

Electronics Diagnose for Jaundice Disease Integrated with Informative SMS Notification: Diagnose Jaundice Expert System (DIJAD)

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Abstract—Medical expert system is very important nowadays to detect any disease as early as we can. Electronics Diagnose For Jaundice Disease Integrated With Informative SMS Notification: Diagnose Jaundice Expert System (DIJAD) has been designed and developed to help early detection of jaundice by identifying the symptoms statistically after diagnosing the patient, based on the information available in its database. The system is conducted to detect the type of the jaundice faster based on the initial sign or symptom of the disease. It will provide the result of diagnosing jaundice and the nearest clinic via Short Message Service (SMS) to the patient. The interview were conducted to validate the functionality and effectiveness of the DIJAD, two method is used which is user test and system function test. The result indicated that 5 random user 2 doctors agree that the system is user-friendly and easy to use. Other than that, the result from system function test. It can be concluded that the system is fully functioning, and no error occurred. This system uses Forward Chaining method. Forward Chaining is method that is driven by the data where the tracking stars from the observation of the input information and the try to describe the conclusions. DIJAD developed using Hypertext Preprocessor (PHP) for the programming language in conjunction with MySQL as a database system. The outcome of DIJAD able to facilitate community in diagnose early jaundice disease that can save time and give positive impact in our effort to prevent jaundice to become worst.

Keywords—Expert System, jaundice, symptoms, disease, treatment, Short Message Service

I. INTRODUCTION

Jaundice is occurred when the skin, nails, tongue and the white eyes turns into yellow colour. This disease appeared when there is excessive amount of bilirubin in blood of human being of all ages. Jaundice indicates the difficulty with the liver. It also known as one of sign liver problem. The causes of jaundice are classified into three types pre-hepatic, intra-hepatic and post-hepatic.

This disease not only experience by the adults but also endure by new born babies. According to a research, 60% normal new born babies and 80% premature babies suffered from jaundice [1]. Neonatal jaundice is very common, and it typically appears in first week of the new born. Neonatal

hyperbilirubinemia is classified as unconjugated or conjugated. Jaundice goes away when baby's liver develops and they begins to feed, which helps bilirubin pass through the body.

DIJAD has the information of jaundice and early treatment suggestions for the patients. At the moment, the awareness about jaundice is considered low in our society. DIJAD is the online system platform where its users can find all the information about jaundice as a one stop center. Many adults would have not been aware if they have jaundice symptoms. Early detection could help the patients to seek appropriate treatment and eventually would reduce the implication of this disease. Early precaution for the patient via Electronics Diagnose for Jaundice Disease Integrated with Informative SMS Notification called DIJAD is the best way for early treatment before it become worst.

The role and importance of healthcare systems to improve quality of life and social welfare in a society have been well recognized. Attention should be given to raise awareness and implementing appropriate measures to improve health care. Therefore, a computer based system is developed to serve as an alternative for people to self-diagnose their health status based on given symptoms. This strategy should be emphasized so that people can utilize the information correctly as a reference to enjoy healthier life. Hence, DIJAD is developed based on expert system technique. Inference technique is employed in the system to enable information about treatment of the diseases based on given symptoms. Web based technology is used as a platform to disseminate the information to users in order for them to optimize the information appropriately. This system will benefit people who wish to increase health awareness and seek expert knowledge on the diseases by performing self-diagnosis for early disease detection.

Thus, the objective of the system are to design and develop web based Diagnose Jaundice Expert System (DIJAD) that can diagnosing the type of jaundice. Other than that, to

validate the functionality of DIAD by implementing System Function Test and User Testing. Besides that, scope of the system user able to access the DIAD at any place and any time, making diagnosing easier and reducing the time for medical expert in consultation. Medical experts can gain access to the DIAD and update useful possible information related to system on their electronic devices.

Remaining of this paper is organized as follows: Section 2 describes study background for literature review that includes artificial intelligence, expert system, forward chaining method and comparison between existing system; Section 3 discusses the methodology; Section 4 presents finding and analysis; Section 5 concludes this study.

II. LITERATURE REVIEW

In this part will discuss about artificial intelligence, expert system, forward chaining and comparison with existing system as per below details.

A. Artificial Intelligence

In artificial intelligence, an expert system is computer system that emulates the decision-making ability of human expert. Electronic Diagnose for Jaundice Disease Integrated with Informative SMS Notification: Diagnose Jaundice Expert System (DIJAD) are designed based on medical expert knowledge, represented mainly as if-then rules rather than through conventional procedure code. Many other AI applications were employed in various healthcare sectors, like Radiology, Screening and Disease Diagnosis. Several hospitals including Mayo Clinic, USA and the National Health Service, UK have developed their own Intelligent system [2,3], as well as Google [4] and IBM's [5] contributions to healthcare technology advancements.

B. Expert System

An expert system can be modified based on current changes. There are three main component in this system; knowledge base, inference engine and user interface [6]. Much like other artificial intelligence systems, expert system's knowledge may be enhanced with add-ons to the knowledge base, or additions to the rules.

Knowledge Base in expert system consist the data and information about custom domain. This knowledge base is important in modern intelligent system and application in information strategy, planning, design, scheduling, error monitoring, diagnosing and so on [7]. Collected data and knowledge will be transformed knowledge representation. There are the fundamental types of knowledge representation technique; production rules, semantic network, frame representation, logical representation and hybrid representation.

Inference engine applies to run operation and processing the knowledge. It will determined when the fact or rule will be applied. User Interface allowed the user and expert system exchange information in two way communication. It is function to obtain the graphical information from user and translate the input into the machine language that understand by the system. As a result, user will receive the advice or suggestion

C. Forward Chaining

Forward chaining system is the system that works from known fact to the hypothesis or goal. This system in fact part IF towards the goal THEN as shown in Figure 1.

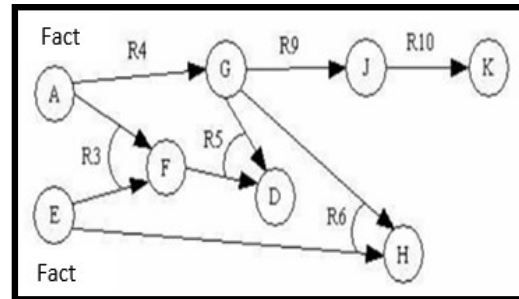


Fig. 1. Forward chaining technique

Electronics Diagnose for Jaundice Disease Integrated with Informative SMS Notification are used the forward chaining technique. This technique selected instead of backward chaining technique. In view of the forward chaining is the system where it works from the recognized fact to the hypothesis or goal.

D. Comparison Between Existing System

The first expert system called MYCIN was introduced in the early 1970s after almost 6 years of development at Stanford University, USA [8]. A few expert system had been listed to compare about the rule, programming language, module, technique used and others specifications. It has shown in Table I.

1) Diagnose Lungs Disease towards Children Expert System.

This expert system is limited to lungs disease towards children [9]. The development of this system is based on the web. Two programming language were used in this system. The result that can be obtained from this expert system are the type of the disease, the explanation of the disease and the treatment suggest to the patient. Logical rule IF-THEN is used for the diagnose result.

2) Diagnose Diabetes Expert System.

This expert system using the Clips programming language [10]. It is develop by providing the diagnose modul that consist some questions based on the diabetes symptom. The questionnaire included in this system based on yes or no answer. In addition, the evaluation based on the laboratory test is possible to be included in this system.

3) Diagnose Migraine Expert System.

The development of this expert system is the prototype that assist doctor to diagnose migraine [11]. This system applied by using knowledge input process to identify the main source of the application where the doctor will be impersonate as the domain expert.

4) Suggestion for Expert System. Diagnose Jaundice Expert System (DIJAD).

This system developed to diagnose the jaundice in Malaysia with additional Informative SMS Notification to

the patients. It will carried out the knowledge regarding jaundice towards new born babies and adults. This system is not only giving the information about jaundice and the type of the jaundice, but also the information of the nearest hospital or clinic will be provided via Short Message Service (SMS). Comparison between all the system as per shown below.

TABLE I. COMPARISON OF EXPE SYSTEM

Specification	Name of Expert System			
	Diagnose Lungs Disease towards Children Expert System	Diagnose Diabetes Expert System	Diagnose Migraine Expert System	Diagnose Jaundice Expert System
Rule	IF-THEN Logic	IF-THEN Logic	IF-THEN Logic	IF-THEN Logic
Programming Language	HTML and PHP	Clips	Clips	PHP
Login Module	Developer and User Login	Developer and User Login	Developer and User Login	Developer and User Login
Technique	Forward chaining and backward chaining	Forward chaining	CLIPS	Forward chaining
Supported Answer	Yes/No	Yes/No	Yes/No	Yes/No
Inference Engine	Knowledge Base	Clip	Knowledge Base	Knowledge Base
Notification	None	None	None	SMS

According to the Table I, all system are using the expert system technique. The software applied to develop this system are *Adobe Dreamweaver*, *Visual Basic 6.0* and *Java Netbeans*. For DIJAD, *Adobe Dreamweaver* software and *MySQL* database will be used. Login Module designed towards the system administrator and user.

This system also using the forward chaining technique to find the result based on the symptoms given. The different between the existing expert system and the suggested expert system is, the Electronics Diagnose for Jaundice Disease Integrated with Informative SMS Notification consist the SMS Notification. This includes the information about jaundice and nearest hospital or clinic for further treatment.

III. METHODOLOGY

In this section, the methodology for completing the expert system development will be discuss. This system applied the qualitative approach to analyse the quality of the object [12].

The effective way to understand the function and the rule of certain matter is from interviewing an expert in specific field [13]. Thus, the interview between the doctor

who diagnose infectious disease, consultation internal medicine and the doctor specialist of children, consultation paediatrician, had been held during proposal stage. All issues or problem related to jaundice and the treatment needed had been ask to the both Specialist Doctor from Putra Specialist Hospital, Batu Pahat, Johor.

Technical issues concern the knowledge had been implemented to describe and design the knowledge system based [14]. Final phase specifically the maintenance phase will be dismissed as it is only practice by the certain organisation only [15]. Table II shows the methodology process in Knowledge Base.

TABLE II. METHODOLOGY PROCESS OF KNOWLEDGE BASE

Phase	Activities	Outcomes
Problem assessment system	Determine the problem. Identify the main engagement for the project. State the objective of the project.	Objective and scope of the project identified. Hardware and software had been determined.
	Write the proposal	Proposal had been verified.
Knowledge Acquisition	Collect and analyse the data and knowledge. Prepare the main concept for the system design.	The symptoms of the disease gathered for analysing. Studied the equivalent system function which is diagnose diabetes Expert System
	Analyse the information and system requirement and user desire.	Select the suitable technique that is forward chaining technique
Prototype system development	Select the requirement to develop the expert system. Modify the data and knowledge representation. Design and implement the prototype system. Examine the prototype with the certain case.	Design the Data Flow Diagram (DFD) and Entity Relationship Diagram (ERD) to explain the function. Design the user interface, database and the accomplishment of the physical architecture system design
Completion of system development	Collect the additional data and knowledge. Develop the user interface. Complete the entire system.	System prototype. The reliable information shown and delivered to user. The interface is user-friendly and easy to be applied.
	Module coding and testing	
Assessment and review	Evaluate the system based on the criteria and performance.	Electronics Diagnose for Jaundice Disease Integrated with Informative SMS Notification had been reviewed to confirm the objective are

		fulfilled
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IV. FINDING AND ANALYSIS

Analysis and system design are the details study to determine the problem and the objective of the system. The accumulate data and information are beneficial for the system development. Designing stages divided into 2 type; interface design and database design.

A. Interface design

The interface design applied to make sure interaction of the user to control and display the system. This interface must be practical to ensure it is suitable to the user requirement.

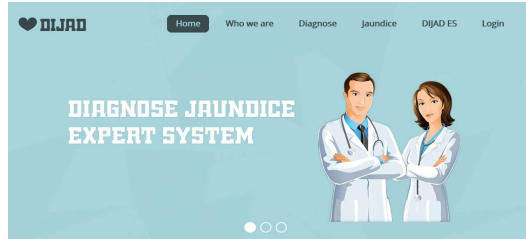


Fig. 2. Interface of DIJAD homepage

B. Database design

Database structure were built based on the Entity Relationship Diagram (ERD). This system using *MySQL* database software. This design is the logical data structure where all the data will be stored by the administrator.

- *Entity Relationship Diagram (ERD)*. ERD portrayed the relationship between the entities in database.
- *Relationship Scheme*. It is the written description respected to the data in the database. The entities as shown below;
 1. Symptom
(id_symptom(pk), id_penyakit, id_pentadbir, id_symptom, peratus)
 2. Disease
(id_penyakit(pk), id_pentadbir, id_kategori, peratus, keterangan, pencegahan, rawatan, penyakit)
 3. Administrator
(id_pentadbir(pk), id_group, email, nama, jawatan, katalaluan, namapengguna)
 4. Category
(id_kategori(pk), kategori)
 5. Result
(id_keputusan(pk), nama, notelefon, jantina, kategori, poskod, id_penyakit, tarikh_create)

C. Electronics Diagnose for Jaundice Disease Integrated with Informative SMS Notification: DIJAD. IF THEN structure.

The interactive system design created to ensure it will be beneficial to user. Criteria decision method is important to generate the appropriate criteria and factor which is

relevant to the problemsolving decision.

1) Inference Network

This technique is the list of jaundice symptoms diagram which identify the type of jaundice.

2) Rule Set

Rule set for Electronics Diagnose for Jaundice Disease Integrated with Informative SMS Notification is using IF THEN rule. This rule related to the symptoms of all types of jaundice suffered by newborn and adult. Knowledge representation schemes is a common rule. The expert system had been commercialized based on rule-base systems.

```
IF Warna urin kuning, coklat
OR Badan letih dan lemah
OR Mendapat lelah atau asma
OR Kulit semakin pucat
ATAU Kulit gatal
ATAU Mata dan kulit berwarna kuning
MAKA Pre-hepatic
```

Fig. 3. IF THEN Structure

3) Database Relationships

This is the important element to make sure the information management restored in database. The information are possible to be added, withdraw and updated. Figure 4.0 shows the coding regarding the database;

```
<?php
$db_host = 'localhost';
$db_name = 'sistempakardijad';
$db_user = 'root';
$db_pass = '';

$link = mysql_connect($db_host, $db_user, $db_pass);
mysql_select_db($db_name); ?>
```

Fig. 4. The relationship of database and Interface in programming

D. Electronics Diagnose for Jaundice Disease Integrated with Informative SMS Notification: DIJAD Implementation.

In this phase, the database programming allow the user manage the information in database. This is the important element to make sure the information management restored in database. The information are possible to be added, withdraw and updated.



Fig. 5. Result was sent via SMS

Your Suspected Jaundice type is:	
TYPE	Pre-hepatic Jaundice
DESCRIPTION	Pre-hepatic jaundice occurs when a condition or infection speeds up the breakdown of red blood cells. This causes bilirubin levels in the blood to increase, triggering jaundice.
TREATMENT	Medication to treat the underlying infection is usually recommended. For genetic blood disorders, such as sickle cell anemia or thalassemia, blood transfusions may be required to replace the red blood cells.
NEAREST CLINIC	<p>Clinic Name: Klinik Desa Skudai Address: Johor Bahru 81300 Johor Bahru Johor. City: Johor Bahru Postcode: Skudai State: 81300 Phone No: Johor</p> <p>Clinic Name: Klinik Kesihatan Tempoi Address: JKR-4069, Batu 5 Jalan Skudai Johor Bahru 81200 Johor Bahru City: Johor Bahru Postcode: Skudai State: 81200 Phone No: Johor</p>

Fig. 6. Diagnose jaundice result details

The result consist the type jaundice disease of new born babies or adult been diagnosed, details about type of jaundice, suggested treatment and the nearest clinic they can visit. This information will be send to patient via SMS notification simultaneously.

The analysis of the system are divided into two part; System function test and user test. This analysis is important to ensure the system provide the feedback and reliable to the user.

E. System function test

For this section, the characteristics and the function will be analysed to verify the information is exact as the data listed before the system developed. The summary of the system function test shown in Table III.

TABLE III. SYSTEM FUNCTION TEST

No.	Experiment Plan	Expected Output	Actual Output
1	User will click the 'Next' button once register	First category question and answer displayed	First category question and answer displayed
2	User will click 'Next' button	Next category question displayed	Next category question displayed
3	User will click the 'Back to Home' button	Diagnose process ended	Diagnose process ended
4	User will click the 'Diagnose Again'	First category question and answer displayed	First category question and answer displayed
5	Diagnose Result	Type of jaundice, explanation, treatment and nearest hospital or clinic displayed. On the same time the SMS	Type of jaundice, explanation, treatment and nearest hospital or clinic displayed. On the same time the SMS Notification

		Notification will be send to the user	will be send to the user
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F. User Test

This test is to make sure the objectives of the system fulfilled. The test had been run by five users and a doctor. The feedback analysis shown in the Figure 7 based on the questionnaire towards the user. It shows that 40% of user mostly approved this user-friendly system while another 60% approved this user friendly system.

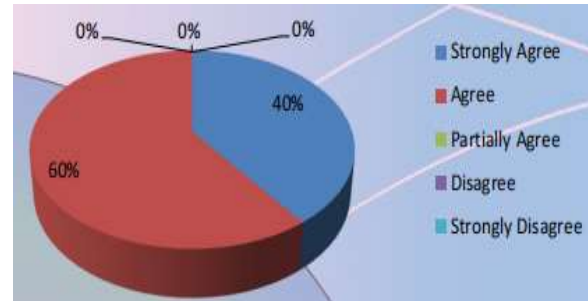


Fig. 7. The feedback of questionnaires

In general, the achievement of the project and suggestion to enhance the productivity of the system;

- Help users to determine whether they suffered from jaundice, suggest the appropriate treatment and provide the information of the nearest clinic.
- Deliver the information related the type of jaundice. Result of diagnose jaundice will receive via SMS to user.
- The system design is easy to manage and user-friendly. User easily to get start diagnose in the system.
- The developer of this system qualified to update the system occasionally.
- To provide the graphical report that shown the statistic of the jaundice that infected in community for beneficial research.

V. CONCLUSION

This system point out that Electronics Diagnose for Jaundice Disease Integrated with Informative SMS Notification: Diagnose Jaundice Expert System (DIJAD) help the patient to diagnose the type of the jaundice, the suitable treatment and recommend the nearest clinic for further consultation and proper treatment. In consequence, this system will help the patient to aware and in the same time able to decrease the risk of the jaundice. The result from the system function test and user test indicates that the system are fully functioning, no logic error occurs and result from questionnaire proved that mostly user are agree that the system are user friendly and able to help user to identify jaundice disease by using IF-ELSE statements.

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