Expert System for Early Diagnosis of Eye Diseases Infecting the Malaysian Population

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***Abstract*– This paper describes a knowledge based system employing certain expert system rules to detect different kind of eye diseases found in Malaysia. The types of eye diseases that can be detected with this system are allergic or infectious conjunctivitis, secondary and senile cataract, open angle glaucoma and acute glaucoma, keratitis and dry eyes syndrome. These are the most frequent eye diseases infecting the Malaysian population. The project was designed and programmed via the object-oriented expert system shell software, EXSYS. Expert rules were developed based on the symptoms of each type of the eye diseases, and they were presented using a tree graph forward chaining with depth search first method. In order to enhance user interaction with the system, graphical user interfaces were employed. Previously, several similar works have been published, but they are limited to detecting a single disease and also required expert medical officer to operate. The expert system described in this paper is able to detect and gives early diagnosis of five types of eye diseases; inclusive of senile, secondary, open angle, acute, allergic and infections.**

***Index Terms*– Knowledge based system, medical expert system, rules, tree graph.**

I. INTRODUCTION

Artificial intelligence in Medicine (AIM) field emerged in the early 1970's in response to several simultaneous needs, opportunities and interests. An increased demand for high quality medical services coupled with the explosive growth of medical knowledge has led to the usage of computer program that could be used to assist physicians and other health care providers in discharging their clinical roles in diagnosis, therapy and prognosis [1].

Artificial intelligence (AI) field began to reach it maturity when first applied for representation and reasoning in medical diagnosis in areas such as thyroid diseases, breast diseases, drug poisoning, electrolyte disorder, jaundice and liver dysfunctions, ventilator management, pulmonary function, hematology, chest pain, ophthalmology and oncology [2].

Kulikowski *et. al.* presented a causal-associational network (CASNET) model for describing disease processes and its application in an expert-level consultation program in glaucoma [3]. Unfortunately, this system only detects glaucoma and requires a well-trained medical officer to operate it.

This paper introduces an expert system for early diagnosis of eye diseases (ESEDED) to detect five types of the most frequent eye diseases experienced by the Malaysian population. The various eye diseases that can be detected by this system are cataract, glaucoma, conjunctivitis, dry eyes syndrome and keratitis. This system uses a symptom-based approach to diagnose eye diseases. Hence, very little medical terms are adapted and it can be operated easily by both medical and non–medical individuals.

II. ESEDED SYSTEM ARCHITECTURE

The ESEDED system architecture consists of three components: knowledge base, the inference engine and the user interface (see Fig. 1) [4]. The knowledge base is formed by means of information gathered from sources such as relevant medical documents, ophthalmologists, nurses and also the patients. The inference engine is the portion of the system architecture that direct the system to choose the appropriate rule based on the information produced by the user. The user interface allows communication between the user and the system.

III. METHODOLOGY

The ESEDED used commercial expert system shell software known as EXSYS Professional (version 2.2). It is a rule based expert system development tool running on an IBM compatible PC with Microsoft Window 98 operating system.

The knowledge obtained for ESEDED system has undergone the knowledge acquisition process as shown in Fig. 2. ESEDED knowledge acquisition consists of eight stages. The first stage began with the literature study on the eye diseases. This led to the second stage, where a suitable questionnaire form was designed and used for a pilot survey (third stage) conducted in the University Malaya Medical Center (UMMC). The survey helps to verify the effectiveness of the questionnaire and at the same time gives further input for an improved questionnaire set (fourth stage).

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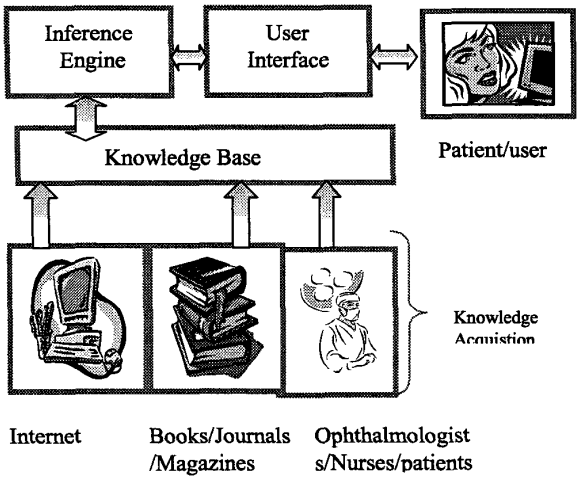

Fig. 1. ESEDED system architecture

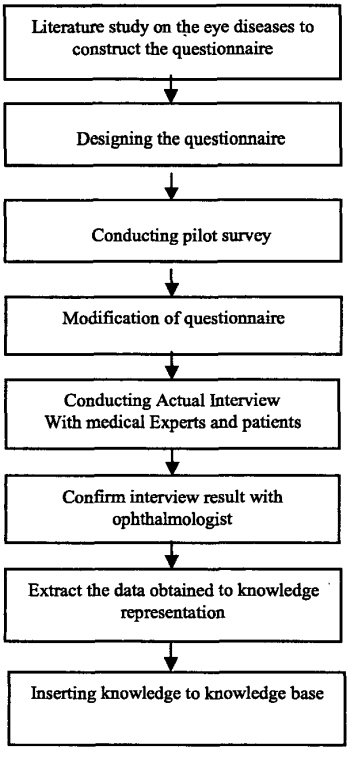

Fig. 2. Flowchart of ESEDED knowledge acquisition

Utilizing the improved questionnaire, new surveys and interviews were conducted at University Hospital (UH), National University of Malaysia Hospital (HUKM), National University of Singapore (NUS) and other private hospitals.

In the sixth stage, the information obtained from the interviews was double-checked and reconciled by ophthalmologists. This stage is important to ensure the integrity and reliability of data.

The next stage is to extract knowledge from the gathered information, and then inserting them into a knowledge base organized in a form of tree-graphs using forward chaining method with a depth search technique. There are three tree-graphs representing the three most frequent symptoms: reduced vision, sore eyes and red eyes. Fig. 3 shows the tree-graph that begins with red eyes.

The tree-graphs are then transformed into artificial intelligent programming language syntax using the 'production rule' (utilizing IF....THEN statements). Example 1 shows one of the production rule implemented for ESEDED using EXSYS.

Example 1

RULE 22
IF
I would like to get more information about ESEDED
And What is the most obvious symptom present? Red Eyes
And Eye Pain No
And Sensitive to light Yes
And Gritty and Sandy Feeling Yes
And Itchy and Irritation Yes
And Discharge Yes
THEN
Most probably you have CONJUNCTIVITIS. Please consult your doctor for verification.

IV. RESULT

The ESEDED has been developed and tested successfully. Due to certain constraints, currently only two patients have had prior consultation using ESEDED before their visit to the ophthalmologist. In these cases, the results obtained by ESEDED are similar to that produced by the ophthalmologist.

V. CONCLUSION

ESEDED using EXSYS has been shown to give an early diagnosis of eye diseases in Malaysia. The representation of the knowledge in a database provides an opportunity for other research for eye diseases in Malaysia to be carried out in future. The software employed provided an easy and interactive human-machine interface that enhances the consultation phase between the user/patient and the system. As a result, a better and faster diagnosis could be achieved.

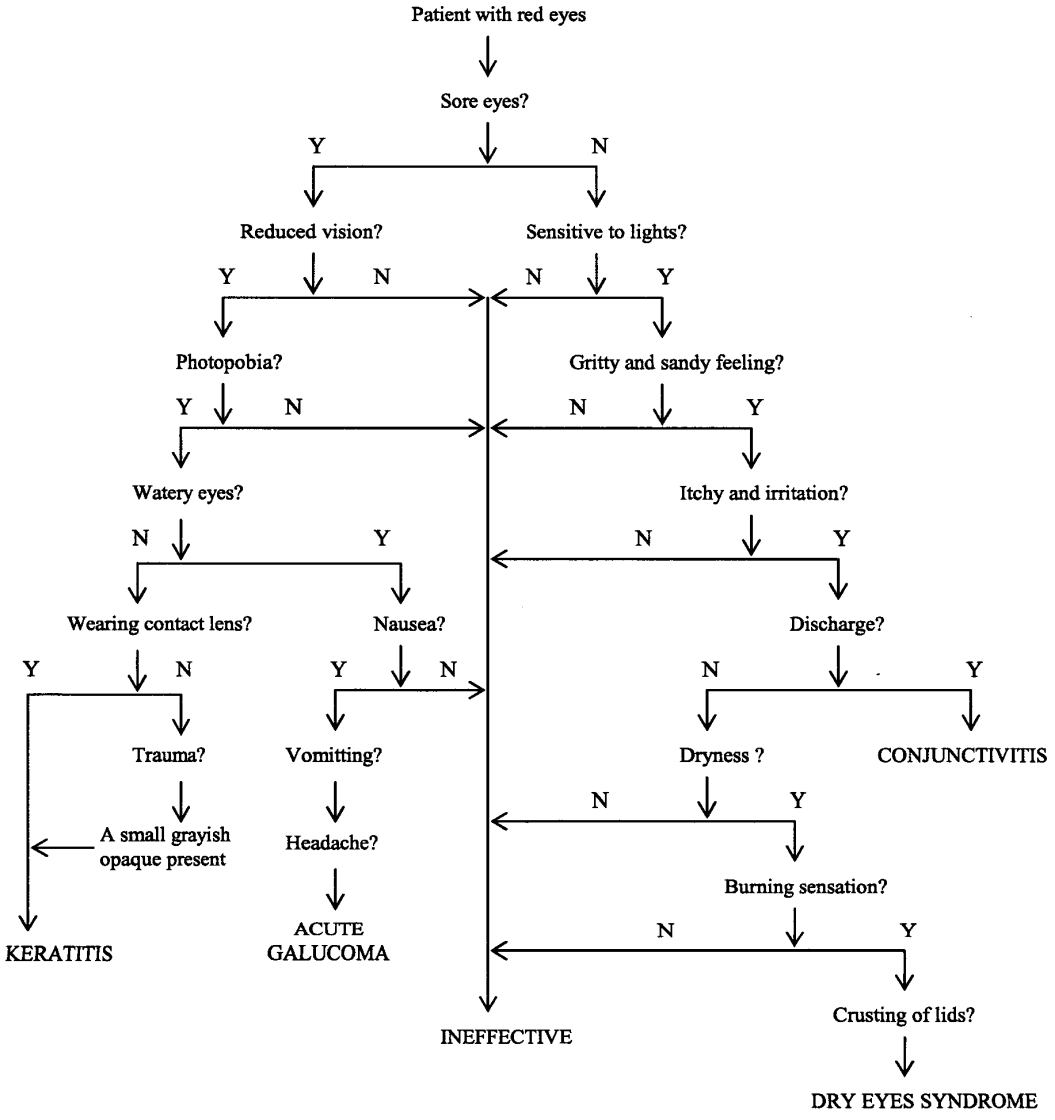

Fig. 3. Forward chaining method tree-graph

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