International Journal of Information, Control and Computer Sciences
ISSN: 2517-9942
Vol:3, No:12, 2009

# A Hybrid Technology for a Multiagent Consultation System in Obesity Domain

Rohana Mahmud, Hairul Aysa Abdul Halim Sithiq, and Haryuna Mohd Taharim

***Abstract*—**In this paper, the authors present architecture of a multi agent consultation system for obesity related problems, which hybrid the technology of an expert system (ES) and an intelligent agent (IA). The strength of the ES which is capable of pulling the expert knowledge is consulted and presented to the end user via the autonomous and friendly pushing environment of the intelligent agent.

***Keywords*—**Expert System, Hybrid Technology**,** Intelligent Agent, Medical Informatics, Multi Agent Consultation System.

## I. Introduction

ALTHOUGH various software applications have been constructed in diverse areas of knowledge, it continues to be a necessity for software products to exchange messages and services between one another. Due to the nature of these problems, the solutions have to be distributed. A single agent would require a substantial knowledge and, in some cases, the problem is quite complex that a single agent cannot solve it [1], as is the case in Artificial Intelligence (AI) applications in obesity domain, which requires the use of multiagent system that share knowledge and expertise to solve problems related to obesity.

With the increasing speed of data and advances in medical informatics research, we believe we will continue to generate, manage and harvest biomedical knowledge effectively and efficiently, allowing us to better understand the complex biological processes of life and assist in addressing the well-being of human kind [2].

The aim of this research is to study the potential of hybrid multiagent with expert system capable of diagnosing symptoms and provide consultation related to obesity problems.

In the multiagent consultation system, the employment of hybrid technologies (1) pull technology; and (2) push technology allows an agent to cooperate efficiently in solving problems and share expert knowledge. It is important that the system is accurate in diagnosing symptoms because it deals with a life of a person [3].

Obesity is considered a chronic non-communicable disease, like diabetes, cardiovascular diseases and cancer. Such diseases are currently the principal causes of death in both developed and developing countries, thus making them the largest contemporary public health problem [4], [5] but these are often curable at local levels if proper diagnosis and treatment plans are given adequately [6].

Studies on weight-related problems have shown that having knowledge and information about obesity, increases awareness and produce reductions on weight status through the modification of healthy lifestyle and physical activities for body fitness and other medical treatment [7]. Tackling the problem is a challenge that goes far beyond giving out healthy lifestyle messages. New approaches are needed to address the challenge of preventing and treating obesity.

In such a scenario, software agents provide a realistic solution. Software agents are proving to be promising because of their reactive, proactive, autonomous, collaborative and knowledge sharing capabilities [6]. With rapid emerging of information and communications technology in the home and work environments, the provision of medical informatics application e.g. multiagent consultation system will capture the knowledge and experiences of the experts and make them available to end user in a convenient and consistent way.

This paper is organized as follows: after the introduction, a brief about the hybrid technology will be explained. Section 3 covers the user requirements for multiagent consultation system, followed by an overview of system architecture and prototype. Finally, the conclusions are drawn.

## II. The Hybrid Technology

### *A. The Expert System: Pull Technology*

There are various techniques on implementing the expert system [3] but the most important part is, how best to present information e.g. should it be sent to the user (push), or should it wait until the user seeks it (pull) [8].

Expert system provides end user with structured questions and structured responses within specialized domain knowledge or expertise, mainly quite narrow fields of medical expertise, but had problems to cover broader areas of expertise. Some of the problems related with the expert systems are their limitation: flexibility, adaptability and cooperation capability. The endowment of the expert systems with cooperation capability is an important research direction [9], [10].

R. Mahmud., is with the Artificial Intelligence Department, University of Malaya, Kuala Lumpur, 50603 Malaysia (e-mail: rmana@um.edu.my).

H. A. A. H. Sithiq, is with University of Malaya, Kuala Lumpur 50603 Malaysia as Research Assistant (e-mail: mygirl_asha@hotmail.com).

H. M. Taharim, is with the University of Malaya, Kuala Lumpur 50603 Malaysia as postgraduate student (e-mail: haryuna_taharim@yahoo.co.uk).

### B. The Intelligent Agent: Push Technology

Agent-based computing represents an exciting new synthesis both for AI and more generally, Computer Science [11]. Multiagent system is one of the best ways to characterize or design distributed computing systems [12], [13]. There are several benefits of using the intelligent agent paradigm for software systems. Agent can provide (1) a high level of abstraction for dealing with intelligent systems [10]; (2) high-level 'human-like' interface [14]; and (3) allowing interconnection and interoperation of multiple existing legacy systems such as expert systems which enable them to cooperate in solving problems and share expertise [15].

The multiagent system employs hybrid technologies: the pull and push approaches, responsible (1) for producing diagnosis of symptoms based on a set of input observations; and (2) considering a possible causes of this symptoms to identify the possible treatment plan.

## III. THE USER REQUIREMENTS

A careful analysis of a questionnaire that has been conducted recently, has led us to the following overview of the topics involved in the computer-based consultation system (Fig. 1).

As shown in fig 1, a total of 20 people with weight problems participated in filling up questionnaire. Finding indicates that 15 people are familiar with the computer-based applications and prefer if the system can provides a dietary daily plan details according to their problems. However, only 50% are comfortable using online system for consultation related to obesity problems, whereas the others would prefer to see doctor or use kiosk.

Mixed application system seems to be the most popular application type because it combines text, voice and multimedia elements, which provides a friendly interface to the user. On top of that, link to other related website would help user to understand more on the system instead of providing explanation facilities.

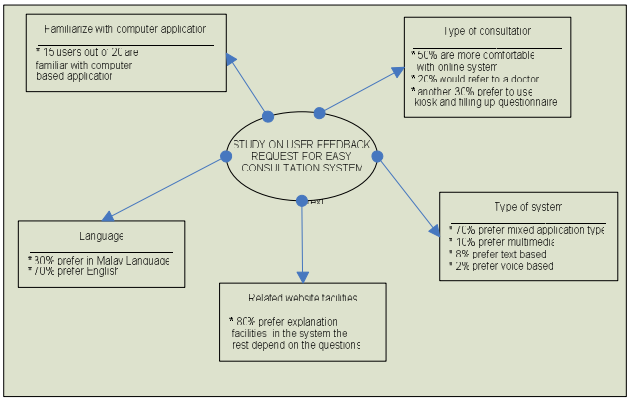


Fig. 1. Users' feedbacks for The Consultation System

## IV. THE ARCHITECTURE AND THE PROTOTYPE

In this section an overview of the proposed hybrid agent technology is provided (Fig. 2), followed by a prototype of a multiagent consultation system (Fig. 3).

### A. The Hybrid Agent Architecture

The proposed multiagent system is constructed with the following components as presented in (Fig. 2). It consists of society of agents, namely (1) a Diagnosis agent (2) a Treatment agent (3) a Collaboration agent and (4) an User interface agent:

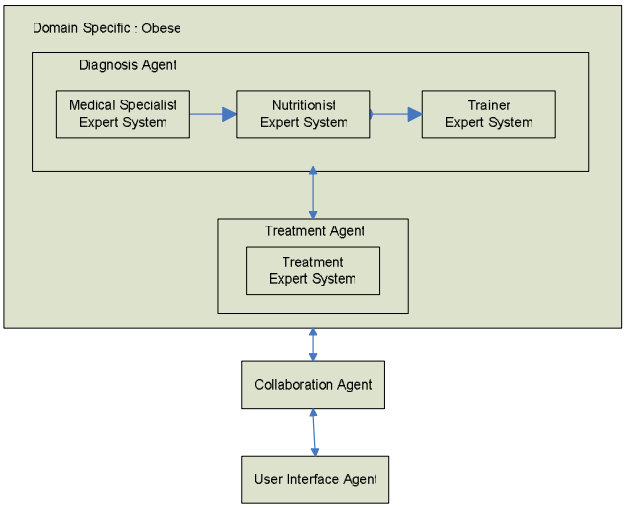


Fig. 2. The Hybrid Agent Architecture

The first component; (1) The Diagnosis agent is responsible for providing the expertise knowledge, which is distributed according to the agent's type [16], e.g. (i) Medical specialist expert system contains medical expertise knowledge about obesity related problems including the symptom, the causes and the diseases (ii) Nutritionist expert system agent contains information about nutrition and diet intake, which are essential for good health. It also help calculates the Body Mass Index (BMI) in measuring body fat based on height and weight (iii) Trainer agent contains information about physical activities and exercises related to obesity problems.

The next component; (2) The Treatment agent will be consulted after a successful diagnosis session. This agent corresponds to diagnosis results and suggests a possible treatment plan. It considers different types of treatments, which is focuses on symptoms given by the user. In addition, it provides advices and guidelines to its user.

Both diagnosis and treatment agents employ inference engine with both forward and backward chaining, which pull the expertise knowledge in order to come out with an appropriate diagnosis result and generate the possible treatment plan and advice.

The third component; (3) The user interface agent will provide access to the diagnosis and treatment agents. Based on the pushing technology, it plays a crucial role in fostering

the awareness of a user's healthy lifestyle and assisting a sustained interest in health topics related to individual needs [7]. Two friendly approaches are explored in making sure the users are able to easily communicate with the multiagent system, which are (a) image-text mapping and (b) lexical relation ontology.

Image-text mapping technique considers the use of image based interface in order to support the appropriate form of interaction between system and user. A rapid growth of agent technology applications has generated a need for systematically designing interactions between the users and agent teams [16]. Because of the agents perform tasks on behalf of the human user, e.g. information processing, therefore,[17] user interface should be designed in a way that allows the user interacting with the agents to clearly know what an individual agent is currently doing, when intervention is necessary, and what information is needed to make effective interventions.

The ontological approach presents the description of the knowledge in the ontological form and will integrate with the domain knowledgebase. For instance, it defines the lexical called "hypertension", which will automatically indicate the concept and attribute of "high blood pressure" common name. This clinical concept is useful and has been used for a variety of purposes, vocabularies, structured data entry and decision support.

The final component; (4) The collaboration agent will integrate all the knowledge bases of the expert systems in the diagnosis and treatment agents. It also functions as the interface between the user interface agent and other agents.

### *B. The Prototype: Multiagent Consultation System for obesity problems*

In the research, the first version of the prototype of the Multiagent consultation system is developed for the obesity related problems domain. It collaborates and integrates two different types of expertise, which are male obesity domain and female obesity domain. It is presented in the following Fig. 3.

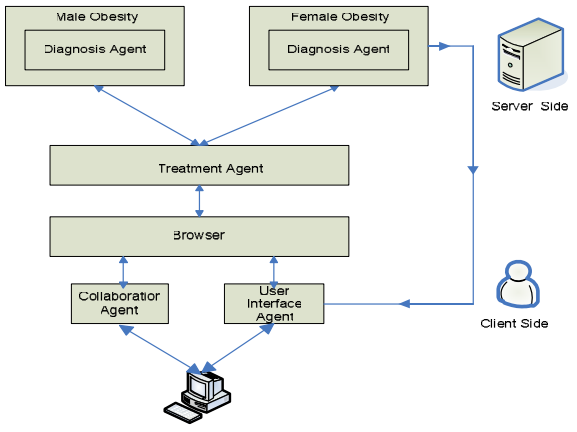


Fig. 3. Architecture of a Multiagent Consultation System

In the prototype, the user communicates with the system through user interface agent, which is working on the client side. Later, the details are spread among the agents at the server side to analyze and produce possible causes contribute to obesity problems.

During diagnosis process, the symptoms classes are elaborated to suspect certain diagnoses. After clarification of the suspected diagnoses, adequate therapies can be determined.

The collaboration agent receives the result and transfers it to the user interface agent. If the user requests for a treatment, the treatment agent attempt to get a possible treatment plan according to the diagnosis results and send it back to collaboration agent, that will transfers it back to user interface agent.

Multiagent consultation system for obesity related problems interface links image of each human body group to a query page related to symptoms and diseases in obesity domain, e.g. when user selects region of human body part which they think they have problems, a set of queries regarding a symptoms of diseases related to obesity connected to that part of body region will be given for user to answer. The lexical relation ontological knowledge base will be referred during treatment process to give further details and explanation facilities.

Based on the architecture discussed in Section A, the flexibility of the hybrid technology allows any addition or deletion of a domain expertise agent without corrupting any other components, for eg. a Child obesity domain diagnosis agent can be added when improving the prototype to the second version.

## V. Conclusion

This paper has shown the architecture and the development of a multi agent consultation system in the obesity domain. The system is available to assist users who have obesity problems. It helps to advise people in being aware of good practices for fitness and good health. However, further work has to be done especially in acquiring the expertise knowledge before implementing the commercial multi agent consultation system.

## Acknowledgment

First and foremost, we offer our sincerest gratitude to our supervisor, who has given us her support, knowledge, encouragement and effort. Without her, this paper, would not have been written or completed. The research is funded under the University of Malaya Short Term Research Grant.

## References

[1] M. B. Geszychter, B. Wilges, S. Nassar, F. Gauthier, "A Model of a Multi-agent Web System for Integration in Expert Systems", *Control and Automation, and International Conference on Intelligent Agents, Web Technologies and Internet Commerce (CIMCA-IAWTIC'06)*, 2006.

[2] H. Chen, S. S. Fuller, W. Hersh, C. Friedman, "*Medical Informatics: Knowledge Management and Data Mining in Biomedicine*"(Book style). Springer, 2005.

[3] R. M. A. Mateo, B. D. Gerardo, J. Lee, "Healthcare Expert System Based on the Group Cooperation Model," *International Conference on Intelligent Pervasive Computing*, 2007.
[4] *Diet, nutrition and the prevention of chronic diseases*, Geneva: World Health Organization/Food and Agricultural Organization, WHO Technical Report Series, p. 916, 2002.
[5] F. Adami, F. Guedes de Vasconcelos, "Childhood and adolescent obesity and adult mortality: a systematic review of cohort studies," Cad. Saúde Pública vol.24 suppl.4 Rio de Janeiro, 2008.
[6] V. K. Mago and M. S. Devi, A Multi agent Medical System For Rural Infant and ChildCare":IJCAI, 2007.
[7] C. Snae and M. Brueckner, "Personal Health Assistance Service Expert System", In Proc. of *World Academy of Science, Engineering and Technology*, vol. 26, ISSN. 2070-3740, 2007.
[8] R. Jones, et al, "What Is eHealth: A Research Agenda for eHealth Through Stakeholder Consultation and Policy Context Review", J Med Internet Res, doi: 10. p. 2196, 2005.
[9] B. Iantovics, "Medical Multiagent System"Scientific International Conference in Interdisciplinary in Engineering, 2007.
[10] M. Wooldridge, G.M.P. O'Hare, and R. Elks, "FELINE-A case study in the design and implementation of a co-operating expert system", In Proc. of the international Conference on Expert Systems and their Applications, Avignon, 1991.
[11] N. R. Jennings, N. R., "*On Agent-Based Software Engineering"*, *Artificial Intelligence 117*(Book style)", Elsevier Press, 2000, pp. 277-296.
[12] K. Shaalan, M. El-Badry, A. Rafea, "A Multi Agent Approach for Diagnostic Expert System Via The Internet: Expert with Applications" vol. 27, pp:1-10, 2004.
[13] M. N. Huhns and L. Stephens, "*Multiagent Systems and Societies of Agents*(Book style)", A Modern Approach to Distributed Artificial Intelligence, Cambridge, MA:MIT Press, 1999, pp. 79-120.
[14] R. Moore, J. Dowding, II. Bratt, J. M. Gawron, Y. Gorfu, and A. Cheyer, "CommandTalk: A Spoken-Language Interface for Battlefield Simulations", In Proc. of *the fifth conference on applied natural language processing*, Washington DC, Association for Computational Linguistics, pp. 1-7, 1997.
[15] II. S. Nwana, "Software Agents: An Overview, *The Knowledge Engineering Review*, vol. 3, pp. 205-244, 1996.
[16] G. Buscher, J. Baumeister, F. Puppe, and D. Seipel, "User-Centered Consultation by a Society of Agents", *K-CAP'05*, 2005.
[17] J. Scholtz, "*Evaluation methods for human–system performance of intelligent systems*", In Proc. of the Performance Metrics for Intelligent Systems (PerMIS) Workshop.