An Expert System for Diagnosis of Human Diseases

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ABSTRACT.
Detecting diseases at early stage can enable to overcome and treat them appropriately. Identifying the treatment accurately depends on the method that is used in diagnosing the diseases. A Diagnosis expert system (DExS) can help a great deal in identifying those diseases and describing methods of treatment to be carried out taking into account the user capability in order to deal and interact with expert system easily and clearly. Present expert system uses inference rules and plays an important role that will provide certain methods of diagnosis for treatment.

INTRODUCTION
Computer-based methods are increasingly used to improve the quality of medical services. Artificial Intelligence (AI) is the area of computer science focusing on creating expert machines that can engage on behaviors that humans consider intelligent[1]. The proposed system DExS is for dealing with the problem of a disease diagnosis is an expert system. An expert system is a system that employs human knowledge captured in a computer to solve problems that ordinarily require human expertise [2],[3]. Expert system seeks and utilizes relevant information from their human users and from available knowledge bases in order to make recommendations [3].

Knowledge acquisition:

The data and knowledge of DExS are collected from different sources. The first primary source is the medical knowledge of expert doctors. The second source is from specialized databases, books and a few electronic websites.

Knowledge representation:
The proposed system is rule-based system and makes inferences with symbols, which require translation of a diseases specific knowledge in the standard symbolic form. In the first phase, the medical background of diseases is recorded through the creation of personal interview with doctors and patients. In the second phase, a set of rules is created where each rule contains in IF part that has the symptoms and in THEN part that has the disease that should be realized. The inference engine (forward reasoning) is a mechanism through which rules are selected to be fired. It is based on a pattern matching algorithm whose main purpose is to associate the facts (input data) with applicable rules from the rule base. Finally, the diseases are produced by the inference engine. This expert system then defines the symptoms for diseases.
DExS
DExS System can be used in consultation since it shows quickly the diagnosis and in addition, it offers explanations of the obtained results, being very helpful to the professional. With the expert system, the user can interact with a computer to solve a certain problem. This can occur because the expert system can store heuristic knowledge.
The proposed system performs many functions. It will conclude the diagnosis based on answers of the user to specific question that the system asks the user. The questions provide the system for explanation for the symptoms of the patient that helps the expert system for diagnosis the disease by inference engine. It stores the facts and the conclusion of the inference of the system, and the user, for each case, in database. It processes the database in order to extract rules, which completes the knowledge base.

1.1 Possible diagnosis methods

Heuristic Approach:

DIAGNOSIS = HEURISTIC CLASSIFICATION

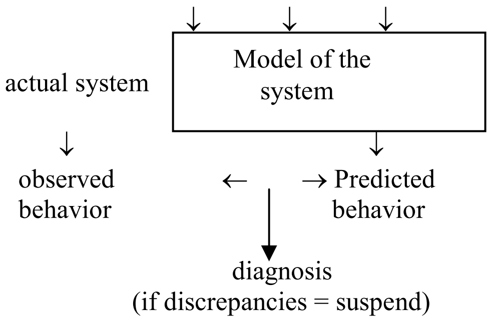
domain expert → heuristic – associational knowledge

Heuristic match
Data abstractions → Solution abstractions
↑ ↓
(data observations) Solutions

Model Based Approach:

“Knowledge level” view:

experiences books …Internet



1.2 DExS Model

To accumulate factual knowledge, data are collected concerning the association between sign and symptoms associated with patients. The sign, symptoms and test reports are the determining factor of a particular disease. These symptoms are organized in groups, which help in diagnosis. Each unit is provided with three groups of symptoms Key group(Kg), Sub group(Sg) and Unexpected(Ue). Kg is a group of symptoms whose presence is necessary & sufficient to confirm the diseases where as the presence of Sg is not sufficient and it is a subset of Kg[6].

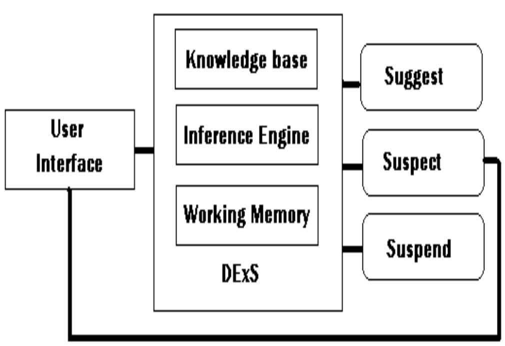


Fig1: Working Model of DExS

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Algorithm :

Input:-Pd{(Kg, Sg)/ Ue}

Output- Suggest; //(Best Case)
        Suspect;
        Suspend;
Method

If Pd=Kg then Suggest
else if Pd=Kg then get Pd;
else if Pd then exit;
end if;
(Pd-Patient data)
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2. Analysis of Diagnosis

The symptoms supplied are the observed symptoms. The presence of symptoms provides the evidence for the presence of the diseases. Each and every Kg/Sg is tried to match with the observed symptoms.

(i)The presence of Kg group(i.e Suggest) can diagnosis the diseases more strongly.

(ii)The presence of Sg group(i.e Suspect) seems to be less strong enough to diagnosis the diseases. Suspect yields partial match with observed symptoms. When suspect state is found there will be request to acquire additional symptom information about the patient.

(iii)Suspended state is found when there is no match occurring or if the symptom information is missing.

2.1 Logical concept:

There are certain factors which can be used to determine the patient's health condition. With the defined conditions(i.e factors), the diagnosis is carried out, thus problem is obtained. Let the determining factor be propositional variables $x[i]$ (i = 1,2,3,4,…,n), preceded or not by the symbol " ¬ ". The Determining Factors are gathered with the conjunction " ∧ " (logically) to determine the Severity. It is assigned an "Severity", say c[j] (where j= 0,1,2,…,n), to each conjunction of the Determining Factors[7]. The determining factors and severity can be represented logically to form the rules and to construct the decision table[5] as shown below.

Determining Factor:	Severity:
x[1]: Age.	c[0]: very low.
x[2]: Gender.	c[1]: Low.
x[3]: Pregnancy status	c[2]: Medium.
x[4]: Lactation status	c[3]: High.
x[5]: Chronically ill	

Mathematically,

$$x[1] \wedge x[2] \wedge \neg x[3] \wedge \neg x[4] \wedge \neg x[5] \rightarrow c[1] \quad (1)$$
$$x[1] \wedge x[2] \wedge x[3] \wedge \neg x[4] \wedge x[5] \rightarrow c[2] \quad (2)$$
$$x[1] \wedge x[2] \wedge \neg x[3] \wedge x[4] \wedge x[5] \rightarrow c[2] \quad (3)$$
$$x[1] \wedge x[2] \wedge x[3] \wedge x[4] \wedge x[5] \rightarrow c[3] \quad (4)$$

Table1 Decision table:

	Rule(i)	Rule(ii)	Rule(iii)	Rule(iv)
Determining factors				
x[1]	1	1	1	1
x[2]	1	1	1	1
x[3]	0	1	0	1
x[4]	0	0	1	1
x[5]	0	1	1	1
Severity c[0]	-	-	-	-
c[1]	1	-	-	-
c[2]	-	1	1	-
c[3]	-	-	-	1

(Boolean 1 and 0 are taken for TRUE and FALSE respectively.)

This procedure has been followed with the rest of the factors and symptoms (shown in Table2) , obtaining in this way all the rules of the Expert system.

Table2 Disease Identification and Treatment Plan.

INPUT	DExS OUTPUT			
x[i], Symptoms/Signs	Disease	Treatment	Severity level	Status
Restlessness, Irritable, Sunken eyes	Some dehydration	Oral treatment with ORS solution according to WHO treatment guidelines	Moderate	Suggest
Watery discharge from eye, fever, sore throat & swollen glands in neck	Viral Conjunctivitis OR allergic conjunctivitis...	Anti bacterial eye drops, 3-4 times per day (two drops) as per IP guidelines.	Mild	Suggest
Temperature >100˚c, Lithergetic, Vertigo, Nausia/Vomitting, Body pain, Chill feeling, Irriatable	-----------------	-------------------	-------------	Suspect (Provide Blood Sample)

3. User Interface Screen

HEALTH CARE PLAN Date: Patient's Name: Age: Gender: Marital Status:	**DExS Output**
P Status: L Status: Chronically ill: **Observed Sign/Symptoms** ➢ Frequent Vomiting ➢ Frequent Loose motion ➢ Sunken eyes ➢ Restlessness ➢ Low body temperature	**HEALTH CARE PLAN** Date: Patient's Name: Age: Gender: Marital Status: Name of the Disease: Diarrhea Severity Status : Reason for the disease: Due to contamination water & food. Immediate treatment: Give 2-3 bottles(if require more as per the severity) of DNS/NS in IV . Suggested treatment: (Norfloxacin + Tinidazole) tablets twice daily, after food for 5 days. As per IP standards.

CONCLUSION

Several properties of this model remain to be investigated. It should be tested on several more databases. Unfortunately databases are typically proprietary and difficult to obtain. Future prospects for medical databases should be good since some hospitals are now using computerized record systems instead of traditional paper-based. It should be fairly easy to generate data for machine diagnosis.

One important aspect of automated diagnosis is the accompanying explanation for the conclusion, a factor that is important for user acceptance. A trained expert would evaluate the quality of the diagnosis performed by the system, followed by adjustment of the utilities.

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