \mid D_i)\,P(D_i) / P(E)}$$
$$\mathbf{= P(E \mid D_i)\,P(D_i) / \sum_j P(E \mid D_j)\,P(D_j)}$$

where the sum over j extends to all diseases, and:

TABLE 1. Equation Explanation

Symbol	Explanation
Di	i'th disease
E	Evidence
P(Di)	Prior probability of the patient having the Disease i before any evidence is known
P(E|Di)	The conditional probability that the patient will exhibit evidence E, given that disease Di is present

2.2 Expert System

A physician may have knowledge of most diseases, but due to the extensive number of diseases, a physician could benefit from the support provided by an expert system to quickly isolate the disease. Specifically, expert systems for medicine can be developed for these purposes [2]:

1. Enhanced the ***accuracy*** of clinical diagnosis through approaches that is systematic, complete, and able to integrate data from diverse sources
2. Increase the ***reliability*** of clinical decisions by avoiding unwarranted influences of similar but not identical cases
3. To improve the ***cost efficiency*** of tests and therapies by balancing the expenses of time, inconvenience against benefits and risks of definitive actions
4. Increase our ***understanding of the structure of medical knowledge,*** with the associated development of techniques for identifying inconsistencies and inadequacies in that knowledge
5. To improve our ***understanding of clinical decision making*** in order to improve medical teaching and to make the system more effective and easier to understand.

From the description, we can understand that an expert system is necessary when it comes to accuracy, cost efficiency, and reliability. In medical, expert system helps us in understanding the medical knowledge and making decision. An expert system should be used in medical practice since it helps improving the quality of care at an acceptable cost in time or money, or if it maintains the existing standard of care at a reduced cost in time or money. [2]

When we define improving the quality of care, we expect the expert system to improve diagnostic accurary and make it easier access to information via better record-keeping system. For BIMES project, these two criterias are important to ensure the project usability. The impressive growth rate of expert systems is an indicator in the acceptance of the technology by industry.

There are some of the well known medical expert systems developed over the last two decades. Clinical practice involves diagnosis of the patient condition from the information collected during the query session, physical examination and laboratory test data, and then suggesting the most appropriate therapy based on the collected data.

Correctness of such practice mainly depends on the knowledge and the skill acquired by the clinician through many years of practice. Many times the procedure is observed to be cumbersome and time consuming. Also the complication involved in taking the decision with more number of variables may lead to an incorrect and less effective diagnosis that further increases the severity of the disease. [3]

Computer based diagnostic system hold promising mean to meet the challenges of the clinical situation. The application of Artificial Intelligence, Expert system, Knowledge system finds its use to supplement the decision making of the clinician. For BIMES project, the system intended to assist Islamic practitioners in diagnosing

patient's diseases. Sometimes, single Islamic practitioners need to entertain a huge number of patients.

An expert system also known as knowledge based system is a computer program that contains the knowledge and analytical skills of human experts, related to a specific subject. On the other hand, an expert system is a software system that incorporates concepts derived from experts in a field and uses their knowledge to provide problem analysis to users of the software. The client may interact with the program directly, or interact with a human expert who interacts with the program. The decision maker may be an expert in his own right, in which case the program may justify its existence by improving his productivity.

An expert system can be distinguished from more conventional applications in that it simulates human reasoning about a problem domain, rather than simulating the domain itself. It performs reasoning over representations of human knowledge. This distinct program module is referred to as the knowledge base and the inference engine. Typical tasks of expert systems involve the intrepretation of data, diagnosis of malfunctions such as equipment faults or human diseases, structural analysis of complex objects like chemical components, configuration of complex objects and planning sequences of actions.

There is several numbers of components in expert system architecture. The knowledge base is the component that contains knowledge obtained from domain expert. To representing the knowledge is by using rules. The inference engine is the component that manipulates the knowledge found in the knowledge base as needed to give result or solution. The user interface is the component that allows user to query the system and receive the results of those queries.

The figure below shows the architecture of an expert system:

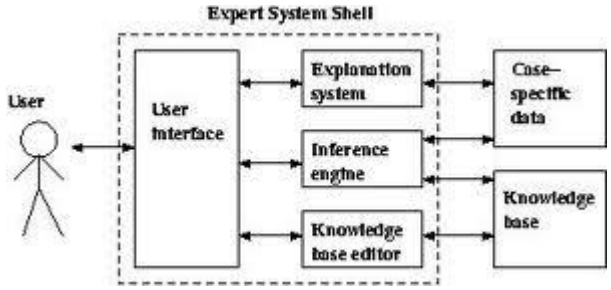


Figure 1: Expert System Architecture

Expert systems are designed and created to facilitate tasks in fields of accounting, medicine, process control, production, and etc. The foundation of a successful expert system depends on series of technical procedures and development that may be designed by related experts. The advantages of the expert system is that it provides consistent answer, hold and maintains significant levels of information, encourages to clarify the logic of decision-making, and never forget to ask question. But the disadvantages are it has lacks of common sense needed in some decision making, cannot make creative response and error may occur in knowledge base that can lead to wrong decision. [4]

Based on paperwork done by Dr Low Tan Jung from Universiti Teknologi Petronas which working on "Mobile Islamic Medication Expert System" says expert system has been used quite widely in modern medical applications for diagnosing illness and suggesting the treatments. For example, CADUCEUS is an expert system for diagnosing blood-borne infectious bacteria, MYCIN for diagnosing infectious blood diseases and recommend antibiotics, STDWizard is for recommending medical screening tests. However, there is none of this kind for the Islamic medication. The nearest of its kind is the Darussyifa' Online portal. BIMES shall works like other expert system that starts by asking the type of illness from the user then displays a list of symptoms for the user to choose from. After which more relevant questions may be asked to allow the system to identify the illness. Finally the system will provide the

solution in the form of Quran verse(s) or hadith with the related gestures/acts to be performed (Dr Low Tan Jung, 2008) [5].

2.3 Islamic Medication Concept

From Islamic point of view, prevention is better than cure. There is a reason for every sickness occurred. Allah made the sickness and the cure itself. It is a responsible and need for the human being to seek the cure and remedy for the sicknesses as long as it does not use forbidden method or prohibited prescription. From the translation upon the Hadith below, there is a remedy for every sickness. If the remedy is right for the sickness, it will cure with Allah's permission. [6]

In Islamic medication concept, the way of the treatment done must be according to the rules in Islamic concept. All the things that been done must be followed with sincerity and accurate with the Prophet Muhammad S.A.W teaching. Al-Quran and Hadith are the main sources of reference regarding anything that related to the life and hereafter for Islamic believers.

Allah said (Al-Quran: Al-Isra': 82)

We send down (stage by stage) of the Quran that which is a healing and a mercy to those who believe: to the unjust it causes nothing but loss after loss

The person who uses these types of treatment is needed to have faith and confidence that Allah is there to help and ones must sincere and be patient. With all this, Allah will cure the sickness.

Muhammad Mahmud (1992)

Whether all or half of the words or phrases from the Al-Quran, it is the highest and the main cure and remedy. Each words in Al-Quran has the cure for our life needs, give the peace in our life and the internal or external sickness or disease with one condition that we must have the faith and believe in Allah who created life-being and gave the Al-Quran. In Islamic perspective, the usage of natural sources and herbs is important rather than using modern medication because modern medication provides a long term side-effect and it will affect human body without human's acknowledgement. Since the 'doa' and Quranic verses had been a practices in Prophet Muhammad S.A.W era to treat the sicknesses, it is should or 'sunat' for Muslims to follow what the Prophet had been doing.

CHAPTER 3: METHODOLOGY

3.1 Project Flow Chart

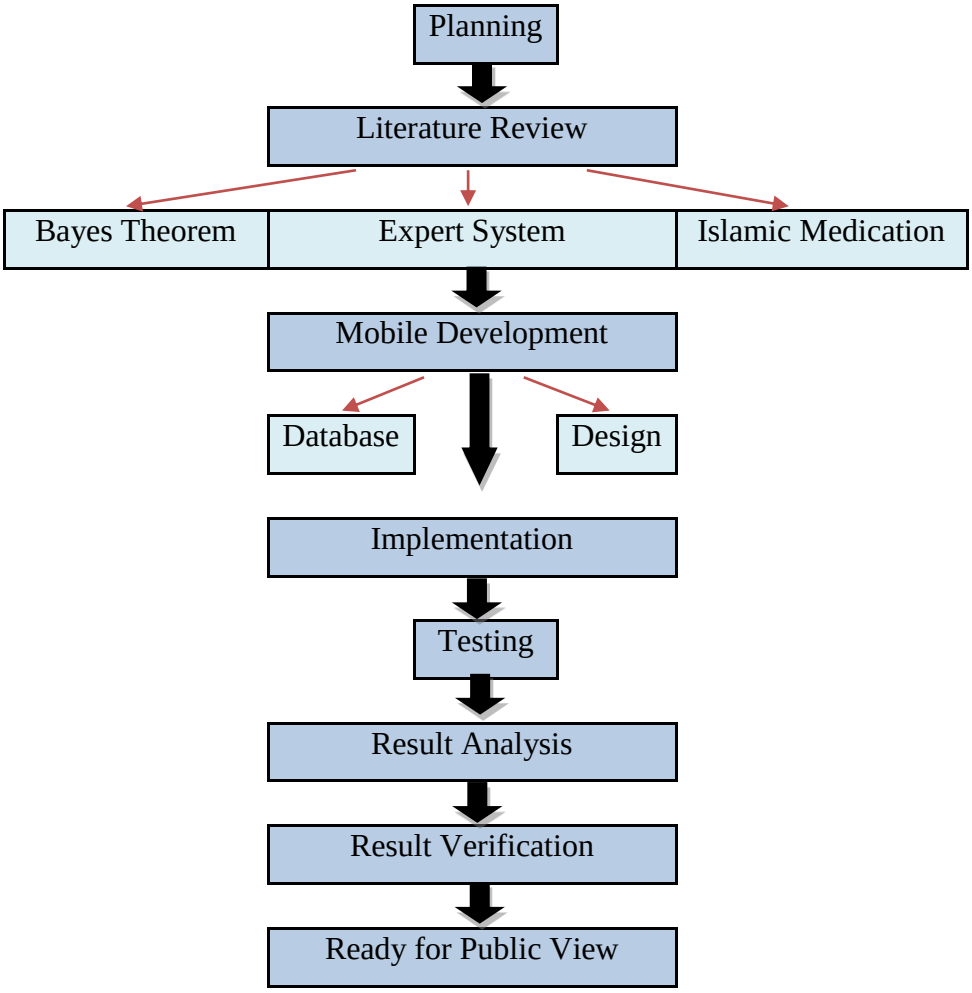


Figure 2: Project Flow for Islamic Medication Expert System on Mobile Platform

Figure 1 shows the project flow for Islamic Medication Expert System on mobile platform. A planning had been done as an initial step for the project. After that, research has been made regarding the Islamic medication system and the types of sicknesses and their symptoms for the expert system. All the types of sicknesses and their symptoms have been identified and being listed for the usage of the next development stage.

The treatment from Quran and Hadith with relevant gestures also have been searched and listed. To implement the system, suitable software for developing the system on mobile platform has been identified which is App Inventor. A testing period will be conducted to detect any undesirable result produced by the system. The result will be analyzed to make a correction for the error occurred. Then, result validation and verification will be done to make sure the output produced is accurate and precise according to the planning. Lastly, the system source code will be uploaded to web hosting server for public view to fulfill the objective.

3.2 Research Methodology

The BIMES project's knowledge acquisition consists of a few stages. The first stage began with the literature review on the expert system. This led to the second stage, where a suitable questionnaire was designed and used for a usability test survey conducted in the University Technology PETRONAS. The survey helps to identified the issues and effectiveness of the Islamic Medication Expert System.

After conduct the usability test, author will move to the third stage where author will analyze the outcome and possible further survey. Then at the fourth stage the system design will be upgrade to enhance the current system.

Last stage is validate and testing the new system. The information on Islamic medication and treatment is reconciled by Islamic expert. This stage is important to ensure the integrity and reliability of data.

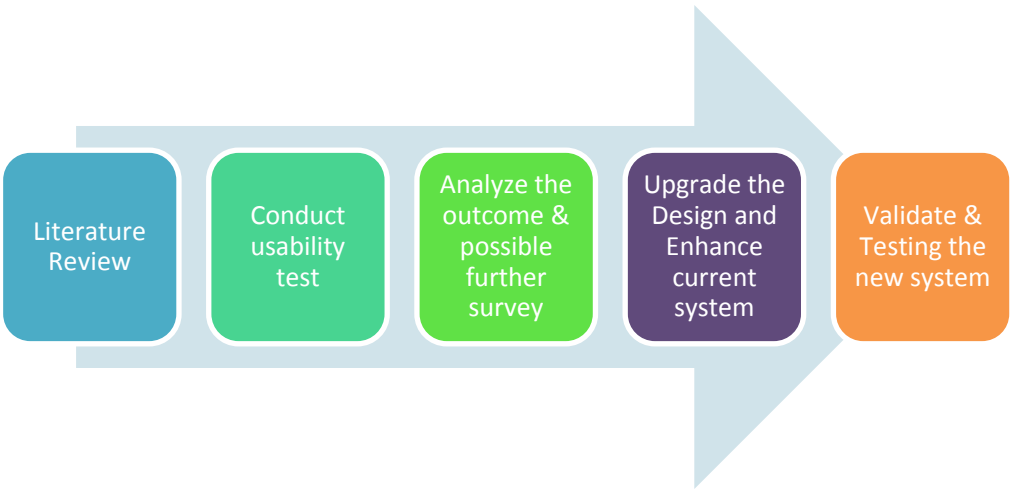


Figure 3. Flowchart of BIMES Knowledge Acquisition

3.2 System Development

The BIMES project system development is using the waterfall system development life cycle. Where the system development consists of four (4) phases they are planning, analysis, design and evaluation. At the phase one, the objectives will be determined and identified the problem statement. Second phase, identified the system requirements and specifications.

Third phase, design the system based on the system requirements and specification. Fourth phase is evaluation, where the system will be evaluate by the Islamic medication expert.

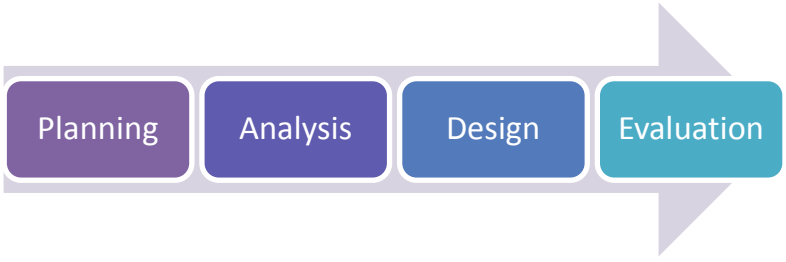


Figure 4. System Development

3.3 Project Activities

Listed below is the list of project activities to be achieved:

1) To gather information on common diseases/sicknesses and their respective remedies in Islamic prospective
    - ✓ Conduct a survey to know the common diseases/sicknesses among Muslims in daily life.
    - ✓ Conduct a survey to know the user acceptance on the Islamic Medication Expert System
    - ✓ Look for best practice in Islamic Medication from accredited references and source.

2) To develop a mobile platform expert system
    - ✓ Search for available and possible solution or technologies to implement the system.

3) To develop an interactive user interface
    - ✓ Search for rules and concept of interactive user interface.

3.4 Key Milestone

Gantt Chart for Islamic Medication Expert System (FYP 2)

No.	Detail/Week	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	Develop mobile app user interface	■	■												
2	Program the Bayes algorithm			■	■										
3	Result validation/verification					■	■	■							
4	Prototype Testing								■	■					
5	Application uploaded on the web										■	■			
6	Submission of Dissertation												■		
7	Oral Presentation / VIVA													■	
8	Submission of Final Dissertation and Technical Report														■

■	Process
■	Suggested milestone

Figure 5: Project Gantt chart

3.5 Tool

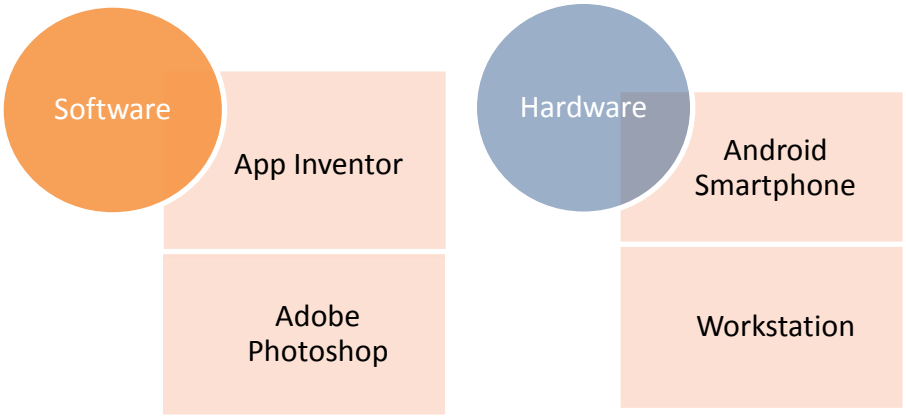


Figure 6: Tools

3.4.1 Software

The software that needed in BIMES project are App Inventor and Adobe Photoshop. App Inventor is an application to create software application for the android operating system. While the Adobe Photoshop CS5 is a graphic editing software. It will be use in this project to create the application banner or any graphic that will be insert in the application system.

3.4.2 Hardware

Hardware's that needed for BIMES project are an android smartphone and a workstation. The android smartphone is use to testing the application and the workstation is use to develop the system.

3.6 Diseases and Symptoms Identification

From the information that author gather from Shahnaz Zaida the sicknesses types and their possible symptoms are listed in table form:

TABLE 2. Sicknesses under Eye Pain Category

	eye burning	eye pain	eye redness
Are you wearing contact lens?		TRUE	TRUE
Do you have any allergies?	TRUE		TRUE
Do you work or live in pollutants environment like in an industrial area or always being exposed to cigarettes smoke?	TRUE		TRUE
Eye is getting red when you strain or having an excessive cough			TRUE
Eye produce more water than usual (Drainage)	TRUE	TRUE	
Feel burning sensation in or around your eye	TRUE		
Feel itchy at your eye	TRUE		TRUE
Feel like there is a foreign object in your eye			TRUE
Feel throbbing, aching, or stabbing sensation in or around your eye		TRUE	
Have vision problem	TRUE	TRUE	TRUE
Have you been going to swimming pool recently?	TRUE		
Injury in your eye and feel irritate in your eye	TRUE		TRUE
Redness on the surface of your eye	TRUE	TRUE	TRUE

TABLE 3. Sicknesses under Fever Category

	chickenpox	flu/influenza	seizure	yellow fever
Bloody, runny or stuffy nose		TRUE		TRUE
Coughing	TRUE	TRUE		
Diarrhea		TRUE		
Eyes rolling up			TRUE	

Fatigue (tiredness)		TRUE	TRUE	
Feeling chills and shivering		TRUE		TRUE
Fever	TRUE	TRUE		TRUE
Have a red, itchy rash	TRUE			
Have abdominal pain or loss of appetite	TRUE			TRUE
Have breathing and talking difficulty			TRUE	
Have small, liquid-filled blisters that break open and crust over	TRUE			
Headache	TRUE	TRUE	TRUE	TRUE
Muscle or body aches		TRUE		
Nausea			TRUE	TRUE
Numbness			TRUE	
Sore throat		TRUE		
Vomiting		TRUE		TRUE

TABLE 4. Sicknesses under Headache Category

	classic migraine	common migraine	cluster headache	tension headache
Difficulty falling asleep and staying asleep				TRUE
Excessive tearing			TRUE	
Excruciating pain, generally located in or around the eye, but may radiate to other areas of the face, head, neck and shoulders			TRUE	TRUE
Eye pain or redness in the eye of the affected side	TRUE		TRUE	
Fatigue or loss of appetite		TRUE		TRUE
Feel depressed or sad		TRUE		
Headache is unilateral and pulsating lasting from 4 to 72 hours	TRUE			
Irritability				TRUE

Nausea or vomitting	TRUE	TRUE		
One-sided headache	TRUE		TRUE	
Restlessness			TRUE	
Seeing flashing lights, light sensitivity, temporary blind spots, zigzag lines	TRUE	TRUE		TRUE
Speech difficulty	TRUE			
Stuffy or runny nasal passage in the nostril on the affected side of your face			TRUE	
Sweating			TRUE	
Throbbing or pounding in the forehead, temple, ear, jaw, or around the eye	TRUE	TRUE		
Vision problem	TRUE	TRUE		

TABLE 5. Sicknesses under Stomachache Category

	appendicitis	Gastritis	indigestion
Belching		TRUE	TRUE
Bloating or feeling full after only a few bites of food		TRUE	TRUE
Burning feeling in your chest (Chest pain, chest tightness, chest pressure)			TRUE
Burning in the stomach or upper abdomen		TRUE	TRUE
Burning or gnawing feeling in the stomach between meals or at night		TRUE	
Constipation or diarrhea	TRUE		
Difficulty breathing			TRUE
Discharge black and tarry stools (Waste from body)		TRUE	
Fever	TRUE		
Growling stomach			TRUE
Having abdominal pain	TRUE	TRUE	TRUE
Hiccups		TRUE	
Loss of appetite	TRUE	TRUE	

Nausea and vomitting	TRUE	TRUE	TRUE
Painful urination	TRUE		
Severe stomach cramps	TRUE		
Unexplained weight loss		TRUE	

TABLE 6. Sicknesses under Toothache Category

	cracked tooth syndrome	dental cavities	gum disease	trench mouth
Bitter taste in the mouth		TRUE		
Feel a sharp pain when biting	TRUE			
Feel pain when chewing	TRUE	TRUE		TRUE
Feel pain when eating hot/cold or sweet food	TRUE	TRUE		
Food deposits between teeth		TRUE		
Fractures on your tooth	TRUE			
Gum bleeding when you brush or floss your teeth			TRUE	TRUE
Gum change to brighter red/red purple and swollen		TRUE	TRUE	TRUE
Gum get easily bleed when chewing and the pain increasing when you eat			TRUE	
Gum only feel tender when being touched and painless			TRUE	
Have fever and fatigue when having the toothache			TRUE	TRUE
Have foul breath		TRUE	TRUE	TRUE
Mouth sore			TRUE	
Tooth look longer than before			TRUE	
Visible holes or pits at your teeth		TRUE		

3.7 System Architecture

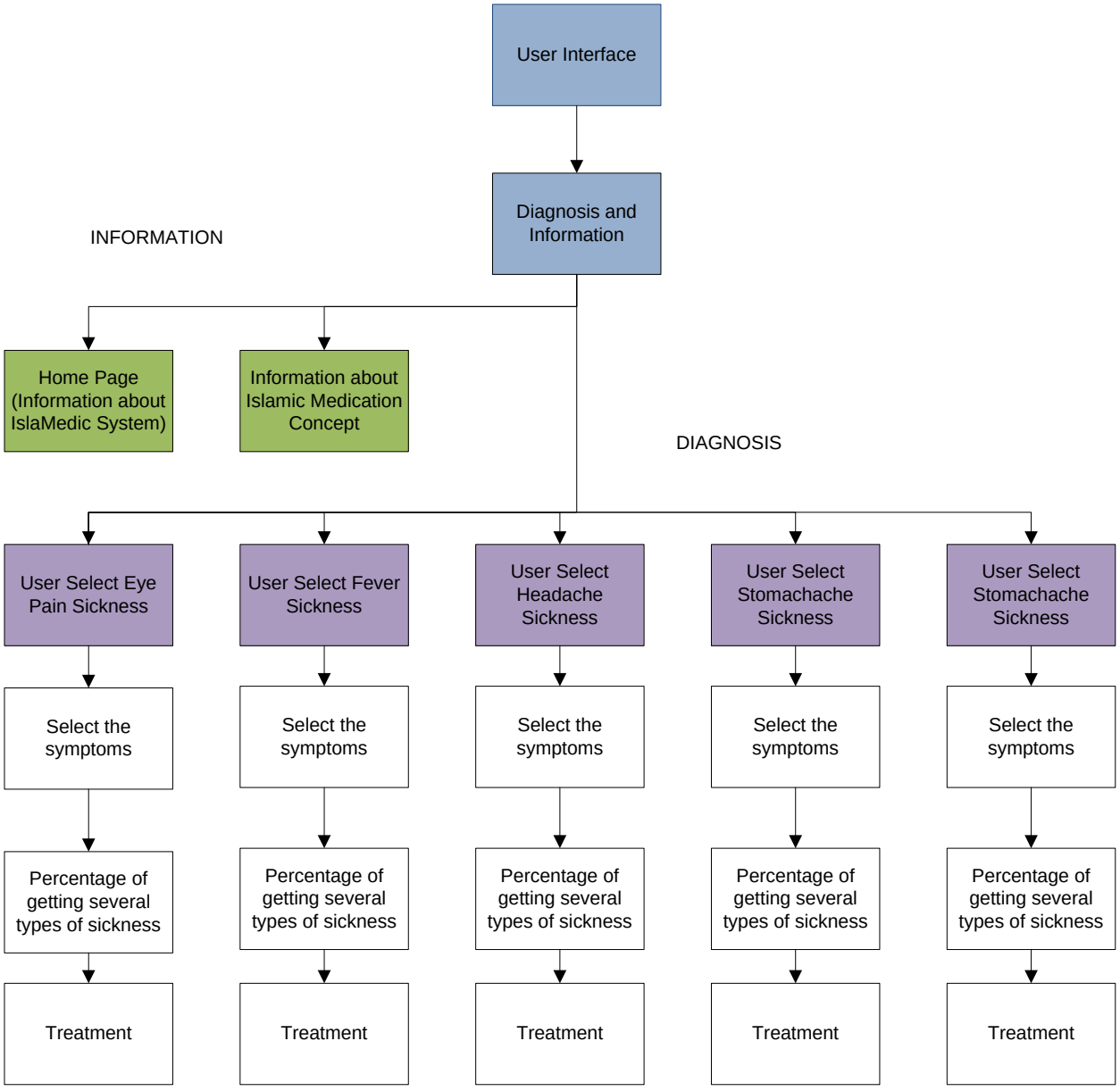


Figure 7. System Architecture

CHAPTER 4: RESULTS AND DISCUSSION

4.1 Survey for Islamic Medication Expert System

In order to gather all the requirements needed for designing and developing the Islamic Medication Expert System in mobile platform, a survey has been conducted to 11 random users. The objective of the survey is to know about their opinion of Bayesian Islamic Medication Expert System that has developed in web platform. At the same time, we want to know the relevancy of developing the system in mobile platform. The survey consists of five questions and the results will be analyzed in this chapter.

Survey Results

1. How easy is to navigate our website?

	Response Percent	Response Count
Extremely easy	9.1%	1
Very easy	**63.6%**	**7**
Moderately easy	18.2%	2
Slightly easy	9.1%	1
Not at all easy	0.0%	0
	answered question	**11**

Analysis: From the survey, it shows that 63.6% respondents find it very easy to navigate the BIMES website and only 9.1% respondent evaluate it slightly easy. It proof that the website flow is understandable to user however the website also must be improved.

2. What do you think about the system user interface?

	Very Poor	Poor	Neutral	Good	Very Good	Rating Average	Response Count
	0.0% (0)	9.1% (1)	27.3% (3)	**36.4% (4)**	27.3% (3)	3.82	11
					answered question		**11**
					skipped question		**0**

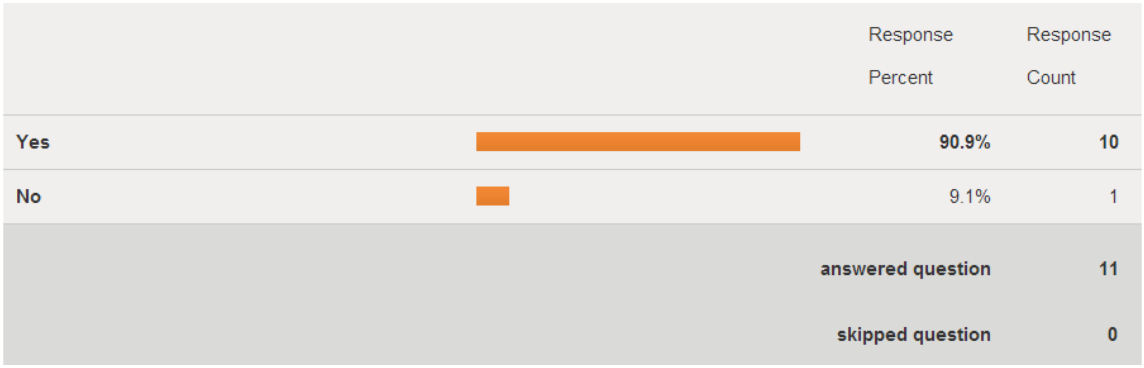
Analysis: From the result, it shows that 36.4% respondents find it having good user interface and 9.1% respondents evaluate it as have poor interface. It proof that the system interface must change to friendlier user.

3. How useful is the system?

	Not Useful	Somewhat Useful	Neutral	Very Useful	Extremely Useful	Rating Average	Response Count
	0.0% (0)	0.0% (0)	27.3% (3)	**45.5% (5)**	27.3% (3)	4.00	11
					answered question		**11**
					skipped question		**0**

Analysis: From the survey, it shows that 45.5% respondents evaluate it as a very useful system. This is proof that the system is benefits the human being and useful to their life.

4. If the system is developed in Android application will you downloaded it?



	Response Percent	Response Count
Yes	90.9%	10
No	9.1%	1
answered question		11
skipped question		0

Analysis: From the result, 90.9% users will install the application in their phone if the BIMES were built in the Android application. While only 9.1% respondent would not download the application

5. What are the ways we could improve the system? (Below are some answers provided by the respondents)

- The user interface (2 responses)
- Keep updating the system
- Hosting in server
- Make a change to time to time

4.2 Dataset Gathering

To apply the Bayes' Theorem concept in BIMES, first need to come up with the diseases datasets. In general, a patient who experiences certain diseases will have between 1 to 3 symptoms. If the patient is found to have more than 3 symptoms, he will be considered to experience critical illness. Hence, the patient needs to be treated in hospital or meet medical expert. BIMES only intended for non-critical sicknesses (eye pain, fever, headache, stomachache, toothache). In average, a patient with non-critical diseases will only experience two symptoms. So, for this project, we will prepare as many as possible combination of two symptoms that may cause an illnesses. Table 6 shows a sample of dataset under eye pain sicknesses:

Symptom 1	Symptom 2	Disease
Allergy	Burning sensation	Eye burning
Burning sensation	Itchy	Eye burning
Burning sensation	Vision problem	Eye burning
Burning sensation	Swimming pool	Eye burning
Burning sensation	Eye injury	Eye burning
Burning sensation	Redness	Eye burning
Drainage	Burning sensation	Eye burning
Pollutants	Burning sensation	Eye burning
Contact lens	Drainage	Eye pain
Contact lens	Throbbing	Eye pain
Contact lens	Vision problem	Eye pain
Contact lens	Redness	Eye pain
Drainage	Throbbing	Eye pain
Drainage	Vision problem	Eye pain
Throbbing	Vision problem	Eye pain
Vision problem	Redness	Eye pain
Allergy	Redness	Eye redness
Contact lens	Redness	Eye redness
Coughing	Redness	Eye redness
Eye injury	Redness	Eye redness
Foreign object	Redness	Eye redness
Itchy	Redness	Eye redness
Pollutants	Redness	Eye redness
Vision problem	Redness	Eye redness

Table 7: Dataset for Eye Pain

From the dataset above, we can know the possible combination of two symptoms that may cause a disease. However, we cannot simply combine any two symptoms. The dataset above is obtained by having consultation with medical experts based on the real case where a patient is likely to have any two possible symptoms when experiencing an illness. From the dataset, we can understand which symptoms are major or minor to certain sicknesses. For simple example, when a patient is having eye redness, the main symptom is experiencing redness in the eye. It is very unlikely that a patient with eye redness does not have the redness in the eye symptom. Therefore, when we produce the dataset for eye redness for example, the redness on the eye symptom

must appear in all possible cases. If not, we cannot consider the case to be under eye redness disease.

4.3 Diagnosis Result

With the prepared datasets, only then we can apply the Bayes' Theorem formula as below:

Naïve Bayesian Theorem

$$P(A|B) = P(A) \times P(B|A)$$

P (A)	=	probability of event A occurring
P (A|B)	=	conditional probability of event A occurs given that event B has occurred
P (B|A)	=	conditional probability of event B occurs given that event A has occurred

User input

Symptom 1: Eye Injury

Symptom 2: Redness

Assume B: {Ba = Eye Injury, Bb = Redness}

P (Eye burning|B)

= P (Eye burning) x P (Ba|Eye burning) x P (Bb|Eye burning)

= P (Eye burning) x P (Eye Injury|Eye burning) x P (Redness|Eye burning)

= 8/24 x 1/8 x 1/8

= 0.005

P (Eye pain)

= P (Eye pain) x P (Ba|Eye pain) x P (Bb|Eye pain)

= P (Eye pain) x P (Eye injury|Eye pain) x P (Redness|Eye pain)

= 8/24 x 0/8 x 1/8

= 0.000

P (Eye redness)

= P (Eye redness) x P (Ba|Eye redness) x P (Bb|Eye redness)

= P (Eye redness) x P (Eye injury|Eye redness) x P (Redness|Eye redness)

= 8/24 x 1/8 x 8/8

= 0.042

Based on the user input, the system will diagnose the probability the user is expected to experience certain diseases. From the calculation, the probability of the user to have eye burning and eye redness is 0.005 and 0.042 respectively. Thus, we can say that the user is most likely to have eye redness illness and the system will suggest the treatment for eye redness.

Based on the calculation, we obtained 0.000 probability for the user expected to experience eye pain sickness. This is because eye injury is not one of the symptoms under eye pain since it is not found in the dataset. Hence, the advantage of using Bayes' Theorem is that it eliminates the disease that is not relevant with the symptoms specified by user.

4.4 Percentage Calculation

As mentioned earlier, Bayes' Theorem calculates the conditional probability a patient is expected to experience certain diseases. But, not everyone understands the concept of probability which is between 0 to 1. So, once the system calculates the probability for each illness, it will convert the probability value into percentage which is more readable to user. Below is how the percentage is calculated:

P (Eye Burning) + P (Eye Pain) + P (Eye Redness)

= 0.005 + 0 + 0.042

= 0.047

Percentage of having eye burning

= 0.005/0.047 x 100

= 10.6 %

Percentage of having eye pain

= 0/0.047 x 100

= 0 %

Percentage of having eye redness

= 0.042/0.047 x 100

= 89.3 %

With the percentage calculation, we can know that the probability of the user to experience eye burning and eye redness is 10.6% and 89.3% respectively. From the percentage, the user will know he is most likely to have eye redness. With this information, the user can refer to the suggested Islamic treatment provided by the system or consult with medical expert.

4.5 System Interface

A draft of design for the system has been made in order to get better understanding about the system. A lot of research for the design should be made to improvise the current design. Figure below shows the homepage of the BIMES web system:

Figure 8. Homepage

Figure 8 is the Homepage of BIMES that has built in the web platform. There is a description about the BIMES at the homepage. There is seven menu buttons namely; Home, About Islamic Medication, Eye Pain Sickness, Fever Sickness, Headache Sickness, Stomachache Sickness, and Toothache Sickness. If the user intends to understand the concept of Islamic Medication, he can just click the About Islamic Medication tab. However, based on the user command, user tends to click the picture. Unfortunately the picture is not interactive or linking to other page.

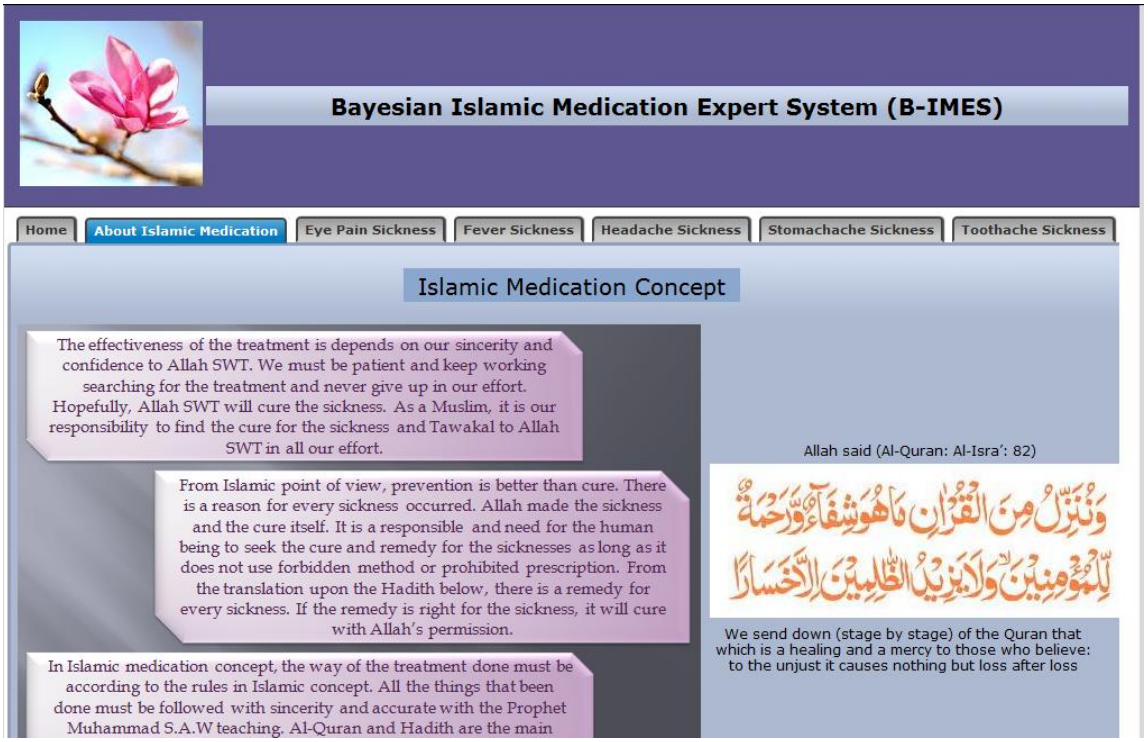


Figure 9. About Islamic Medication Interface

Figure 9 is the About Islamic Medication interface. The first step in diagnosis the disease is to choose the type of sickness. There is five type of sickness namely; eye pain, fever, headache, stomachache, and toothache. User needs to choose any one sickness tab and tick the possible symptoms that he may experiences for the particular sickness. Below is the interface if the user selects eye pain sickness:

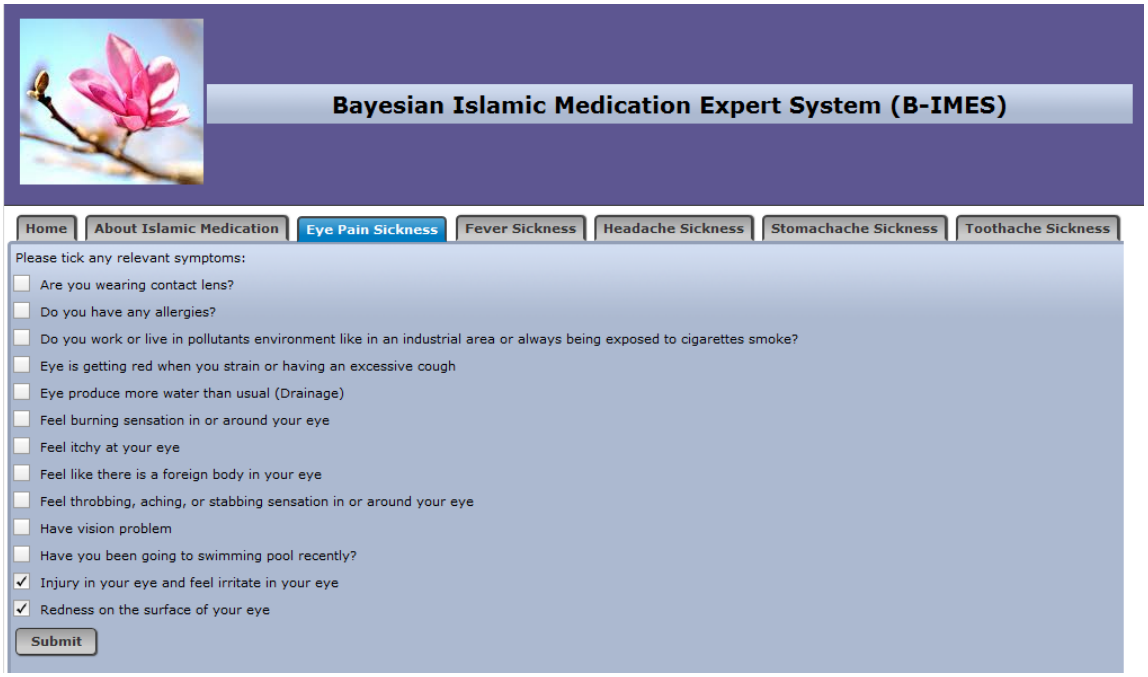


Figure 10. Eye Pain Sickness Tab

Figure 10 above is the eye pain sickness tab. The symptoms of the particular sickness will appear at the screen and user requires ticking the checkbox for any relevant symptoms. Then user must click submit button in order to process the result.

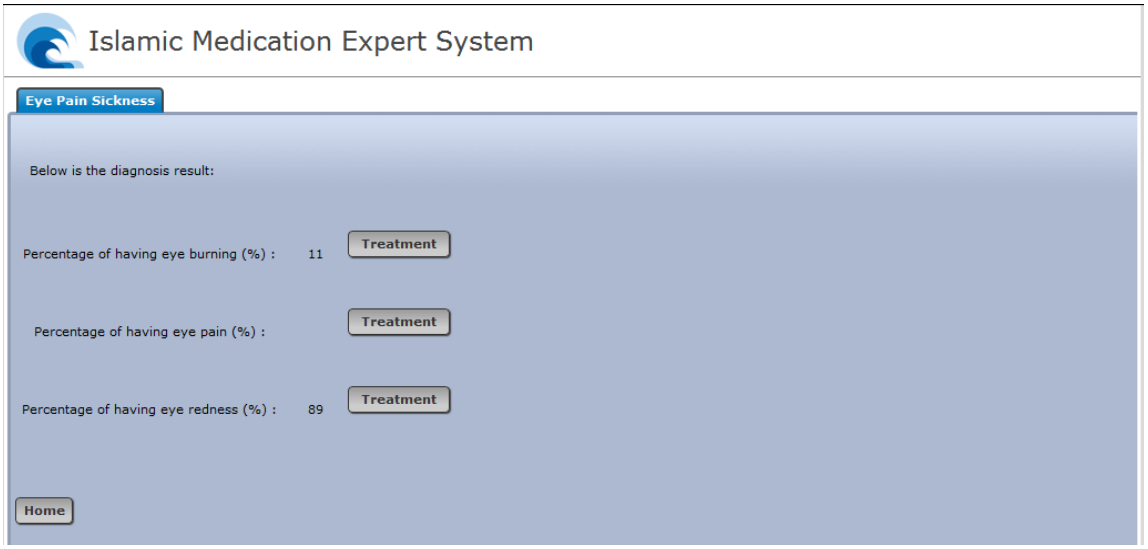


Figure 11. Diagnosis Result Interface

Figure 11 above shows the diagnosis result interface. The result will be displayed in form of percentage as to show the possibility of sickness experienced by user. User can click to the Treatment button to review the Islamic treatment of the particular sickness. Below is the interface once the system has calculated the percentage the user is likely to have certain diseases.

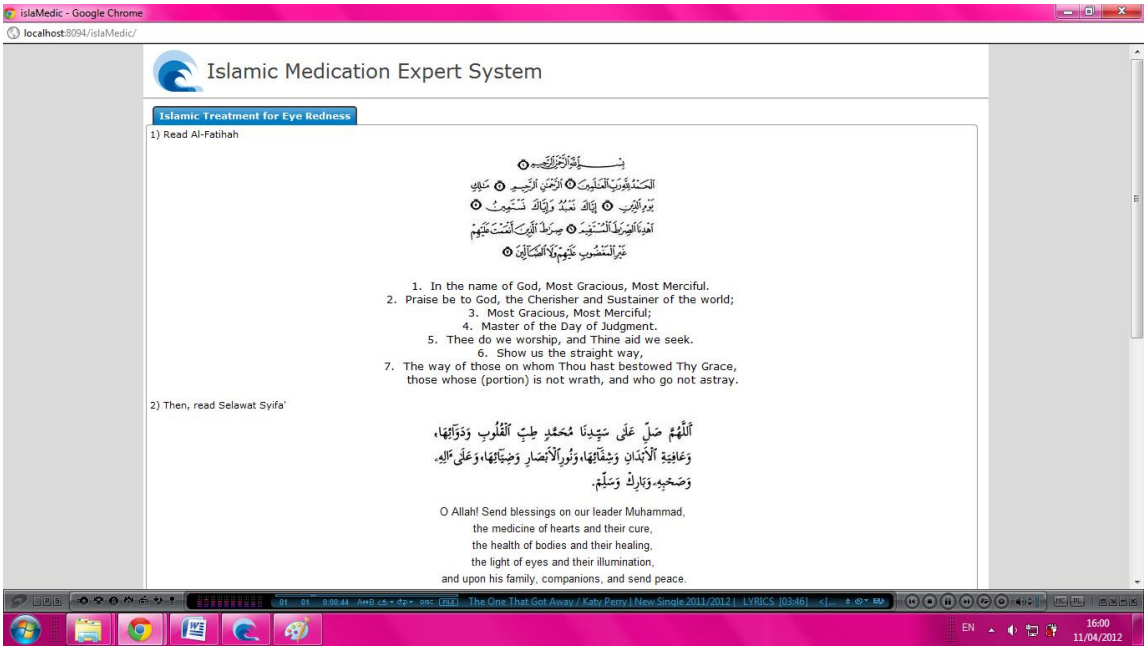


Figure 12. Islamic Treatment Interface

Figure 12 above shows the Islamic treatment interface. The reciter of Quran or Hadith appears at the screen to cure the particular sickness. The instruction of body gestures or explanation of the verses also will appear on the screen.

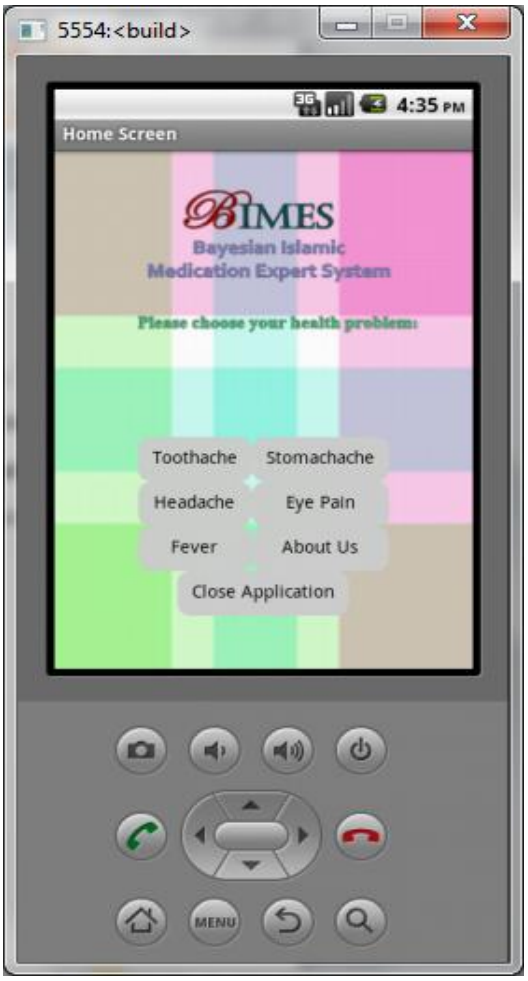


Figure 13. Homepage

Figure 13 shows the Homepage. There is seven menu buttons namely; Toothache, Stomachache, Headache, Eye Pain, Fever, About Us and Close Application. User can go to the disease symptoms by clicking the button of disease. If the user have enquiries of the system user can click the About Us button it will appears the contact person. If user wants to close the application, the close application button located below of the screen will be used.

Figure 14. Toothache

Figure 14 above is the toothache symptoms. User must tick the checkbox for any relevant symptoms that user facing. Then, user must click submit button to allow the system process the result.

Figure 15. Sickness Analysis

Figure 15 above is the Sickness Analysis. After user selects their sickness symptoms the system will analyse the combination symptoms and calculate it in the Bayes Theorem to output the possible disease that user facing. The result will appear at below of the screen in types of sickness that user chosen. It will show how many percentage of the probability sickness. Then, user can click Treatment button to see the treatment.

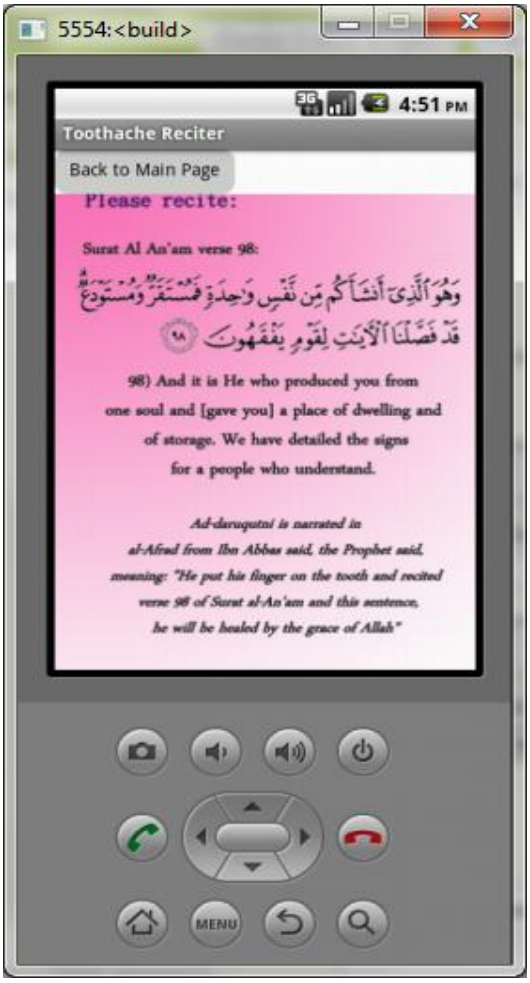


Figure 16. Islamic Treatment Interface

Figure 16 is the Islamic treatment interface. The reciter of Quran or Hadith appears at the screen to cure the particular sickness. The instruction of body gestures or explanation of the verses also will appear on the screen.

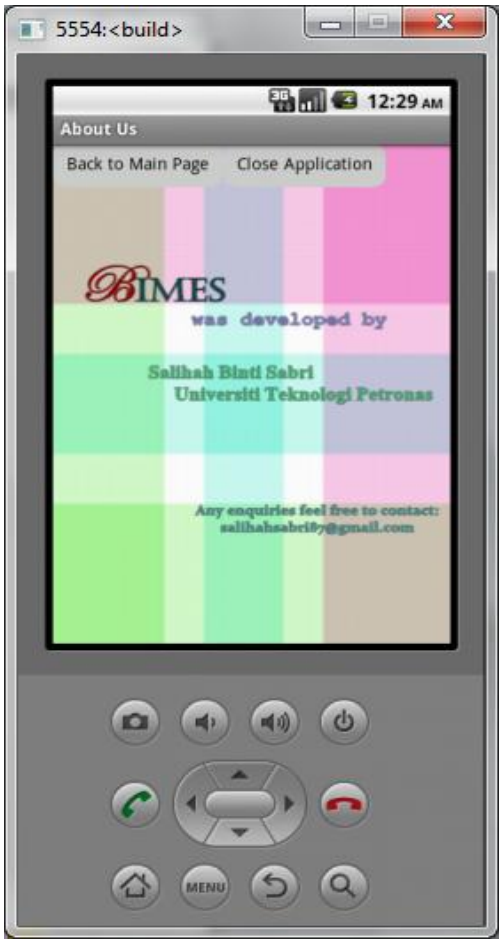


Figure 17. About Us

Figure 16 above shows the screen of About Us where the contact of author appears on the screen. User can send email if user have any enquiries.

4.6 The Comparison between Bayes' Theorem and Rule-Based

The major difference of the two algorithms is the selection of symptoms to be used for the diagnosis process. A few numbers of tests had been carried out in order to compare the result of both systems. The same sickness category and symptoms had been chosen to be tested in both systems. Below is the symptoms table for fever used derive the production rules:

TABLE 8. Symptoms Table for Fever

	chickenpox	flu/influenza	seizure	yellow fever
Bloody, runny or stuffy nose		TRUE		TRUE
Coughing	TRUE	TRUE		
Diarrhea		TRUE		
Eyes rolling up			TRUE	
Fatigue (tiredness)		TRUE	TRUE	
Feeling chills and shivering		TRUE		TRUE
Fever	TRUE	TRUE		TRUE
Have a red, itchy rash	TRUE			
Have abdominal pain or loss of appetite	TRUE			TRUE
Have breathing and talking difficulty			TRUE	
Have small, liquid-filled blisters	TRUE			
Headache	TRUE	TRUE	TRUE	TRUE
Muscle or body aches		TRUE		
Nausea			TRUE	TRUE
Numbness			TRUE	
Sore throat		TRUE		
Vomiting		TRUE		TRUE

From the table above, we can understand that there are 6 symptoms for chickenpox, 10 symptoms for flu/influenza, 6 symptoms for seizure, and 7 symptoms for yellow fever. By using Rule-based algorithm, the system is not concern with the major symptom or minor symptoms of certain diseases. Below is the dataset for fever for the system using Bayes' Theorem:

TABLE 9. Dataset for Fever

Symptom 1	Symptom 2	Disease
Abdominal pain	Small blisters	Chickenpox
Coughing	Fever	Chickenpox
Coughing	Itchy rash	Chickenpox
Coughing	Small blisters	Chickenpox
Fever	Itchy rash	Chickenpox
Fever	Small blisters	Chickenpox
Itchy rash	Abdominal pain	Chickenpox
Itchy rash	Small blisters	Chickenpox
Itchy rash	Headache	Chickenpox
Small blisters	Headache	Chickenpox
Chills	Sore throat	Flu
Coughing	Diarrhea	Flu
Coughing	Fatigue	Flu
Coughing	Chills	Flu
Coughing	Sore throat	Flu
Diarrhea	Sore throat	Flu
Fatigue	Sore throat	Flu
Fever	Sore throat	Flu
Headache	Sore throat	Flu
Muscle body	Sore throat	Flu
Runny nose	Coughing	Flu
Runny	Diarrhea	Flu

Symptom 1	Symptom 2	Disease
Breathing difficulty	Numbness	Seizure
Eyes rolling up	Fatigue	Seizure
Eyes rolling up	Breathing difficulty	Seizure
Eyes rolling up	Headache	Seizure
Eyes rolling up	Nausea	Seizure
Eyes rolling up	Numbness	Seizure
Fatigue	Breathing difficulty	Seizure
Fatigue	Headache	Seizure
Fatigue	Nausea	Seizure
Fatigue	Numbness	Seizure
Headache	Numbness	Seizure
Nausea	Numbness	Seizure
Abdominal pain	Nausea	Yellow fever
Chills	Fever	Yellow fever
Chills	Nausea	Yellow fever
Fever	Abdominal pain	Yellow fever
Fever	Headache	Yellow fever
Fever	Nausea	Yellow fever
Fever	Vomiting	Yellow fever
Headache	Nausea	Yellow fever
Nausea	Vomiting	Yellow fever
Runny nose	Chills	Yellow

nose					fever
Runny nose	Fatigue	Flu	Runny nose	Fever	Yellow fever
Runny nose	Chills	Flu	Runny nose	Nausea	Yellow fever
Runny nose	Fever	Flu			
Runny nose	Headache	Flu			
Runny nose	Muscle body	Flu			
Runny nose	Sore throat	Flu			
Runny nose	Vomiting	Flu			
Sore throat	Vomiting	Flu			

Testing 1

In testing 1, we assume a user is actually experiencing chickenpox but yet to know his real illness. The user has select only one **major** symptom of chickenpox which is itchy rash. From Table 9, we can determine the percentage of the user to have certain illnesses by using both Bayes Theorem and Rule-Based:

TABLE 10. Diagnosis Result for Testing 1

	Bayesian				
FEVER	Chickenpox	Flu	Seizure	Yellow fever	Total (%)
One symptom (Main) (Itchy rash)	100				100

	Rule-Based				
FEVER	Chickenpox	Flu	Seizure	Yellow fever	Total (%)
One symptom (Main) (Itchy rash)	100				100

Analysis: Based on Testing 1, both algorithms diagnose the disease of the user accurately where both calculate 100% on chickenpox. There is no value for other illnesses because itchy rash is not the symptom for flu, seizure, and yellow fever.

Testing 2

In testing 2, we assume a user is actually experiencing chickenpox but yet to know his real illness. The user has select only one **minor** symptom which is fever. From Table 10, we can determine the percentage of the user to have certain illnesses by using both Bayes Theorem and Rule-Based:

TABLE 11. Diagnosis Result for Testing 2

FEVER	Bayesian				
	Chickenpox	Flu	Seizure	Yellow fever	Total (%)
One symptom (Not main) (fever)	27	18		55	100

FEVER	Rule-Based				
	Chickenpox	Flu	Seizure	Yellow fever	Total (%)
One symptom (Not main) (fever)	42	24		34	100

Analysis: From testing 2, Rule-Based System gives more accurate result because it calculates the highest percentage the user is expected to experience is chickenpox with 42% which is true on the other hand Bayesian system only calculates the percentage of having chickenpox to be 27%. But, we need to bear in mind that the user had provided the minor symptom of chickenpox which is fever.

In Bayesian system, the number that fever symptom appears in the dataset is small. Hence, it gives a lower probability the user is expected to experience chickenpox. Fever is the main symptom of yellow fever. This explains why Bayesian system gives the highest percentage to yellow fever which is 55%. While the main symptoms for flu/influenza is runny nose and sore throat.

Compared to Rule-based system, it does not concern whether the symptom is major or minor to certain sicknesses. As long the symptom is considered under certain

diseases, the symptom will be calculated. Below is the part of declarative knowledge of the system represented in the form of production rules with an example of the testing above:

IF Having fever

THEN Diagnosed kind of fever under chickenpox, flu/influenza, and yellow Fever

Percentage of having possible type of sickness

$$= \frac{\text{Total number of sickness in the question tick}}{\text{Total number if each sickness in the database}} \times 100$$

Eventually, the rules are expressed in the form:

+Fever = having fever

Possible_type1 = Chickenpox_42%

Possible_type2 = Flu/Influenza_24%

Possible_type3 = Yellow_fever_34%

Although the user only provided one symptom, the Rule-based system has calculated different percentages to each disease. Rule-based system gives the highest percentage to chickenpox because in Table 10: Symptoms Table for Fever, chickenpox only has 6 symptoms. So, when we calculate it, it gives a higher percentage compared to flu/influenza and yellow fever.

Testing 3

Testing 3 is intended for negative testing. In this testing, we assume the user is not having any disease and simply provide any two unrelated symptoms to the system. In this case, we assume the symptoms are itchy rash and runny nose. These two symptoms are rare combination of illnesses experienced by a patient. Below is the diagnosis result for this testing:

TABLE 12. Diagnosis Result for Testing 3

FEVER	Bayesian				
	Chickenpox	Flu	Seizure	Yellow fever	Total (%)
Two symptoms (Main, None) (itchy rash, runny nose)	NA	NA	NA	NA	NA

FEVER	Rule-Based				
	Chickenpox	Flu	Seizure	Yellow fever	Total (%)
Two symptoms (Main, None) (itchy rash, runny nose)	42	24		34	100

Analysis: From testing 3, Bayesian system will give no result to the user because the combination of symptoms itchy rash and runny nose does not appear in dataset chickenpox, flu/influenza, seizure, and yellow fever. Whereas Rule-based system will definitely gives percentages to certain diseases as long as the symptoms exist in their rules.

Testing 4

Testing 4 is intended for negative testing. In this testing, we assume the user is not having any disease and simply tick all symptoms. Below is the diagnosis result for this testing:

TABLE 13. Diagnosis Result for Testing 4

FEVER	Bayesian				
	Chickenpox	Flu	Seizure	Yellow fever	Total (%)
Click all symptoms	NA	NA	NA	NA	NA

FEVER	Rule-Based				
	Chickenpox	Flu	Seizure	Yellow fever	Total (%)
Click all symptoms	25	25	25	25	100

Analysis: Based on the testing, the Bayesian system is more accurate because it is very unlikely a user is experiencing more than 5 symptoms. As mentioned, Rule-based system is not concern with the symptoms combination or symptoms weightage. As long all the symptoms appear in the rules, all of the symptoms are being calculated. In this case, it gives equal percentages to all illnesses.

The Accuracy

It is very difficult to test which system is more accurate. If the test case concerns about the symptoms weightage in the dataset, it is recommended to use Bayesian system. However, if the test case concerns with production rules, it is recommended to use Rule-based system. After all, both algorithms may have their own advantages and limitations in certain scenarios.

Advantages of Bayesian Theorem

By using Bayesian Theorem, the system will eliminate any irrelevant diseases based on the combination of symptoms provided by the user. Hence, the user can focus on the treatment for the expected illness. At the same time, the system can detect if the user simply tick any symptoms and return null results to the user to alert that there is no such combinations found from the dataset.

Disadvantages of Bayesian Theorem

Bayesian system might not give accurate results for certain scenarios as compared to Rule-based system. For example, a user might experience both chickenpox and flu. But if the symptoms combination provided by the user is not found in the dataset, Bayesian system strictly return no value to the user. In this case, Rule-based system can anticipate the sickness the user is likely to have.

CHAPTER 5: CONCLUSION AND RECOMMENDATION

5.1 Conclusion

With this BIMES, the author hopes that it is able to provide an alternative help to people, especially Islamic scholars, to better understand the usage of the Quran for medication purposes. This will encourage people to find out more about this topic by using mobile application because they are easier compared to waiting for long queue in Darussyifa'.

We also hope by having this project, it will help people in need because Islamic healing method is easy to apply anytime and anywhere plus there are increasing number of smartphone user around world. Eventually, people will get themselves near to our Creator by implementing Islamic therapy because we need to recite certain Al-Quran verses as a method of medication. This project's objective to enable users to use an expert system is achieved.

In a conclusion, the Islamic Medication Expert System on the mobile platform is successfully developed with several types of sicknesses can be diagnosed such as eye pain, fever, headache, stomachache, and toothache. However, to implement the Bayes Theorem in diagnosis process is a very challenging task due to some of its limitations developed the mobile application using App Inventor. For example, in App Inventor the system cannot sending values more than one value to the other screen. Thus, author has decided to retrieve the diagnosis value on the same screen of symptoms sickness. Besides that the App Inventor also cannot save database in picture format. The App Inventor of web server database only can save database in string. Thus author keep the result of treatment in the other screens. Author had put a lot of work and time to finish the coding in Bayes Theorem.

Author has asked Universiti Teknologi Petronas medical expert at Klinik Che Wan to test the BIMES. The Bayesian Theorem concept had been properly implemented in the diagnosis process and the result produced by the system is satisfactory. However there have some advices to increase the combination of the symptoms and also the number sickness. Besides that, based on the previous report the Bayesian Theorem might not give the most accurate result compared to other algorithm. In general, two kinds of tasks are involved in BIMES system. The first task is diagnosis: How can we infer the most probable causes of observed diseases given a set of evidence or symptoms? The second task is making treatment decisions: What can we do to treat the problem? In a medical application, the hypotheses are possible diseases, and the findings can include patient history and symptoms.

Conceptually, the method is extremely straightforward and easy to explain. Users can see immediately how the probabilities are derived from the past data. General computer programs have been written which could be applied to any database. Despite the success of this simple Bayesian scheme in several of these medical applications, there is some limitations.

One reason might have been the general lack of attention to integrating systems with the habits and environment of the diagnostic practitioner. An important lesson from this experience is that superior diagnostic performance alone is not sufficient for acceptance. A second and more often-cited reason is the restrictiveness of the assumptions of mutual exclusivity and conditional independence. [7]

More generally, critics have pointed out the limited expressiveness of this formulation and the apparent mismatch between the rigorous, formal, quantitative approach of probabilistic inference and the informal, qualitative character of human reasoning. This mismatch leads to difficulties in encoding expertise and explaining results so that users can understand and trust them (Davis 1982; Gorry 1973; Szolovits 1982).

5.2 Recommendations

Upon completing the project, the author feels that there are few recommendations that can be made to improve the project in the future. The system can be improved by adding more types of sickness or verses that can cure black magic, family problems or children problems. This is because Muslims nowadays like to recite the verses more to heal their family problems or children problems and black magic. It would be an advantage if the scope of BIMES is widen into other types of problems. During testing the application, author also received some suggestion from the medical expert in Klinik Che Wan to add more common disease such as, giddiness, bloating/dyspepsia and ear pain. The medical expert also suggests author to increase the number of combination of symptoms in the dataset of disease.

Apart of that, author feels that the system would be more interesting if it have audio to read the Hadith or Quran verses. So that, user can listens to the audio if they are not good reciting in Jawi.

Author would like to suggest for next improvement the system should be developing a database that connects with the system to store database. With database storage also will allow developer adding more sickness and treatment in the future. However, author would like to suggest developing the mobile application by using Eclipse rather than App Inventor due to some of limitations such as limitation in retrieving more than one value at other screens and also limitation on the database.

REFERENCES

[1] Giarratano J.C. and Riley G.D. (2005) **Reasoning under Certainty: Conditional Probabilities using Bayes' Theorem.** Expert System: Principles and Programming.

[2] Soni SR, Khuntenta A, Gupta M. **A Review on Intelligent Methods Used in Medicine and Life Science.** International Conference and Workshop on Emerging Trends in Technology (ICWET 2011) – TCET, Mumbai, India

[3] Dhok GP, Ladhake SA. **Application of Expert System for Arrhythmia Analysis.** International Conference and Workshop on Emerging Trends in Technology (ICWET 2011) – TCET, Mumbai, India

[4] Jackson P. (1999) **"What are Expert System?".** Introduction to Expert Systems. Addison Wesley Longman Limited: 1-10.

[5] Dr Low Tan Jung, Rozana Kasbon, Hanita Daud, 2008. *Mobile Islamic Medication Expert System.* pp168.

[6] Dato' Dr. Haron Din. **Konsep Perubatan Islam.**

[7] Henrion M., Breese J.S, and Horvitz E.J (1991). **Decision Analysis and Expert Systems**. AI Magazine Volume 12 Number 4