DEVELOPMENT OF EXPERT SYSTEM FOR DIAGNOSIS AND TREATMENT OF DHF, TB AND TYPHOID FEVER

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ABSTRACT

Artificial Intelligence (AI) is a subdivision of computer science devoted to creating computer software and hardware that attempt to produce results such as those produced by people. An expert system is a subdivision of Artificial Intelligence field and it is a knowledge–intensive program that solves problem normally requiring human expertise. It performs many of the secondary functions than an expert does, such as asking relevant questions and explaining its reasoning. In this paper, we will build an Expert System to distinguish three types of diseases such as Dengue Haemorrhagic Fever (DHF), Tuberculosis (TB) and Enteric Fever. First, we will analyze the symptoms of each disease. Second, we will develop the Expert System to advice the diagnosis and treatment of these three diseases. The symptom analysis of diseases and stage distinguishing program is the first part of our system. The second part is to advise how to give treatments to each disease according to each level or stage. The entire system is implemented by using java programming language.

Keywords: Artificial Intelligence, Expert System, Expert, Expertise, Inference Engine, Forward Chaining, Backward Chaining.

1. INTRODUCTION

Dengue Haemorrhagic (DHF) is one of the most dangerous diseases for children under the age of 15 as ten percent of childhood cases of DHF are fatal because of severe internal bleeding. DHF occurs in many tropical and sub-tropical areas in Asia, Africa, Central and South America.

Tuberculosis (TB) is also a dangerous disease. Unless a patient take systemic treatment, he/she will die because of this disease. Moreover other people living near the TB patient can be infected by this disease if a patient does not take care of his/her behavior systematically. So it is also a very dangerous disease in the world.

Enteric Fever is caused by Salmonella typhi through fecal-oral route. Incubation period is 10-14 days. Bacilli may live in the gallbladder of carries for months or years.

This paper will implement an Expert System based on Artificial Intelligence (AI). Benefits of AI technologies will help doctors, and reduce mortality of children and adults.

Modern computer technologies will be used to implement this Expert System. Therefore, this study hopes to reduce the mortality from DHF, TB and Typhoid and provides effective way to diagnose and treat each disease.

2. RELATED WORK

AI technology is being developing and there are many areas of research. The areas of research in AI field are: Human System Management (Bonissone, P.P), Robotic and Vision (Dornan, S.L), Natural Language Processing System (Tennant, Harry), Medical Diagnosis System (Harry E., Jr) and etc. Eleven percent of the Expert system applying AI technology is used in medical fields. This paper is related with medical field. Our system can be used to diagnose and treat three kinds of diseases. The diseases that our system can detect are DHF, TB and Typhoid.

3. EXPERT SYSTEM

Expert System is a subdivision of Artificial Intelligence (AI). Artificial Intelligence (AI) is a subdivision of computer science devoted to creating computer software and hardware that attempt to produce results such as those produced by people [1]. Computers already emulate some of the simple activities of the human minds. They can

perform mathematical calculations, manipulate number and letters, make simple decision and perform various storage and retrieval functions. AI is concerned with two basic ideas. First it involves studying the process of humans; second, it deals with representing those processes via machines. AI is the study of how to make computer do things at which people are better.

An expert system is a knowledge–intensive program that solves problem normally requiring human expertise. It performs many of the secondary functions than an expert does, such as asking relevant questions and explaining its reasoning. Characteristics common to expert system are best seen by examining what they do:

- They solve very difficult problems as well as or better than human experts.
- They reason heuristically, using what experts consider effective rules of thumb.
- They interact with humans in appropriate way, including the use of natural language.
- They manipulate and reason about symbolic descriptions.
- They function with erroneous data and uncertain judgmental rules.
- They contemplate multiple competing hypotheses simultaneously.

4. BASIC COMPONENTS OF EXPERT SYSTEM

4.1 EXPERTISE

Expertise is the extensive, task-specific knowledge acquired from training, reading, and experience. The following types of knowledge are examples of what expertise includes:

- Facts about the problem area
- Theories about the problem area
- Hard-and-fast rules and procedures regarding the general problem area
- Rules of what to do in a given problem situation regarding problem solving
- Global strategies for solving these types of problems
- Metal-knowledge

These types of knowledge enable experts to make better and faster decisions than non-experts in solving complex problems.

4.2 EXPERTS

It is difficult to define what an expert is because we actually talk about degrees or levels of expertise. Typically, human expertise includes a constellation of behavior that involves the following activities:

- Recognizing and formulating the problem
- Solving the problem quickly and properly
- Explaining the solution
- Learning from experience
- Restructuring knowledge
- Breaking rules
- Determining relevance
- Degrading gracefully

Expert can take a problem stated in some arbitrary manner and convert it to a form that lends itself to a rapid and effective solution.

4.3 TRANSFERRING EXPERTISE

The objective of an expert system is to transfer expertise from an expert to a computer and then on to other humans (non-experts). This process involves four activities: knowledge acquisition, knowledge representation (in the computer), knowledge inference, and knowledge transfer to the user. The knowledge is stored in the computer in a component called a knowledge base. Two types of knowledge are distinguished: facts and procedures regarding the problem domain.

4.4 Inference Engine and Rules

It is part of the program that interprets the expert systems rules. The inference engine accepts user input queries and responses to questions through the I/O interface and use this dynamic information together with static knowledge stared in the knowledge base. An understanding of the "inference rule" concept is important to understand expert systems. An inference rule is a statement

that has two parts, an if-clause and a then-clause. This rule is what gives expert systems.

There are two main methods of reasoning when using inference rule: backward chaining and forward chaining.

4.4.1 Backward Chaining

Backward chaining is a goal-driven approach in which it starts from an expectation of what is to happen, then seek evidence that supports expectation. On a computer, the program starts with a goal to be verified as either true or false. Then it looks for a rule that has that goal in its conclusion. It then checks the premise of that rule as an attempt to satisfy this rule. It checks the assertion base first. If the search there fails, the ES looks for another rule whose conclusion is the same as that of the premise of the first rule. An attempt is then made to satisfy the second rule. The process continues until all the possibilities that apply are checked or until the first rule is satisfied.

4.4.2 Forward Chaining

Forward chaining is a data-driven approach. In this approach we start from available information as it comes in, or from a basic idea, then try to draw conclusions. The computer analyzes the problem by looking for the facts that match the If portion of its IF-THEN rules. For example, if a certain machine is not working, the computer checks the electricity flow of to the machine. As each rule is tested, the program works its way toward a conclusion.

4.5 Explanation Capability

Another unique feature of an Expert System is its ability to explain its advice or recommendations and even to justify why a certain action was not recommended. The explanation or justification are done in a subsystem called the justifier, or the explanation subsystem. It enables the system to exmine its own reasoning and to explain its operation.

5. STRUCTURE OF EXPERT SYSTEM

The following figure shows the structure of an Expert System. In this figure, the basic components are collected together to form an Expert System.

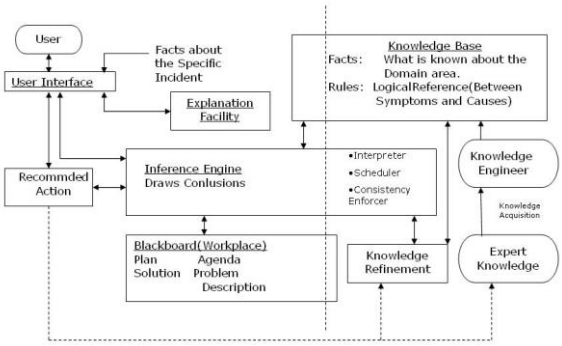

Figure 1. Structure of Expert System

6. COMPARISON OF CONVENTIONAL SYSTEMS AND EXPERT SYSTEMS

6.1 Conventional System

1. Information and its processing are usually combined in one sequential program
2. Program does not make mistakes
3. Do not explain why input data are needed or how conclusions were drawn
4. Changes in the program are tedious
5. The system operates only when it is completed
6. Execution is done on a step-by-step basic
7. Need complete information to operate
8. Effective manipulation of large databases
9. Representation and use of data
10. Efficiency is a major goal
11. Easily deal with quantitative data
12. Capture, magnify, and distribute access to numeric data or to information

6.2 Expert System

1. Knowledge base is clearly separated from the processing mechanisim
2. Program may make mistakes
3. Explanation is a part of most ES

4. Changes in the rule are easy to accomplish
5. The system can operate with only a few rules
6. Execution is done by using heuristics and logics
7. Can operate with incomplete or uncertain information
8. Effective manipulation of large knowledge bases
9 Representation and use of knowledge
10 Effectiveness is a major goal
11 Easily deal with qualitative data
12 Capture, magnify, and distribute access to judgment and knowledge

7. BENEFITS OF EXPERT SYSTEM

Expert System can provide major benefits to users.

- **Increased Output and Productivity** Expert System can work faster than Increased output means fewer workers needed and reduced costs.

- **Increased Quality**- Expert System can increase quality by providing consistent advice and reducing error rate.

- **Reduced Downtime-** Many operational Expert System are used for diagnosing malfunctions and prescribing repairs. By using Expert System it is possible to reduce downtime significantly.

- **Capture of Scarce Expertise-**The Scarcity of expertise becomes evident in situations where there are not enough experts for a task, the expert is about to retire or leave a job, or expertise is required over a broad geographic location.

- **Flexibility**- Expert System can offer flexibility in providing services and in manufacturing.

- **Easier Equipment- Operation** Expert System makes complex equipment easier to operator.

- **Elimination of the Need for Expensive Equipment-** Expert System can perform the same tasks with lower-cost instruments because of their ability to investigate mere thoroughly and quickly the information provided by instruments.

- **Obseration in Hazardous Environments** This characteristics is extremely important in military conflicts; it can also enable workers to avoid hot, humid, or toxic environments, such as a nuclear power plant that has malfunctioned.

- **Accessibility to Knowledge and Help Desks -** People can query systems and receive advice. One area of applicability is support of help desks. Another is the support of any advisory service.

- **Reliabiliy -** Expert System is reliable. ES also consistently pay attention to all details and so do not relevant information and potential solutions.

- **Increased Capabilities of Other Computerized Systems -** Integration of Expert System with other systems makes the other systems more effective they cover more applications, work faster, and produce higher quality results.

- **Integration of Several Experts' Opinions -** In certain cases, ES forces us to integrate the opinions of several experts and thus may increase the quality of the advice.

- **Ability of Work with Incomplete or Uncertain Informaiton -** Expert System can, like human experts, work with incomplete information.

- **Provision of Traingin-** Expert System can provide training. Novices who work with Expert System become more and more experienced.

- **Enhancement of Problem Solving** Expert System enhances problem solving by allowing the integration of top experts'

judgment into analysis. They also increase users' understanding through explanation. ES can be used to support the solution of difficult problems.

- **Ability of Solve Complex Problems** Expert System may, one day, solve problems whose complexity exceeds human ability.

- **Knowledge Transfer to Remote Locations -** One of the greatest potential benefits of ES is its ease of transfer across international boundaries. This can be extremely important to developing countries that cannot pay for knowledge delivered by human experts.

8. DENGUE HAEMORRHAGIC FEVER (DHF)

8.1 DHF (NON SHOCK)

Grade(1): Fever accompanied by non-specific constitutional symptoms and a positive
Hess test
Grade(2): Patient with minimal spontaneous bleeding in the form of coffee ground
vomitus in a addition to the above manifestation.

8.2 DSS (SHOCK)

Grade(3): Circulatory failure manifested by rapid and week pulse narrowing of pulse pressure (20 mmHg or less) or hypotension with the presence of cold clammy
skin and restlessness.
Grade(4): Profound shock with undetectable blood pressure and pulse.

9. TUBERCULOSIS (TB) CASES (GRADES)

Case 1: New smear-positive patients (New case)
Case 2: Previously treated sputum smear-positive PTB (Old case)
Case 3: New smear-negative PTB
Case 4: Chronic and MDR-TB case

10. ENTERIC FEVER (TYPHOID) GRADES

- First weak: Fever, Headache, Myalgia, Relative bradycardia, Constipation, Diarrhoea and vomiting in children
- End of First Week: Rose spots on trunk, Splenomegly, Cough, Abdominal distension, Diarrhoea
- End of Second Week: Delirium, Complications, then coma and death (if untreated)

11. SYSTEM DESIGN

This section will discuss about the system operation. The system flow chart is shown in Figure 2. As shown in figure, this system will accept the symptoms from user. User may be a patient or a doctor. According to the symptom input, the system will distinguish diseases. If the symptoms are beyond the scope of the system's knowledge base the disease will not be recognize.

As described above, the system can only recognize only three diseases. If the input symptoms are not the symptoms of DHF or TB or Typhoid, the system will display message such as "Not DHF or TB or Typhoid". If the in put symptoms are the symptoms of DHF or TB or Typhoid, the system will display which disease is being suffered from.

After the symptom analysis process is completed, the level of the disease is disease is distinguished. Then, the treatment for the specific disease is searched through the knowledge base. After that, the appropriate treatment will be displayed. If the user of the system has desire to analyze more, the system will start again. If not, the system will be terminated.

In this system, the knowledgebase is created as shown in the following figure. This knowledgebase contains the treatments of diseases. This knowledgebase can be updated in the future as the treatments are changed or modified. In this

flowchart, the knowledgebase update process is omitted for the sake of simplicity.

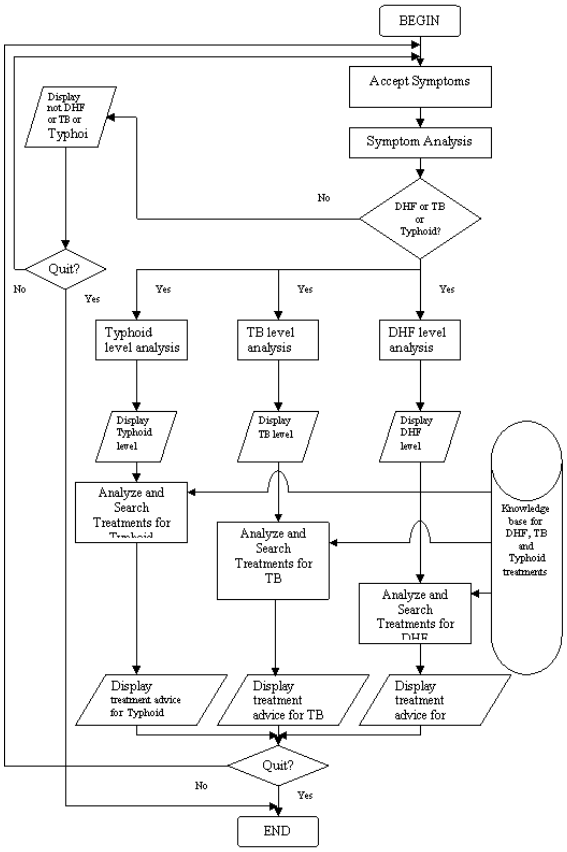

Figure 2 System Flow Chart

12. BENEFITS OF THESIS

- Diagnose the Dengue Hemorrhagic Fever, Tuberculosis and Enteric Fever.
- Treat necessary medical treatment with the aid of computer.
- Reduce the mortality from Dengue Hemorrhagic Fever, Tuberculosis and Enteric Fever and effective way to diagnose and treat these diseases through modern computer technology.
- Training and seeking direct advice, teaching the student and improving or increasing the knowledge base.

13. CONCLUSION

In conclusion, this paper will provide knowledge about DHF, TB and Enteric Fever stage and treatments. By using this knowledge we implement Expert System for diagnose and treatment of DHF, TB and Enteric Fever diseases. This system can provide people with basic knowledge about DHF, TB and Enteric Fever. This system also hopes to provide everyone with simple and easy access. It will also provide quick and accurate responses. This system acts as an assistant when the doctor diagnoses and gives treatments for patients. It can also be used on behalf of doctor in emergency cases. The accuracy of this system is eighty percent.

So, our system helps peoples to improve their medical knowledge and guard them from fatality, and public health of our nation will also be improved. In addition, our system can be extended by updating knowledgebase with other kinds of diseases.

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