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A Novel Approach for Design of Ontology Based Clinical Decision Support System

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Abstract: Ontologies are becoming increasingly prevalent and important in a wide range of medical applications. Medical applications are using ontologies for decision making. In Medical system collecting data is extremely important for growth and change. Analyzing data resulting from your unit outcomes, discovering strategies to tackle the issue, and formulating a plan for improvement will assist you in making better clinical decisions. Medical data is one of the most crucial data to be processed for decision making. Decision making systems of such kind is fully automatic take the benefit of knowledge engineering-based architectures.

Medical time series contain important information about the condition of a patient. However, due to the large amount of data and the staff shortage, it is difficult for physicians to monitor these time series for trends that suggest a relevant clinical detoriation due to a complication or new pathology.

***Keywords*:** Diabetic disease, Malaria Disease, Knowledge Management, Knowledge Engineering, Ontology Engineering

I. INTRODUCTION

The Medical Application is one of the most crucial systems. Doctor has to take instant decision. Slight mistakes in deriving the decision cause death of the patient. Medical data is one of the most crucial data to be processed for decision making. As a result of this, there is a greater need for an easy and automatic procedure for diagnosing tropical disease in order to reduce the rate of mortality. In recent times, Artificial Intelligence (AI) methods have significantly been used in medical applications and research efforts have concentrated on medical expert systems as complementary solution to conventional techniques for finding solution to medical problems.[1]

Decision support systems for patients based on normative frameworks have a goal of generating insight into the decision process[2], rather than providing a critique of a decision[3,4] or finding the optimal treatment based on a treatment protocol. These systems achieve this goal by educating the patient about the options and outcomes for a disease, assessing their preferences for the outcomes with psychometric methods (standard gamble, visual analog scale) and revealing to the patient the implications of his or her preferences for their choice of a treatment. Throughout this process, the system attempts to help the patient to understand the significant outcomes, how his or her preferences may differ from other's and the effect those preferences should have on the specific treatment option being evaluated by the system[2]. Although both types of systems share many common design needs, they do have specific differences. Unlike a support system that often needs objective information from health professional, normative decision support systems for patients must also be able to acquire and manage subjective value measurements from patients. The goal of said management is to ensure accuracy and reduce the burden of questioning [2].

Once the ontology for a decision support system for health professionals is established, the system usually assumes that the knowledge acquired is accurate and complete. However, normative patient support systems must expect and be able to deal with errors and inconsistencies in preference measurements which can occur during the elicitation process [5]. Since normative patient systems are frequently driven by calculation from the underlying decision model, to maintain such systems, developers needs only to manage a small set of methodologies and ontologies specific to decision analysis. With the development of information technology and wide use of the Internet in the recent years, the existing knowledge system available is not sufficient to satisfy the great deal of knowledge in the Web. So, there is need for the scholar to currently resolve the problem to organize knowledge validly, and to make it apply efficiently to the system. Ontology is a discipline that is part of the knowledge representation field and could resolve the bottleneck problem within the knowledge to obtain.

The rapid development of computing technologies has a major impact on healthcare, particularly in intensive care units (ICUs). This growth in computer technologies has been accompanied by an increase in complexity and number of monitoring equipment, thus generating large amounts of data that must be rapidly interpreted by the medical staff.

II. METHODS

We sought to construct a clinical decision support tool that would elicit information about symptoms at the time of checking for a routine clinic visit, organize that information to emphasize what is most useful for clinical care, present that information in an easy-to-use form at the point-of-care, and recommend clinical responses based on that information. We chose these design factors because they encompass a broad range of information management necessary for clinical care. In addition, many of those design factors have been shown to help integrate computerized systems into clinical workflow.[15]

III. DIABETES

Diabetes a chronic illness, requires continuous medical care and patient self-management education to prevent acute complications and to decrease the risk of long-term complications. Diabetes treatment focuses on controlling blood sugar levels to prevent various symptoms and complications through medicine, diet, and exercise. The American Diabetes Association [16] categorizes diabetes into type-1 diabetes, which is normally diagnosed in children and young adults, and type-2 diabetes, i.e., the most common form of diabetes that originates from a progressive insulin secretary defect so that the body does not produce adequate insulin or the insulin does not affect the cells. Either the fasting plasma glucose (FPG) or the 75-g oral glucose tolerance test (OGTT) is generally appropriate to screen diabetes or pre-diabetes. Additionally, the cause of diabetes has not been identified, and it is also affected by an uncertain environment. Therefore, both genetics and environmental factors, e.g., obesity, race, gender, age, and lack of exercise, apparently play important roles in the diagnosis of diabetes.

SYMPTOMS OF MALARIA AND DIABETES :

Cold Stage	High fever	Sweating stage	fever	vomiting	headache	joint pain	General Weakness
2	2	1	1	1	1	1	1
2	2	1	1	0	0	0	1
1	1	0	1	0	0	0	0
2	2	0	0	0	0	0	0
1	2	1	1	1	0	0	0
2	1	1	1	1	0	0	0
1	1	1	1	1	1	1	1

Frequent or urgent urination	Feeling very thirsty all the time	Feeling hungry all the time	Feel tired all the time	Feel tingling in your hands and feet.
2	2	2	2	2
1 2	1 2	1 0	1 0	1 1

Concept Symbol	Concepts	Variable
C1	Fever	None, Not Severe, Severe, Very Severe
C2	Headache	None, Not Severe, Severe, Very Severe
C3	Abdominal Pains	None, Not Severe, Severe, Very Severe
C4	Vomiting	None, Not Severe, Severe, Very Severe
C5	General Body Weakness	Severe, Very Severe None, Mild,
C6	Loss of Appetite	None, Not Severe, Severe, Very Severe
C7	Diarrhea	None, Not Severe, Severe, Very Severe
C8	Convulsion	None, Not Severe, Severe, Very Severe
C9	Palour	None, Not Severe, Severe, Very Severe
C10	Loss of Consciousness	None, Not Severe, Severe, Very Severe
C11	Dehydration	None, Not Severe, Severe, Very Severe
C12	Jaundice	None, Not Severe, Severe, Very Severe
C13	Malaria Parasite Test	None, Not Severe, Severe, Very Severe
DS1	Diseases Severity	None, Not Severe, Severe, Very Severe

Table 1: Concepts in the Symptoms Based Clinical Decision Support System.

IV. KNOWLEDGE MANAGEMENT

Efficient knowledge management is very essential for an organization to have greater productivity and competitive strength. In this fast contemporary era, competitiveness among organizations depends largely on how they exploit and maintain their knowledge. This is the age of Information Technology. Today, information is available everywhere. Earlier news papers were very good source of information. The advancement in science and technology, has resulted in enhancing a wider range of options. Radio & Television are the major audio and visual sources of getting information. Now even, the news papers are available on the Internet. Most of the information in Intranet or Internet is weakly structured. Finding relevant information and maintaining it is difficult. If the information on the Internet is not utilized effectively it is useless. In most of the knowledge management systems, the search is based on keywords and the chance of irrelevant information due to keyword ambiguity is high. Software agents used in extracting information do not have common sense to assist effectively in the search. Also they are unable to integrate information from different sources. Ontologies enable high scalability in searching, extracting, maintaining and generating information. Figure 1 shows the knowledge management in healthcare system :

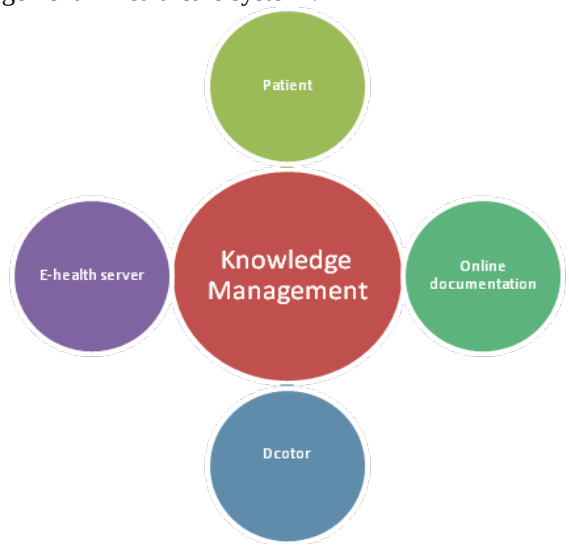

Figure 1 : Knowledge Management in Healthcare System

V. KNOWLEDGE ENGINEERING

Relational databases are well suitable for modeling data required by information system. Information systems are used to manage the systems especially for automatic electronic data processing, taking decisions based on the data to achieve a goal. Processed data gives Information. Information changes in to the Knowledge. Knowledge again changes to Intelligence. With the current shape of data of information system it is quite impossible to convert information to knowledge and then to intelligence for the real time need of system users.

Looking towards this problem a new area entitled by Knowledge Engineering has come into picture. Knowledge engineering is an engineering discipline that involves integrating knowledge in computer systems in order to solve complex problems normally requiring a high level of expertise.

Ontology extraction would be a key component of such information architecture. Ontology language has a clear and unambiguous semantics which enables the use of automatic reasoning support to designer. For a special purpose application a schema is designed on the basis of requirement of data. Ontologies extracted from the Relational Schemata and updations in it on the basis of dynamic population of data prompt the process of learning for the ontologies to help automatic decision making.

VI. ONTOLOGY BUZZWORDS

Few of the terms which are very common in the field of ontology are:

Concept: A concept represents a group of objects or beings sharing characteristics that enable us to recognize them as forming and belonging to this group.[9]

Term: The term is lexical representation of concept.

Ontology Engineering: Techniques for handling large ontologies.

Ontology Engineer: A person who engineers large ontologies.

Ontologist: A person who builds ontologies or whose job is concerned with ontology science or engineering.

Ontological Theory: A set of formulas which are intended to be always true according to a certain conceptualization.

Ontology Learning: Ontologies can be developed manually and automatically. Ontology learning focuses towards semi-automatic and automatic techniques for learning ontologies from either existing ontologies or from other data sources.

VII. ONTOLGOY ENGINEERING

Ontology Engineering is the branch of knowledge engineering which exploits the principle of (formal) Ontology to build Ontologies. [7] Defining ontology is a modeling task based on the linguistic expression of Knowledge. [8] "The Need of real time intelligence in information systems" really motivated to work in this project. Whole model of work can be divided in to three stages. In first we will talk about techniques for developing ontology from the relational schemata. In second we will suggest the model of updating the ontology dynamically. In case of working for multiple domain [11] the issue of ontology reconciliation will be added at this stage.[12] In third stage decision ontologies can be prepared from the ontology prepared at second stage for automatic decision making. The Decision Ontology (DO) provides basic means for describing decision and decision making.[10][14][14] It is formalized in the Web Ontology Language (OWL). The current DO prototype is intended to be extended with additional features as the work on the decision format progresses.

VIII. TOOL USED

In my research work for the Design of a Clinical Decision Support System Based on ontology learning for Diabetes & Malaria Disease MATLAB as a tool will be used.

IX. CONCLUSIONS

In this paper, we developed a Symptoms Based Clinical Decision Support System for diagnosing tropical diseases. The knowledge-based approach used in this research is a powerful Soft computing technique to address the issue of uncertainty in medical data. Without sound diagnosis, medical practice is as good as guess work. Decision support systems for patients based on symptoms have a goal of generating a decision or finding the optimal treatment based on a treatment protocol. These systems achieve this goal by educating the patient about the options and outcomes for a disease and revealing to the patient the implications of his or her preferences for their choice of a treatment. Throughout this process, the system attempts to help the patient to understand the significant outcomes, how his or her preferences may differ from other's and the effect those preferences should have on the specific treatment option being evaluated by the system

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