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PROTOTYPE EXPERT SYSTEM USING BAYESIAN NETWORK FOR DIAGNOSE SOCIAL ILLNESS

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ABSTRACT

The social illness has become main problem in Indonesia such as drug addiction, prostitution, game addiction, and so on. Based on Indonesian government, through its anti-drug agency, the National Narcotics Board (BNN) in 2015 the number of drug users are 5 million people. Drugs have caused for as many as 15,000 deaths each year in Indonesia. Peoples did not get information about social ills such as the types of drugs that have the same characteristics. As a largest Muslim country in the world may be reduce the social ills with the Islam approach. Recently, the integration of Islamic science and technology has become popular. At times the people get obstacles to get information and advice directly from expert and scholars in Islamic science. This paper is to develop a prototype expert system by providing prevention and best treatment based on Quran and Hadith. We use some of the data for knowledge base obtained from Selat Panjang, Riau. Based on the preliminary results, it has similar diagnoses with expert. A prototype expert system using Bayesian Network has been successful and capability for early diagnosing and educating the peoples in social ills cases based on Quran, Hadith and advice of experts but still has plenty room for improvement.

Keywords: *Bayesian Network; Expert System; Social Illness*

1. INTRODUCTION

A social illness is a term synonymous with the phrase social conflict, social problem or social issue. A social illness has become main problems exists areas out of capital city when a condition is undesirable to some members of a community. Like a diseases infection, the social illness also spread quickly. In a society where the permissiveness and promiscuity are encouraged to proliferate. The pressure on individuals is very high indeed. The youth generally lack maturity and are vulnerable to the social ills if they are overwhelming. Some of social ills include drug addiction, free sex, bullying, crime, online games addiction racism, delinquency, discrimination, family disintegration, poverty, homelessness and so on.

Indonesia as a country with the largest Muslim population in the world may be reduce social ills with the Islam approach. Many of the scholars in Islamic science who could give guidance, intelligence and advice to the younger generation to solve social ills. At times the people get obstacles to get information and advice directly from scholars. This study obtained the data from areas out of capital city namely Kepulauan Meranti Regency Selat Panjang. Selat Panjang is part of the province of Riau in Indonesia. Selat Panjang is separated by a narrow channel from Sumatra, and

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west of Singapore across the Strait of Malacca. Poverty stops people in Selat Panjang to get advice from the scholars regularly. Thus, many people did not get the necessary advice from an expert and therefore they do not take the big problems in social ills seriously. Online self-diagnosing is one of the solutions as the Internet is relatively cheap to get more information and cybercafé is one of the prevalent ways for poor people to search about their difficulty. Based on data obtained from the police and hospital in Selat Panjang, it has been found alcohol, methamphetamine, marijuana, game addictions and prostitution cases. Knowledge base acquired from the scholars in Islamic science. However, self-diagnosis is prone to misdiagnosis that may endanger the users health and social if users make a wrong decision.

Actually, there are several online articles, magazines and health books containing about how to recognize the drug abuses based on physical symptoms. There are many symptoms, both physical and behavioral, that indicate drug use. Each drug has its own unique indications, but there are some general signs that a person is using drugs. Building an expert system for the social ills are challenging because it is required to create a knowledge base that is appropriate with desires of scholars in Islam, doctors, psychiatrists and psychologists. Distinction with another cases, the expert system for diagnosing social issues based on different content of knowledge base data that consist of symptoms and treatment instruction based on medical science and Islamic science. It has many expert system integrated with Islamic Science as we have explained in the related works. Nevertheless, an expert system for social ills that integrate with Islamic Science and medical science is still not exist. Thus, the main goal of this project is not just to develop a prototype expert system but for educating the peoples in social ills cases based on Quran, Hadith and advice of experts so that people will get advice and treatment appropriately and as early as possible. In this project, we have developed a prototype expert system for social issue. A prototype expert system had used Bayesian Network. It has proved its capability for educating the peoples in social ills cases based on Quran, Hadith and advices of experts. Based on the preliminary experimental results, it can be concluded that the implementation of Bayesian Network shows a promising result. On the other hand, we have been providing a medium for educating the peoples regarding the risks of social issues, the information to avoid and treat of social ills based on the Quran, the Hadith, psychology and medical science. Based on the preliminary experimental results, it can be concluded that the implementation of Bayesian Network shows a promising result.

Nowadays, there are many expert systems being used in Islam science such as Classification of Ahadith, Using Social Network on Publishing and Serving Islam, expert system for Inheritance or Fara'id [1]. The scholars give treatment based on the al-Quran and hadith. A method in Quran to treat the social ills namely *Al-adabiyijtima'iy* method used for knowledge base. In this study, we used the Bayesian Network method for inference engine.

One of the advantages in using Bayesian Network in this project is that Bayesian Network considered more popular as network-based Bayesian inference is consistent when handled with uncertainty. Bayesian networks can facilitate learning about the causal relationship between the variables [2] Bayesian Network Easy to be converted into tools for decision support to assist the management of natural resources [3].

In addition, graphic in Bayesian Networks to clearly show the relationship between different components of the system. Therefore, Bayesian Network comfortable for researchers from different backgrounds to understand the concept of Bayesian Network [4]. The use of Bayesian inference can readily updated for new knowledge and Bayesian networks can produce a good prediction accuracy [2, 5]. Bayesian Network used to determine which type of social illness has the probability to be effecting a user. Bayesian Network calculate the chances based on existing symptoms and the system will later on be able to appropriate preventive, medical solutions advice and treatment based on Quran and Hadits to the type of illness accordingly.

2. RELATED WORK

Lately, integration of Islamic science and technology had become popular. Kashif Bilal and Sajjad Mohsin presents a novel approach for the classification of the religious scriptures, the Hadith [6]. A novel approach has been used to simplify and digitize the task of Hadith classification. Service Oriented Architecture (SOA) is used for Cloud computing compatibility, and to solve the communication problems faced by the legacy Web based distributed expert systems. The social network one of the best ways to serve and publish Islam. Beside that, students determine that the existence of a religious person is very important as a resource of Islamic information. Therefore, Da'wah persons must take care about social

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network and be an active member there because they have a big effect on the member as the respondent mention by 80% [7]. Furthermore, Houssen Himeda had discussed web based expert system for Islamic inheritance law for all Muslims, and identify the rules of wealth distribution as stated in the Quran through a knowledge acquisition process with an expert in Faraid [1].

There are several studies in the field of artificial intelligence, especially expert system that has been done. Meigarani [8] using Bayesian Network to diagnose the disease. Bayesian Network used to diagnose leukemia by getting to the positive and negative decisions. Bayesian Network was used for data analysis and knowledge of experts, especially on uncertainty. This method is used as a solution to a problem that is not certain. This method can be used to create a model system for transformation between expert knowledge to computer in difficult medical cases [9-11]. Bayesian networks can be prepared with decision support tools in uncertainty case [12, 13].

Bayesian Network became very popular in the last decade because it is used for a variety of intelligent system applications such as machine learning, text processing, natural language processing, speech recognition, signal processing, bio-informatics, medical diagnosis, forecasting, mobile networks, and other intelligent system applications. A Bayesian Network consists of a directed acyclic graph of 'nodes' and 'links' that conceptualise a system. Bayesian Network is Probabilistic Graphical Models (PGM) which consists of probabilistic and graph. Probabilistic theory related to the data. The relationships between nodes are described by conditional probability distributions that capture the dependences between variables. Bayes Formula [14]:

$$P(A|B) = \frac{P(A)\,P(B|A)}{P(B)} \quad (1)$$

Where:
A = a particular state, conditional on the evidence provided.
P(A|B) = posterior
P(A) = prior probability of the hypothesis
P(B|A) = likelihood
Joint distribution formula:

$$P(A|B) = P(A)\,P(B|A) \quad (2)$$

3. RESEARCH METHODOLOGY

We have stated in the paper about the limitation of this research. A self-diagnosis is prone to misdiagnosis that may endanger the user, health and social if user make a wrong decision. Thus, the main goal of this project is not just to develop a prototype expert system but for educating and giving the awareness to the society about social ills cases based on Quran, Hadith and advice of experts so that people will get advice and treatment appropriately and as early as possible. Currently, we just concentrate in drug abuse diagnosis features. Meanwhile for the games addiction, the prostitution, the sexual deviation cases and so on will be done in further research, because of the complexity of rules and need more the data. This study is not the final result of expert system in social ills, for encouraging results we need the additional experimentation and much data for knowledge base (symptoms, kinds of social ills, treatment). It also requires full development of expert systems in the future with a more comprehensive in Islam science and Medical Science. There has plenty work needs to be done before a full-size expert system is constructed with standard expert systems components, improvement of knowledge base by more associating the statistical science, medical science or drug rehabilitation centers with the Islamic laws and scholars in order to avoid a misdiagnosis.

The following are the research methodology of this study. The construct stages of this study are based on the popular evolutionary prototyping. The stages are as follows:

3.1 Literature Review

The literature review is a select analysis of existing research which is relevant to expert system and social ills topic, showing how it relates to this study. It describes and validates how this research investigation may assist answer some of the questions or gaps that related in this study. This step include reading and searching information regarding Bayesian Network, social issues on books, journals, and other scientific resources such as web pages and articles related. The literature review is a select analysis of existing research which is relevant to expert system and social ills topic, showing how it relates to this study. It describes and validates how this research investigation may assist answer some of the questions or gaps that related in this study. This step include reading and searching information regarding Bayesian Network, social issues on

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books, journals, and other scientific resources such as web pages and articles related.

3.2 Feasibility Study

This is where the problems are defined, the objectives are stated, the resources, the methods, the experts, the costs and the time frame are clearly identified. This step is the requirement analysis usually carried out in the system development life cycle.

3.3 Knowledge Acquisition

Knowledge acquisition is the step in this study for extracting, organizing and structuring knowledge from the human experts to computer. This is often the major obstacle in building an expert system. Knowledge elicitation is also conducted and test cases were prepared in this time. The type of knowledge gathered in this stage is factual knowledge.

3.4 Prototype Development

In this step, we selected the appropriate method to address the problem. Bayesian Network used in this study is for calculating the possibility of people affected by the social ills. Knowledge base obtained from experts such as doctor in hospital and scholars in Islamic science. The treatment and solutions are presented based on Quran and hadith using *Al-adabiyijtima'iy* method. Analysis carried out in order to the system worked accordance with expected. First, we build a small system containing few of the features and it will evolves into better system in few cycles.

3.5 Testing

The system testing and validation is based on the black box method and User Acceptance Test (UAT). UAT is conducted by using several cases of social ills. The pleminary results of a prototype expert system will be assessed by an expert. Based on the analysis and advise, the development step will go back to step Knowledge Acquisition to correct and expand the factual knowledge on the basis of the domain expert's comments. The purpose of this cyclic development is to improve the quality of knowledge base and how the inference mechanism.

3.6 Pleminary Experiment

The special purpose of the pleminary experiment is therefore to study the effectiveness of a cooperation Bayesian Network for a prototype expert system for social ills. The system has been assessed considering the accuracy as the indicator. For this experiment, 10-case sample extraction was made. Each case was then presented to the system to obtain the corresponding diagnosis. This diagnosis was later compared to the one provided by the expert to determine whether the system's diagnosis is correct or not.

4. ANALYSIS

Here are some of the process of the analysis which has been carried out:

4.1 Analysis of Interface

Inference used for the construct of this expert system, which is Bayesian Network in the diagnosis process of social ills.

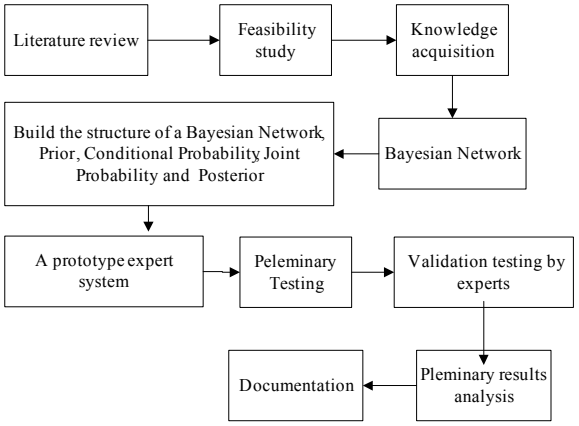

Figure 1: The Steps to Build Expert System

Bayesian Network provided the diagnostic results use the rule based as the learning. The process was performed using the Bayesian Network method and calculating the probability of each symptom from users. Subsequently, the final diagnosis based on the probabilistic final process. The overview of implementation of Bayesian Network in a prototype expert system process is shown in Figure. 1.

4.2 Implementation of Bayesian Network

Bayesian network used to determine the probability of a user in kinds of social ills based on symptoms or characteristics. There are several steps to implement Bayesian network that is shown in Figure. 2.

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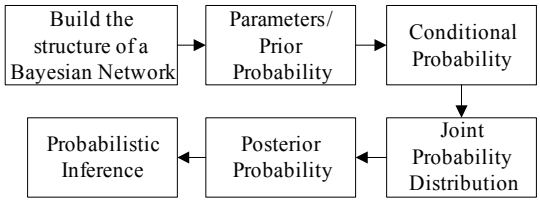

Figure 2: Analysis of Bayesian Network as Inference Engine

4.2.1 Build the structure of a bayesian network

The structure of Bayesian network formed using graph theory that connects the symptoms or characteristics with the kind of social ills. Bayesian network structure as shown in Figure 3.

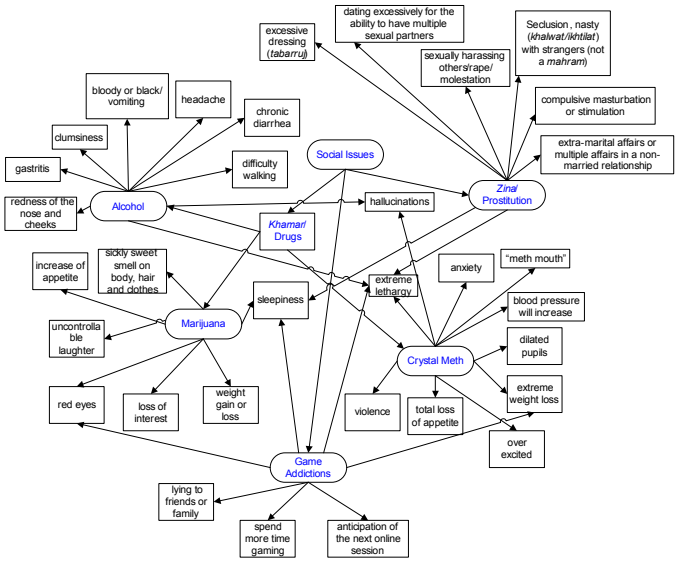

Figure 3: The Structure of Bayesian Network with Certain Symptoms and Kind of Social Ills Based on Expert Knowledge

4.2.2 Prior probability

Prior probabilities are the original probabilities of an outcome, which be will updated with new information to create conditional, joint and posterior probabilities that is shown in Table 1.

Table 1: Example of Prior Probability.

No.	Symptoms	Values
1.	Total loss of appetite	0.5
2.	Meth mouth	0.3
3.	Dilated pupils	0.25

4.2.3 Conditional probability

The conditional probability of an event B is the probability that the event will occur given the knowledge that an event A has already occurred. This probability is written in formula (1) where event A has no effect on the probability of event B, the conditional probability of event B given event A is simply the probability of event B, that is P(B).

Table 2: Example of Conditional Probability Table (CPT).

Meth mouth	Social issue	
	Present	Absent
Present	0.7	0.25
Absent	0.3	0.75

4.2.4 Joint probability distribution

We have used the formula (2) Joint distribution formula to obtain the Joint Distribution Table (JPT). Based on the formula (2), the calculation of joint probability distribution is multiplying the prior probability Alt conditional probability. Suppose the joint probability distribution will be calculated in meth mouth. The meth mouth *present* probability is 0.7, while *absent* 0.3. The Joint Distribution Table (JPT) is shown in Table 3.

Table 3: Joint Distribution Table (JPT)

Meth mouth	Social issue	
	Present	Absent
Present	0.3 × 0.7 = 0.21	0.7 × 0.25 = 0.175
Absent	0.3 × 0.3 = 0.09	0.7 × 0.75 = 0.525

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4.2.5 Posterior probability

In statistical terms, the posterior probability is the probability of event A occurring given that event B has occurred. Based on The Joint Distribution Table (JPT) in *meth mouth*, The posterior probability is:

$$\frac{0.21}{0.21 + 0.175} = 0{,}54$$

Table 4: Example of Posterior Probability.

No.	Symptoms	Values
1.	Total loss of appetite	0.54
2.	Meth mouth	0.4
3.	Dilated pupils	0.67

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4.2.6 Probabilistic inference

The Probabilistic inference is done by tracing the relationship of each symptom and kind of Social ills based on Bayesian Network Structure. Sometimes, BN combined with Rule-Based Reasoning (IF-THEN) for assist the probabilistic inference [8]. Example:

P (Crystal Meth |Symptoms of Crystal Meth)

$$= \frac{0.54 + 0.4 + 0.67}{3} = 0{,}53$$

Thus, its can be concluded that a people uses crystal meth that is with belief percentage is 0.53 × 100 % = 53 %.

5. IMPLEMENTATION

The construction phase does two things: constructs and assessments a functional system that fulfills organizational design requirements, and implements the interface between the new expert system and the existing system. We have constructed the knowledge database, inference engine, application programs, user and system interfaces, and networks. We developed the system based on the results of the previous model that has been designed, so that it can be used in the real situation.

6. EXPERT SYSTEM TESTING

System testing and evaluation is the final phase in this study. System testing and evaluation is ran to evaluate the effectiveness of the system. The develop system has to produce the desired outcome in accordance with its objectives with high accuracy without any systemic error. Testing are conducted using the black box method.

User acceptance test was conducted to validate the system output directly to the experts and end-users. 10 cases have been selected and assessed and tested by experts. The following table compares diagnostic results by expert systems and the human expert.

Table 5: Expert System results.

Cases	Diagnosis by Expert System and Probability	Diagnosis by Human Expert
1	Marijuana (63%)	Marijuana
2	Marijuana (46%)	Marijuana
3	Crystal Meth (55.5%)	Crystal Meth
4	Game Addictions (52.5%)	Game Addictions
5	Crystal Meth (30%)	Crystal Meth
6	Alcohol (41%)	Alcohol
7	Crystal Meth (42%)	Crystal Meth
8	Crystal Meth (45%)	Crystal Meth
9	Marijuana (77.5%)	Marijuana
10	Marijuana (48.25%)	Marijuana

Regarding the preliminary results that have used some of the knowledge base, it has similar diagnoses with human expert. The diagnosis is more accurate if the user selects many of the symptoms. Thus the prototype expert system results according to the expected.

7. CONCLUSION AND FUTURE WORK

We have developed a prototype expert system for social issue. A prototype expert system had used Bayesian Network. It has proved its capability for educating the peoples in social ills cases based on Quran, Hadits and advice of experts. Based on the preliminary experimental results, it can be concluded that the implementation of Bayesian Network shows a promising result.

However, this study is not the final result of expert system in social ills, for encouraging results, additional experimentation and much data for knowledge base (symptoms, kinds of social ills, treatment) are needed. It also requires full development of expert systems with a more comprehensive in Islam science and holistic. There has plenty work needs to be done before a full-size expert system is constructed with standard expert systems components, improvement of knowledge base by more associating the statistical science, medical science or drug rehabilitation centers with the Islamic laws and scholars in order to avoid a misdiagnosis.

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