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Review: Multi-agent Expert System for Recommendations in Self-Management of Diabetes

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Abstract: ***The development of expert system for treatment of Diabetes disease by using natural methods is new information technology derived from Artificial Intelligent research using ESTA (Expert System Text Animation) System. The proposed expert system will contain knowledge about various methods of natural treatment methods (Massage, Herbal/Proper Nutrition, Acupuncture, Gems) for Diabetes diseases of Human Beings. The knowledge for the said system will be acquired from domain experts, texts and other related sources. The goal of multi-agent systems research is to find methods that allow building complex systems composed of independent agents who, while operating on restricted knowledge and owning only limited abilities, are nevertheless capable of performing the desired global behaviors. Self-monitoring of Blood Glucose (SMBG) and Diabetes related disease. In comparison with the other expert systems invented to manage blood glucose level, this expert system includes different aspects of diabetes and is usable for both experts and diabetes patients.***

I. INTRODUCTION

Diabetes education is effective for improving clinical outcomes and quality of life, at least in the short-term. An expert system is a software system created in a way as to be able to use the ability of the user in dealing with problem successfully. It is divided into two parts, one fixed, independent of the expert system: the inference engine, and one variable: the knowledge base. The system uses knowledge and information of an expert and a set of rules which defined by a knowledge engineer to begins a process for the purpose of inferring a problem. DSME has been shown to be most effective when delivered by a multidisciplinary team with a comprehensive plan of care. Within the multidisciplinary team, team members work interdependently, consult with one another, and have shared objectives. The team should have a collective combination of expertise in the clinical care of diabetes, medical nutrition therapy, educational methodologies, teaching strategies, and the psychosocial and behavioral aspects of diabetes self management.

The first well known medical expert system developed by Short life at Stanford University to help doctors, not expert in antimicrobial drugs, prescribe such drugs for blood infections. These expert systems represent the expertise knowledge as data or rules within the computer. These rules and data can be called upon when needed to solve problems. Books and manual guides have a tremendous amount of knowledge but a human has to read and interpret the knowledge for it to be used. A computer program designed to model the problem solving ability of a human expert. Expert systems and Artificial intelligence encompasses such diverse activities as game playing, automated reasoning, natural language, automatic programming, machine learning, robotics and vision, software tools, modeling human performance and expert systems for complex decisions. Complex Medical decisions are central in each phase and our system help to solve this field of expert system. Easy Diagnosis is expert system software that provides a list and clinical description of the most likely conditions based on an analysis of your particular symptoms. Easy Diagnoses focuses on the most common medical complaints that account for the majority of physician visits and hospitalizations. It has a poorly designed user-interface, the user is required to answer a large number of questions without

any notion that gives him the feeling that his data is accepted and will be diagnosed. PERFEX is a medical expert system that support solving problems clinicians currently have in evaluating perfusion studies. The heart of the PERFEX system is the knowledge-base, containing over 250 rules. DXplain is a decision support system which uses a set of clinical findings (signs, symptoms, laboratory data) to produce a ranked list of diagnoses which might explain (or be associated with) the clinical manifestations. PUFF is an expert system for the interpretation of pulmonary function tests for patients with lung disease.

To help meet the goals a expert system variety of treatment methods are employed. Lifestyle changes, including dietary and exercise, as well as quitting smoking, remain of paramount importance to good blood sugar, cholesterol and blood pressure control in diabetes. According to clinical trial results, lifestyle changes appear to be as or more effective than insulin therapy for people with poorly controlled diabetes. 11 Patients with Diabetes Mellitus (DM) are encouraged to have no more than 7% of their dietary calories come from fat, and to eliminate trans fats. Limiting carbohydrate intake to reduce blood glucose and monitoring the glycemic index and/or glycemic load (see below) of carbohydrates are helpful as well. Caloric restriction (eating less) is recommended if weight loss is necessary.

II. Literature Review and Related Work

Medical diagnosis expert systems have been an interesting topic for many researchers since introduction of MYCIN in 1970 decade. They have been used in psychiatric treatment, prostate cancer diagnosis, lung disease diagnosis, oncology and even selecting surgical candidates. There are some expert system in Maxillofacial diagnosis too, most notably, ORAD which is a Bayesian belief network oral lesions diagnostic expert system. Some other oral expert systems are COMRADD and ICOHR. Usual approaches in designing expert systems consist of rule- based expert systems, Bayesian belief networks, fuzzy logic expert systems and artificial neural networks. We will have a short overview of each approach and discuss their weak and strong points. Rule-based Expert Systems are the _rst approaches taken in developing a medical expert system. However their mandatory questions which are crucial for diagnosis, put limitations on their usage.

Cranfield and Pan [9] described relations between model-driven architecture and ontology engineering. By using ontology, Weng and Chang [10] constructed user profiles in research and then made a research document recommendation. Lee et al. [11][12] proposed an ontology-based intelligent decision support agent for capability maturity model integration (CMMI) applications and an automated ontology construction for unstructured text documents. Yager and Petry developed a multicriteria approach to data summarization using concept ontologies and a framework for the resolution of apparently contradictory evidence for decision making. Buche et al. [15] designed a fuzzy querying scheme for incomplete. Grelle etal. [19] proposed an architecture using the agent paradigm as a simple and powerful bridge to design a complex hybrid control environment. Lee and Wang designed an ontology-based intelligent healthcare agent for respiratory waveform recognition.These kind of expert systems present good results for problems which cannot be formalized very well. The major problem in developing a medical decision support neural network is its dependency on large number of training cases which are required to gain a good diagnostic ability. These large number of training cases may not always be available.

III. Proposed Work and Objectives

Computer agents are usually implemented to be selfish/self interested by lots of researchers, e.g., game theorists, economists, ecologist etc. The selfishness has become a tacit aspect of agents. When selfish agents interact with each other, MAS coordination appears. Coordination is thus considered as an intrinsic property of agents in performing some activities. Diabetes self-management education (DSME) is the ongoing process of facilitating the knowledge, skill, and ability necessary for diabetes self-care. This process incorporates the needs, goals, and life experiences of the person with diabetes and is guided by evidence- based standards. The overall objectives of DSME are to support informed decision-making, self-care behaviors, problem-solving and active collaboration with the health care team and to improve clinical outcomes, health status, and quality

of life. In this paper, a doctor or a person capable of managing diabetes is considered to be the expert. The inputs of the expert system are the values.

For developing the expert system first we have to identify the problem and its behaviors. This expert system is a software system created in a way as to be able to use the ability of the user in dealing with problem successfully. It is divided into two parts, one fixed, independent of the expert system: the inference engine, and one variable: the knowledge base. The system uses knowledge and information of an expert and a set of rules which defined by a knowledge engineer to begins a process for the purpose of inferring a problem. The problem could probably be information or data collected in a study. The semantic fuzzy decision making mechanism then executes the fuzzy inference rules to make a decision on the possibility of individuals suffering from diabetes and to present the knowledge with semantic descriptions. Finally, the results are stored in the diabetes decision support repository. Experimental results indicate that the proposed method can analyze data and further transfer the acquired information into the knowledge to simulate the thinking process of humans.The proposed expert system includes 4 internal separate sub-expert systems:

Section 1: Body weight and daily energy and macronutrient requirements assessment. This section contains two parts. One part determines daily requirements of calorie, carbohydrates, proteins and fats based on patient's weight, height, age, gender and physical activity level. Proteinuria is a condition of presence of protein in the urine and is the predictor of diabetes nephropathy. People with proteinuria have to consume less protein. In this case, system calculates protein lower than that of the same condition according to engineer-defined rules. Another part of this section calculates BMI (body mass index) and body fat percent and compares them with defined ranges. In the case of overweight or obesity system declares what the normal ranges of weight and body fat percent are. After that, patient can get some weight reduction advices according to the sample code in and correspondent recommended message will be visualized to the user **.**

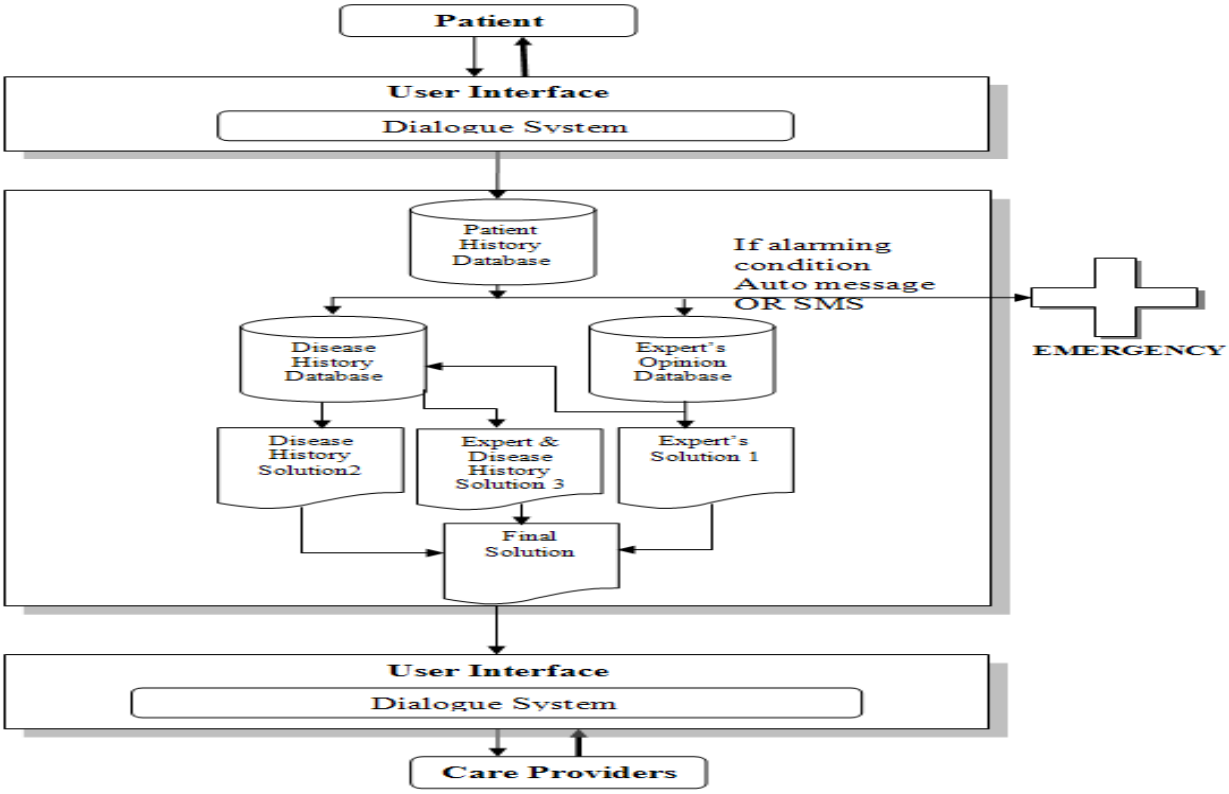
Section 2: Hypoglycemia and hyperglycemia symptoms. When hypo- or hyperglycemia develops different symptoms may occur. In this section if the patient mark the symptoms he/she experiences, the system is able to guess to which condition (ex: hyperglycemia) the symptoms may be related. It declares the patient his/her status and asks for blood glucose monitoring. Then the knowledge-based part and interface engine will provide the user with recommendations according to the level of the blood glucose .The recommendations are based on the type of diabetes (type 1 or type 2).

Section 3: Self-monitoring of Blood Glucose (SMBG). SMBG is an important component in effective and safe diabetes management. Patients may perform SMBG before meals, 1 to 2 hours after meals, at bedtime and during the night or whenever needed to know whether symptoms are caused by hypo- or hyperglycemia.

Section 4: Diabetes associated disease. Last section of this expert system contains a database of diseases which are associated with diabetes or may develop as a result of it such as overweight/ obesity, hypertension, hyperlipidemia, hypothyroidism, heart disease, celiac disease, gastroparesis, and diabetic neuropathy. If each of these problems is chosen, the related nutrition recommendations appear. Also definitions of key terms are available**.**

An multi-agent system (MAS) is a coupled network of software agents that interact to resolve problems that are beyond the individual capacities or knowledge of each expert. A multi-agent system consists of several agents interacting reciprocally with other agents both within themselves, knowledge and with their surrounding environment. An agent is either a digital computer program or a program capable of independent action. In other words, the agents are autonomous. Agents either compete through negotiation, or cooperate in a distributed problem-solving scenario. Multi-agent decision systems is the agents participating in the system must together make some joint decisions. This provides a framework for researchers to adopt when they analyze, design and implement agent-based system in social environments. In this paper type of diabetes is information the system uses to conduct proper recommendations in hypo- or hyperglycemic conditions. Moreover, by using signs and symptoms of hypo- or hyperglycemia and patient's blood glucose level this system is able to make proper recommendations. By encompassing

different aspects of diabetes and ease of use, this expert system is usable by both experts and diabetes patients. But there are some obstacles for patient usage. Fundamental obstacles are accessibility to the technology and patient computer skills. As a result in comparison with the other expert systems which designed and based on diabetes studies, there is not much relevance between proposed expert system and others; hopefully we will provide comparative results and statistical analysis based on this software in our future works.



It consists on user interface, database, database management tool and MAS model to analyze the results. In proposed MAS, patient interacts with the user interface. If there is alarming conditions then system will call the emergency automatically. Otherwise system appends the current information with the history of patients disease and start matching it with diabetes cases in the past. Then after, it selects the most similar case with the optimal solution (including diet and exercise plan) of the case, at the same time the system get the optimal solution (including diet and exercise plan) from the database of expert opinion database according to the patients conditions. Now the solution from experts opinion database is matched with the diabetes cases history database to find, where the experts solution had been applied in history? What were the conditions of patients? And what was the output of the solution? All three solutions (disease history, experts opinion, experts opinion plus Disease history) compared and combined into one report. That report sends to relevant care providers (doctor, nutritionist, exercise instructor). They will take final decision and sends to patient and other care providers of the patient. User interface is way of communication between the users and MAS. It deals with ease of use, accessibility and human machine interaction. User interface of MAS in Diabetic eHealth Care is user friendly, as most users of are elderly patients of diabetes with low computer skills. MAS interface follows the design principal in order provide more flexibility and ease of use to diabetes patients as most of patients are elders and they are not much familiar with computers.

IV. APPLICATION

- The Proposed system will enable a patient to find out the diseases and gives the basic instruction of diet and exercise at home that improves the quality of patient's life.
- It provides the intelligent decision support both to care providers and patients. Due to this, some unnecessary visits to care providing centers may be avoided.

- It also decreases the communication problems of the diabetes health-care management and health care centers provide the higher quality of health-care at lower cost.

- MAS in Diabetic eHealth Care provides the 24-hours services to the patients of Diabetes. Patient can access the IDSS from anywhere and anytime with help of web services or mobile services.

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