DEVELOPMENT OF AN EXPERT SYSTEM FOR SELECTED BLOOD DISEASES DIAGNOSIS AND TREATMENT

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ABSTRACT: Research had stated that there is increase in the number of people dying of blood diseases likewise there is a large number of people suffering from different kinds of blood diseases due to unavailability of human experts and inaccessibility of Haematology consultation. Hence this paper designs an expert system application for diagnosing selected blood diseases using rule-based method. The computer programming language employed was the C# programming language and MySQL as the Relational Database Management System (RDBMS). The results obtained showed that the expert system was able to successfully diagnose blood diseases corresponding to the selected symptoms entered as query.

KEYWORDS: Expert System, Anaemia, Haemophilia, Leukaemia, Homochromatic, Knowledge base, Inference Engine, Interface and Knowledge Acquisition.

1. INTRODUCTION

Blood disease is the most dangerous disease that infects millions of people around the world. The disease that affects the blood is called blood disease. These types of diseases such as blood diseases, heart diseases, cancer and eye diseases etc. needs continuous follow-up, those which are done by computer application expert systems and online diagnosis systems for these diseases. There are few types of artificial intelligence that have practical application and expert systems are the most frequently used one. Expert systems is the computer program that uses rules and facts to diagnosis, classification and solve problems in different fields and built applications in medical, engineering, physics and chemistry etc. Medical expert system is an important expert system because they are used to save lives of millions around the world by prompting the service to the user and providing cost savings because the user can use the systems at home. There are two stages to build medical expert systems. In the first stage; the medical background of the blood diseases is collected by interviewing with doctors and the specialists. In the second stage, the information that collected are represent by rules and facts consist from IF and THEN parts, the IF part presenting the reasons or symptoms and THEN part contain the disease that is recognized [NO08]. In this paper, an expert system for blood disease diagnosis has been developed. The system identifies selected blood diseases such as Anaemia, Haemophilia, Leukaemia and Homochromatic. The structure of the proposed expert system is as shown in figure 1. According to this figure 1, the proposed expert system consists of different components that are discussed in section three of this paper.

2. LITERATURE REVIEW

Medical expert system is one of the most commonly used expert systems thanks to its quick servicing to distant places and its cost saving quality. In the last decade, the use of the medical expert systems has increased because of the observed increase in the diseases that require seriousness care such as blood disease, cancer, heart diseases etc.

Dendral was the first medical expert system developed by the AI researcher Edward Feigenbaum and the geneticist Joshua Lederberg beginning with 1960. MYCIN was blood disease expert system was developed in the Stanford University at 1970 within five or six years by Edward Shortliffe as doctoral dissertation using lisp and more than 500 rules the system asked question to the user and the user response as Yes/No. MYCIN has never been used in practice because it's difficult and not useable but it gives high performance in the diagnosis of diseases another weakness of MYCIN its conclude the result nearly within twenty minutes [BS84].

In the field of genetics, the MOLGEN is the most famous expert system that supply intelligence consultant to molecular geneticist on the designing of experiments include the treatment of DNA. For changing DNA material the geneticist has different types of available laboratory techniques (deletions, insertions, cuts, joins), different techniques for defining the biological consequences of the changes, different tools for measuring effects [Fei86]. [NO08] developed an expert system that urges the patient with conditions for suitable analysis of some of the eye diseases. The eye has always been viewed as a

tunnel to the inner workings of the body. The disease states frequently generate symptoms from the eye. CLIPS language is used as a tool for drawing expert system. A preliminary evaluation of the expert system was passed out and a optimistic response was acknowledged from the users.

[Ahm12] presented a Rule-Based Expert System for Neurological Disorders. This system diagnoses and treats more than 10 types of neurological diseases. It helps the patients to acquire the required recommendation regarding the unusual disorders attack to them due to their nervous system disorders. The expert rules were built up on the symptoms of each type of neurological disease, and they were offered using decision tree and deduced using backward-chaining technique. The knowledge base contains information, gathered from volumes and practitioners about neurology and its disorders.

[OI11] developed an expert system for diagnosing Leukemia using Neuro–Fuzzy Expert System which is able to tell the patient his current condition as regards leukemia. No parameters are retrieved for this expert system.

3. MATERIALS AND METHODS

3.1 Research Procedure

Research procedure is represented the flow diagram consisting of: Preliminary Study, data collection, data analysis, system design and system implementation as shown in figure 1.

Preliminary Study: This is the stage where the authors collect information, study materials and data sources related to expert systems and these include; rule-based reasoning, the selected of blood diseases in humans, symptoms of the selected diseases and treatment.

Data Collection: Data sources used in expert systems to diagnose the selected blood diseases in humans include: data of the blood disease, each of the blood disease symptoms, disease information and solutions provided. The data required in this study were obtained from Literature Study and Consultation/Interview with experts, in this case ophthalmologist.

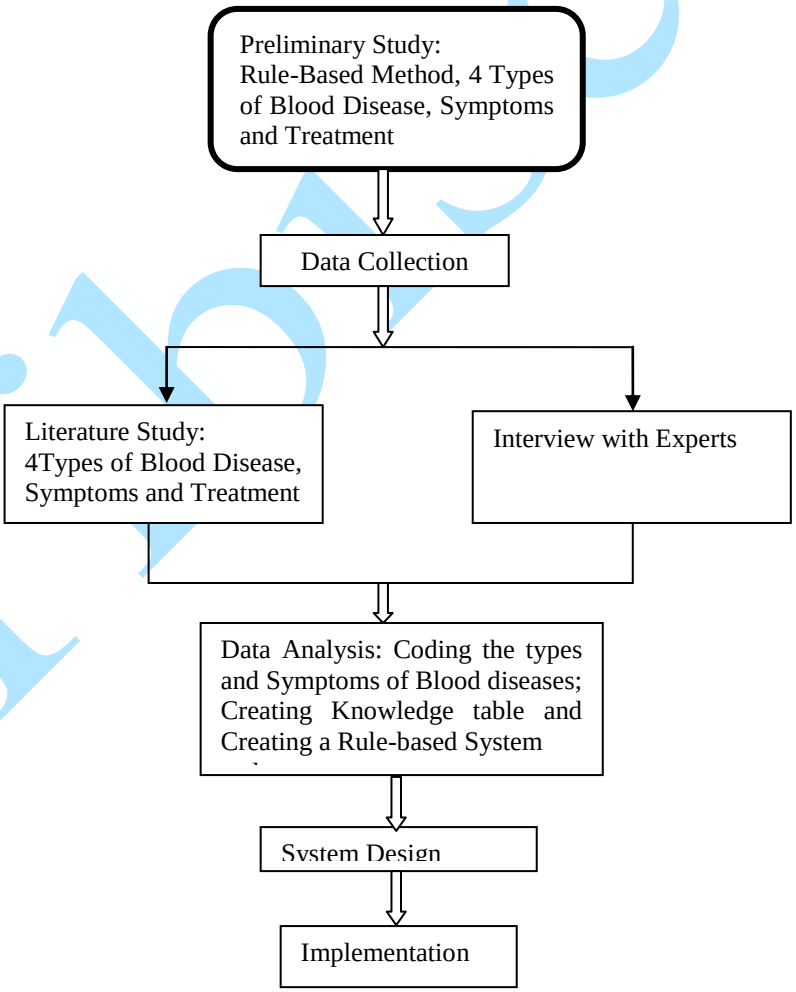


Figure 1: Flow Diagram of the proposed Expert System

Data Analysis: Based on the collected data, we conducted the following analysis steps: (i) made a list and coded blood diseases along with symptoms. This expert system software can diagnose 4 types of blood diseases with 27 symptoms of the disease; (ii) Made Rule-Based System. In order to recognize the

type of blood disease, rules in expert system tracing are required.

System Design: The design of this system includes design process described by using hierarchical structure, the system flow chart, the design of the database and user interface.

System Implementation: The activity performed at this stage was the programming or coding. This stage was the translation of the design into the form of computer programming language. This research employed C# programming language.

3.2. Proposed Expert System Structure

The proposed Expert system structure is shown in the Figure. 2. The main components of the expert system are knowledge base, inference engine, user interface and knowledge acquisition.

i. Knowledge Base

Knowledge base is a unit where the knowledge of an expert system is accumulated. Knowledge base is one of the most important components of an expert system, because the quality of this unit determines how the user will deal with the expert or the system.

The Knowledge Base encloses information with reference to diseases which are characterized as a set of if-then production rules. The knowledge base is analogue to the long-standing human memory. The whole sorting of production rules is prepared in the knowledge base and this can be understood with the help of examples. For example:

IF Fatigue, Dizziness, shortness of breath, Pale skin, Cold hands and feet

THEN Anaemia

ii. Inference engine

It functions like an engine; it directs the search in different directions in the knowledge base up to answer to the question. An inference engine can be either simple or complicated, depending on the structure of the knowledge base. In the proposed system, the inference engine selects a rule for testing and examines whether the condition(s) of this rule are valid or not. These conditions are examined through asking the users some questions. When the conditions of a rule are valid, then the result of that rule will be correct and valid. Therefore, this rule is activated and its result is added to the knowledge base. In addition, this result is displayed on the user interface as information in each stage.

iii. Explanation

This mode allows the system to explain its conclusions and its reasoning process. This ability comes from the AND/OR trees created during the production system reasoning process.

iv. User interface

The user interface is communicated between the user and the system, Success of any expert system depends on the quality and the easiest to implement the user interface.

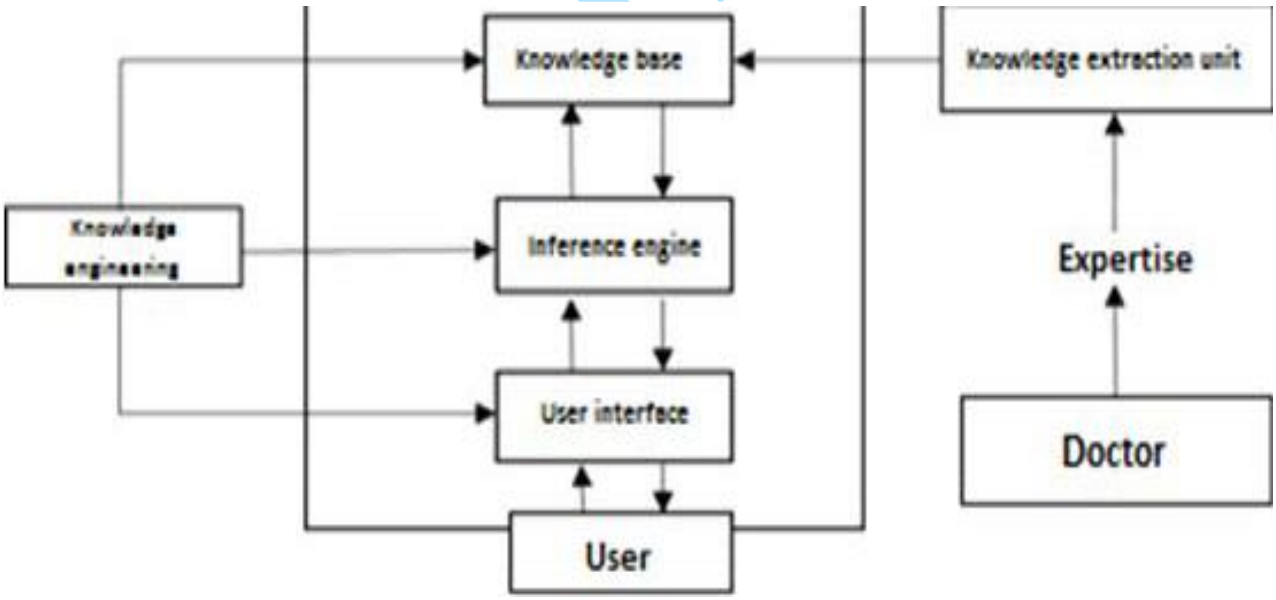


Figure 2: The relationship between different components of the proposed expert system

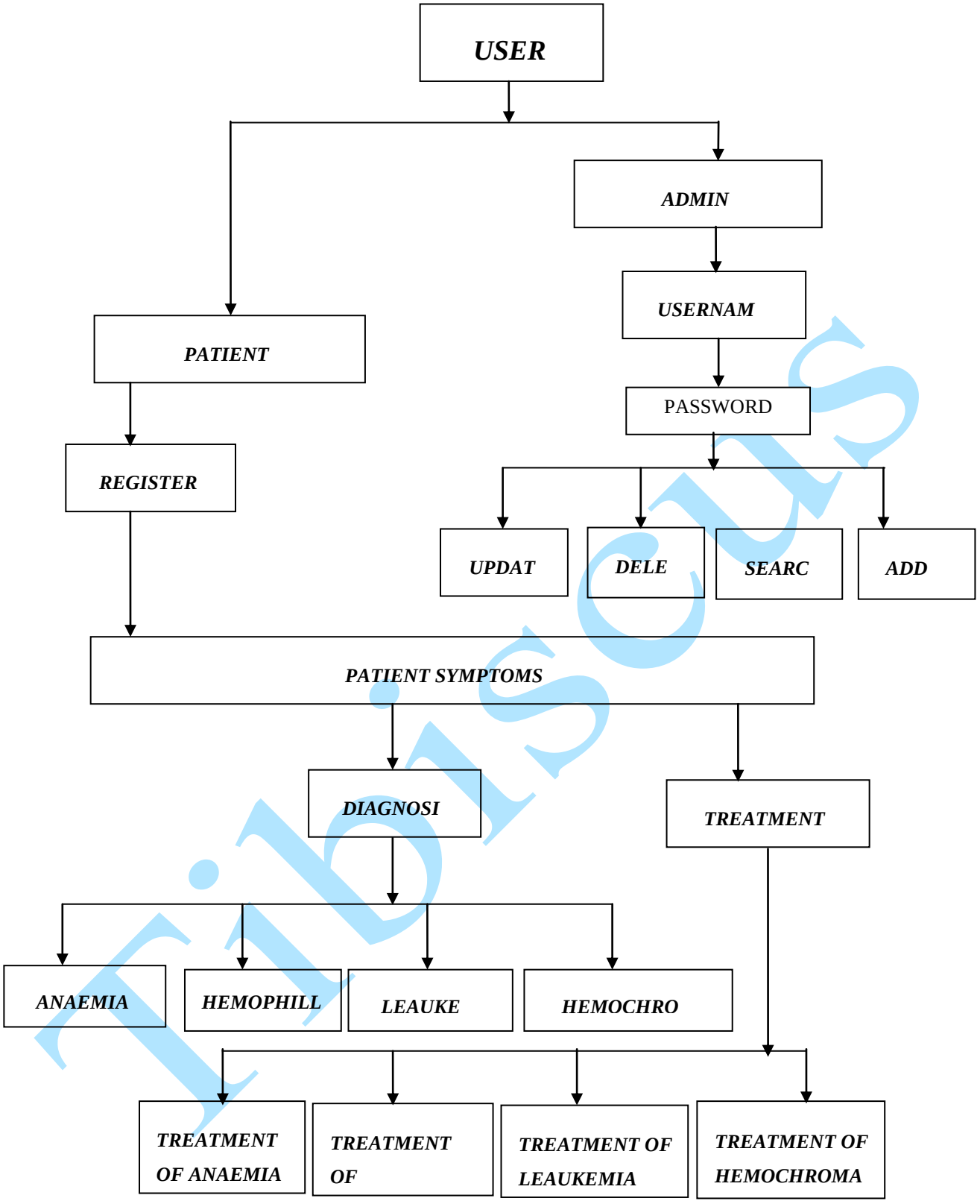


Figure 3: Hierarchical Structure of the Proposed System

v. Knowledge Acquisition

Knowledge acquisition means getting knowledge of a particular domain from some source, usually human, and building it into a computer system. The knowledge acquisition can be classified into three categories: manual, semiautomatic and automatic. In this paper, manual method is adopted. In Manual methods the knowledge engineer extracts expert knowledge and then codes it in a suitable format. Methods of knowledge acquisition in this system are as follow:

- Knowledge acquisition through free interviews with experts in the problem domain. Interview with knowledge experts is one of the most useful methods for extraction and adaptation of new

knowledge. Knowledge acquisition through interview helps the support of knowledge extraction without knowledge engineering. Figure 2 shows the relationship between an expert and the knowledge base.

- Knowledge acquisition through studying books and journals to extract knowledge. In this method, the required knowledge is extracted after studying the relevant references and applying knowledge engineering.

3.3 System Design

The system design is the art of designing how the program works using tools. This phase consists of the input design, output design and design tools. The hierarchical structure is adopted in this paper.

3.3.1 Input Design

Input is the raw data that are fed into the computer system in order to perform an operation.
The input devices are the keyboard and the mouse.

3.3.2 Output Design

Output design refers to the information produced after processing the data that was fed into the system through the input device. The output device is the computer screen and paper.
The outputs expected from new system are:

- Patient records
- Information about haematology

3.3.3 The System Design Tool

The system design tool employed is Hierarchical Structure.

4. SYSTEM IMPLEMENTATION

4.1 Overview

This discusses the detail of putting this design into implementation. It discusses the system requirement in terms of hardware and software requirement that will be needed to facilitate smooth running of the application and the choice of programming language to be used.

4.2 Choice of Programming Language

The programming language suggested for the implementation this system (haemaxpert) is C-Sharp. C-Sharp was chosen because it is a very flexible and powerful programming language developed by Microsoft Corporation.

4.3 System Requirement

For this design to work perfectly, some basic hardware and software are required.

4.3.1 Hardware Requirement

Input Devices: Enhanced/Standard Keyboard
Mouse
Memory: 2.0GB RAM
Processor: Dual Core
Output Device: 2.4GHZ Laptop
A printer that is compatible with the computer system you are using.

4.3.2 Software Requirement

Operating System: Microsoft Window Ultimate
Application Packages: Visual Studio 2010
Microsoft Accesses

4.4 Features of the Application

Main Application Page: the main application page is to contain all the major menu of the system as shown in figure 4. This is where you can login into the various sections of ‘Admin’, ‘Medicals’ and ‘Patient’.
Patient Module: The patient module is to allow the user to give the patient bio data is as shown in figure 5. It has the following submenu:

- Add
- Delete
- Search
- Update

Diagnosis Module: The patient’s disease is diagnosed here by clicking on the symptoms that correspond to the patients compliant.
Result Module: This module gives the result of the diagnosis made for the patient and then gives the name of the disease the patient is suffering from.
Treatment module: This module provides information about the necessary treatment for diagnosis made.
There are sections for Admin, Medicals and Patients.
Admin Section: The knowledge engineer is to access the software for any modification.
Patient Section: This allows any user to be able to register and make use of the expert system.

Figure 4: Main Application Page

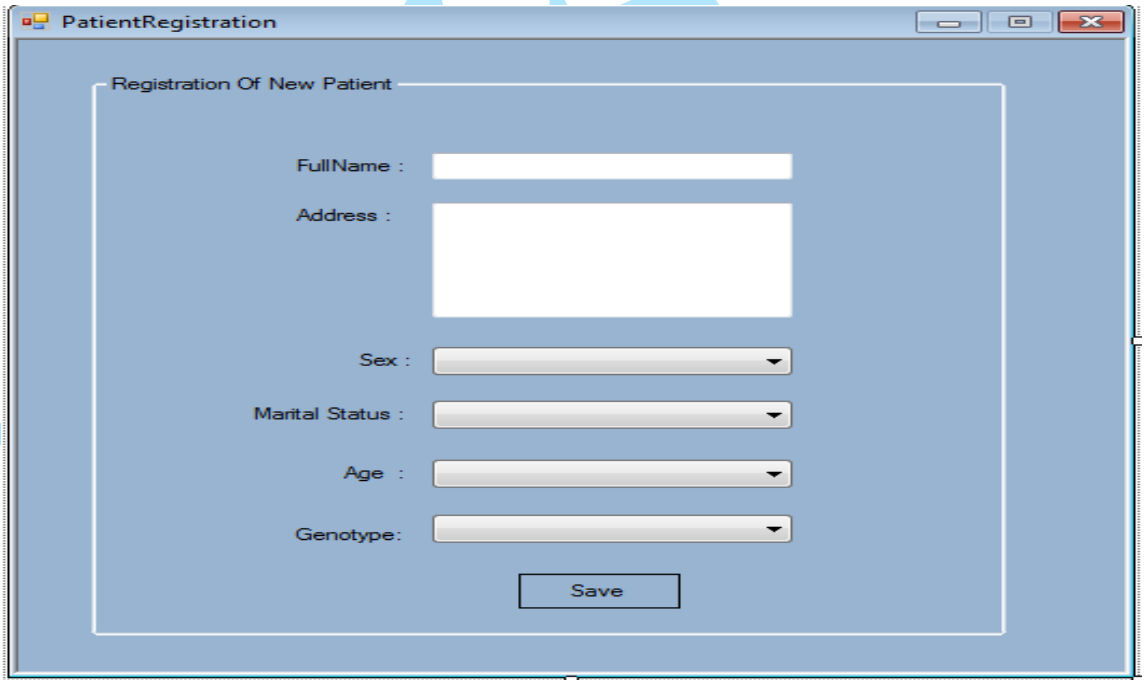
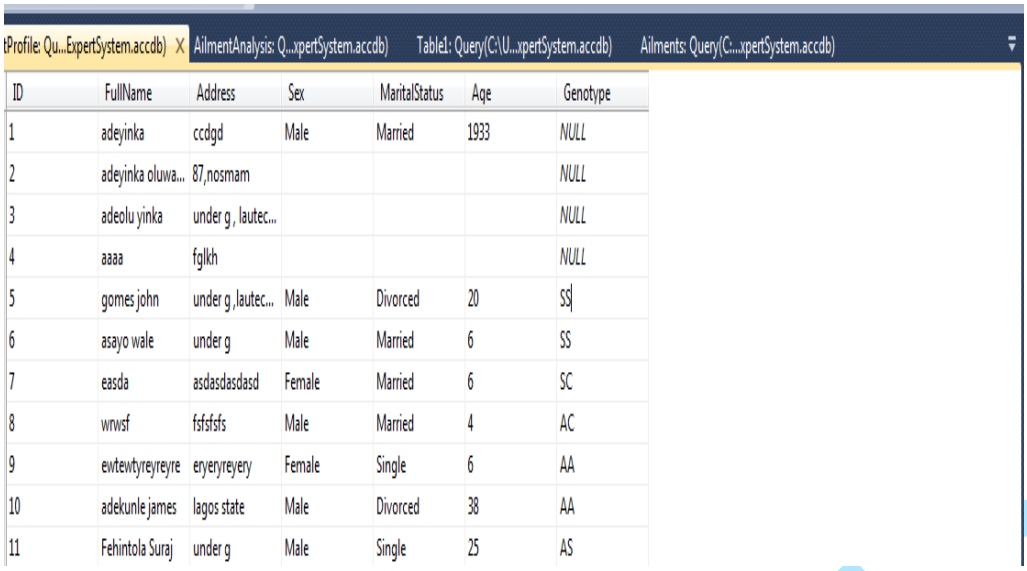


Figure 5: Interface for Patient Registration



ID	FullName	Address	Sex	MaritalStatus	Age	Genotype
1	adeyinka	ccdgd	Male	Married	1933	NULL
2	adeyinka oluwa...	87,nosmam				NULL
3	adeolu yinka	under g , lautec...				NULL
4	aaaa	fglkh				NULL
5	gomes john	under g ,lautec...	Male	Divorced	20	SS
6	asayo wale	under g	Male	Married	6	SS
7	easda	asdasdasdasd	Female	Married	6	SC
8	wrwsf	fsfsfsfs	Male	Married	4	AC
9	ewtewtyreyreyre	eryeryreyery	Female	Single	6	AA
10	adekunle james	lagos state	Male	Divorced	38	AA
11	Fehintola Suraj	under g	Male	Single	25	AS

Figure 6: Interface showing patient profile

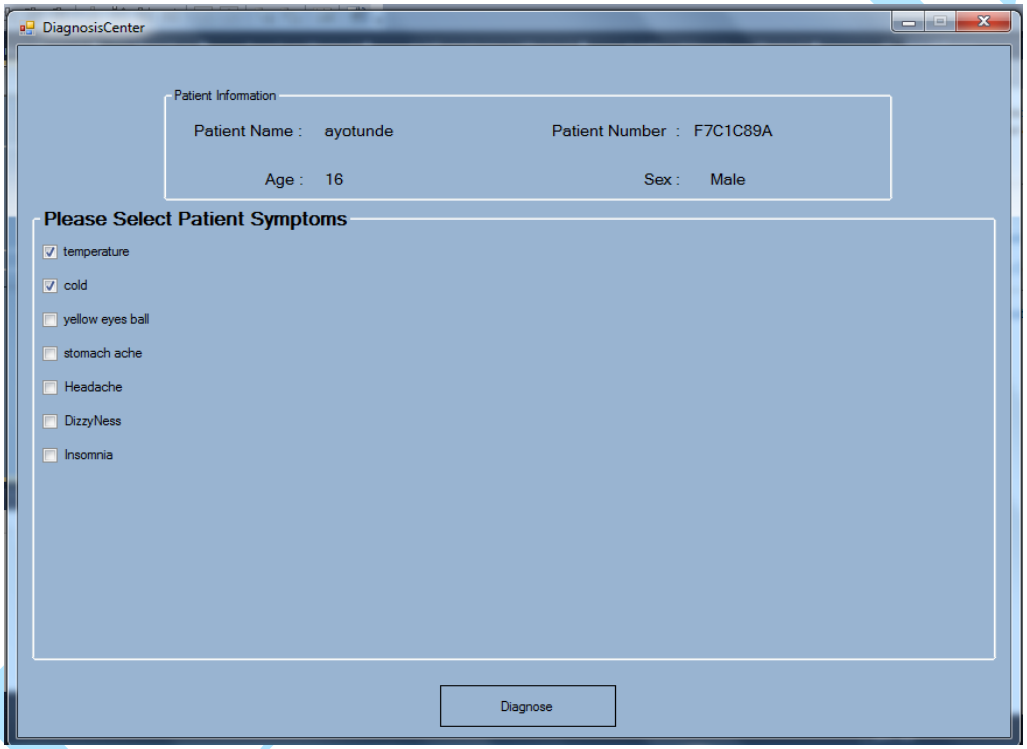


Figure 7: An Interface where user can select symptoms and can be diagnosed

Table 1: The Table containing Diseases, Symptoms and Treatment

S/N	DISEASES	SYMPTOMS	TREATMENT
1	Anemia	Paleness, Weakness, Cold hands and feet Tiredness, Shortness of Breath, Heart Palpation, Chest Pain, Pale skin, Dizziness	Increase in in-take of iron in foods like liver, sea foods, dried fruits, lima beans, Eating foods that contain vitamin C, foliate, and vitamin B12 which help your body absorb iron.
2	Hemophilia	Blood in the urine, Blood in the stool, Deep bruises, Large and unexplained bruises, Excessive bleeding, Bleeding gums, Frequent nosebleeds, Pain in the joints, tight joints, Irritability (in children)	Stop and Prevent bleeds with the clotting factor that is lacking.
3	Leukaemia	Excessive sweating, especially at night, fatigue and weakness that don't go away with rest, unintentional weight loss, bone pain and tenderness painless, swollen lymph nodes (especially in the neck and armpits), enlargement of the liver or spleen, red spots on the skin, called petechiae, bleeding easily and bruising, easily fever or chills	Chemotherapy uses drugs to kill leukaemia cells; Radiation therapy; Stem cell transplantation, Biological or immune therapy

4	Hemo-chromatosis	Lack of energy, Abdominal (belly) pain, Loss of sex drive, Loss of body hair, Heart flutters, Memory fog, Weight loss, Weakness, Abnormal colouring of the skin (gray or bronze)	Reduce the amount of iron they get from their diet; They should avoid iron-fortified processed foods; iron pills, and vitamins and supplements that contain iron; They should also avoid raw seafood and excess alcohol.

5. CONCLUSION

In this paper, an expert system that evaluates the software development for selected Blood Disease Expert System is presented. The results of the study show that the expert system closely follows the procedure of diagnosis and providing the treatments by a doctor. The determination of the type of the blood disease at an early phase is important for the doctors for the treatment of these diseases and to save the lives of the patients, the usable of the system give chance to normal users to use the system without doctor visitation. Future work can be targeted toward other blood related diseases.

REFERENCES

[Ahm12] **Ahmad A. Al-Hajji** - *Rule Based Expert System for Diagnosis and Symptom of Neurological disorders*, proceedings of ICCIT 2012.

[BS84] **B. G. Buchanan, E. H. Shortliffe** - *Rule-Based Expert Systems*, vol.3, Addison-Wesley, 1984.

[Fei86] **E. A. Feigenbaum** - *Expert systems in the 1980s*, Crit. Asian Stud., vol. 18, no. 3, pp. 16–28, 1986.

[NO08] **Samy S. Abu Naser, Abu Zaiter A. Ola** - *An Expert System for Diagnosing Eye Diseases Using CLIPS*, Journal of Theoretical and Applied Information Technology, pp. 923-930, 2005-2008 JATIT.

[OI11] **J. C. Obi, A. A. Imianvan** - *Interactive Neuro-fuzzy Expert System for Diagnosis of Leukemia*, Global Journal of Computer Science and Technology vol. 11, issue 12, version 1.0, July 2011.