

# An Introduction on Internet Agent Technology in Basic Healthcare

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## **Abstract**

The purpose of this study is to introduce internet agent technology in basic healthcare part. Firstly, this study is to suggest a general outline of healthcare and the contents about application of internet agent technology to healthcare. Especially, this research will try various studies from the aspect of agent technology, which is being issued recently. Also, for concrete analysis, this study will analyze the architecture of healthcare applying agent, which will give a huge influence to internet business. Healthcare service is a human based service. However which way the service will be suggested if this health care service relates with information technology could be seen. Since many healthcare services applying internet are attempted, this research will be able to lead suggestions from many aspects.

## **INTRODUCTION**

The purpose of this study is to examine IT(Information Technology) in health care service. Especially the research will try out various studies from the view of 'Agent Technology', being recently issued. And as for a more concrete analysis, the study will analyze new health care service applying agent, which will give a huge influence to the Internet business.

The health care service is a non-

mechanic, human-based service. We will see what possible suggestions or advises can be made to the health care service if it adapts "Agent Technology". Because many health care services using IT have been attempted over the recent years, this study will hopefully be able to come up with good suggestions from different aspects. Especially, this study is about the interface agent of various agents. Interface agents emphasize autonomy and learning in order to perform tasks for their owners.

Finally, inequality (information asymmetry) between producer (physician) and consumer (patient) in health care service will be decreased by introduction of this agent technology.

### **Agents Definition and Typology**

Intelligent agent is a new paradigm for developing software applications. More than this, agent-based computing has been hailed as 'the next significant breakthrough in software development' and 'the new revolution in software'<sup>1)</sup>. Currently, agents are the focus of intense interest on the part of many sub-fields of computer science and artificial intelligence. Agents are being used in increasingly wide variety of applications, ranging from comparatively small systems such as email filters to large, open, complex, mission critical systems such as air traffic control. At first sight it may appear that such extremely different types of system can have little in common.<sup>2) 3)</sup>

Nwana and Ndumu(1998) identify seven types of agents:<sup>4)</sup>

1) collaborative agents: collaborate agents emphasize autonomy and cooperation with other agents in order to perform tasks for their owners in open and time-constrained multi-agent environments.

2) interface agents: interface agents emphasize autonomy and learning in order to perform tasks for their owners. Maes (1994) points out that the key metaphor underlying interface agents is that of a personal assistant who is collaborating with

the user in the same work environment.

3) mobile agent: mobile agents are software processes capable of roaming wide area networks such as the www, interacting with foreign hosts, performing tasks on behalf of their owners and returning 'home' having performed the duties set them.

4) information/Internet information agents perform the role of managing, manipulating, or collating information from many distributed sources. Information agents are defined as to what they do, in contrast to collaborative or interface agents, which are defined by what they are.

5) active agents : reactive agents respond in a stimulus-response manner to the present state of the environment in which they are embedded.

6) hybrid agents : the hybrid agent refers to both the deliberative and the reactive functions of agents. For instance, they use the reactive functions for faster response times and adaptability.

7) smart agents : smart agents are heterogeneous agent systems in an integrated set-up of at least two or more agents that belong to two or more different agent-classes. It may also contain hybrid agents.

## **PROTOTYPING OF INTERFACE AGENT**

### **1. Introduction of interface agent**

Interface agents emphasize autonomy

and learning in order to perform tasks for their owners. Pattie Maes(1994), a key proponent of this class of agents, points out that the key metaphor underlying interface agents is that of a personal assistant who is collaborating with the user in the same work environment<sup>5)</sup>.

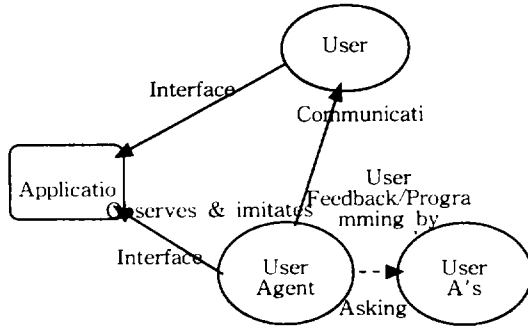


Figure 1. How Interface Agents Work (Source: Maes, 1994)

Fig 1 depicts the functioning of interface agents. Essentially, interface agents support and provide assistance, typically to a user learning to use a particular application such as a spreadsheet or an operating system. The user's agent observes and monitors the actions taken by the user in the interface (i.e. 'watches over the shoulder of its user'), learns new 'short-cuts', and suggests better way of doing the task. Thus, the user's agent acts as an autonomous personal assistant which cooperates with the user in accomplishing some task in the application. As for learning, interface agents learn typically to better assist its user in four ways (Maes, 1994) all shown in Fig 1:

- By observing and imitating the user

(i.e. learning from the user):

- Through receiving positive and negative feedback from the user (learning from the user);
- By receiving explicit instructions from the user (learning from the user);
- By asking other agents for advice (i.e. learning from peers).

And there is a case study for face characteristics of interface agents. Interface agents will serve as our colleagues that help us to deal with information overload in the new future. Current human-machine interface with direct manipulation will be replaced by the new agent-based interface with indirect management. Graphical representation of agents is the key to make users feel at ease with cooperative work with agents<sup>6)</sup>.

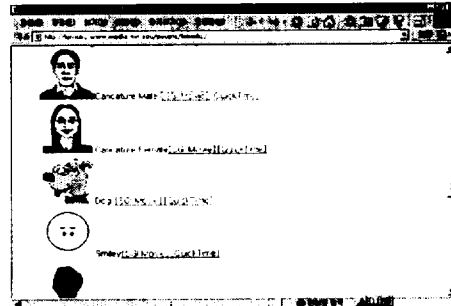


Figure 2. Interface agent for face characteristics

In addition, as a case of internet agent, chatting agent was proposed [vperson.com]<sup>7)</sup>. The following Fig 3 is the site scene for vperson.com and by the natural processing technology, the communication(chatting agent) can be performed.



Figure 3. Vperson.com site

## 2. Current study of Agent Technology in healthcare

For the purposes of simplicity, It could be classified the process of medical diagnosis and treatment of disease into the following six categories<sup>9</sup>

1. Diagnosis-the understanding and identification of the problem.
2. Treatment-a set of procedures identified to correct the illness identified in diagnosis.
3. Recuperation-the process of recovering from the treatment and diagnosis.
4. Follow-up-a set of monitoring procedures that occur after treatment and recuperation to ensure that the solution is successful.
5. Administration-the management of the entire process from diagnosis to follow-up, and it refers to the process of making things happen and paying for them.
6. Education-learning about illness, preventing disease, new procedures, treatments, and so on.

In some cases, it might not be necessary

to follow all these phases when dealing with an illness. The next question that arises is, Where can agent technology be of assistance in the whole field of medicine? High-quality health care at low cost, improved outcomes, complete care coverage from the hospital to the home, and decision support for patients and health care teams are some of the crucial challenges for improving future health care worldwide. Services are being consolidated under larger enterprises of managed care where needs for primary care are rapidly displacing specialty care. Cost containment puts a strong emphasis on fewer patient visits, fewer diagnostic tests and procedures, and shorter hospital stays. The need has become acute for having up-to-date patient information readily available anywhere within the enterprise of care, including the home.

In this paper, We will introduce Guardian Angel of Agent Study<sup>8)</sup>

Current health information systems are built for the convenience of health care providers and consequently yield fragmented patient records in which medically relevant lifelong information is sometimes incomplete, incorrect, or inaccessible.

We are constructing information systems centered on the individual patient instead of the provider, in which a set of guardian angel (GA) software agents integrates all health-related concerns, including medically -relevant legal and financial information, about an individual (its subject). This personal system will help track, manage, and interpret the subject's health history,

and offer advice to both patient and provider. Minimally, the system will maintain comprehensive, cumulative, correct, and coherent medical records, accessible in a timely manner as the subject moves through life, work assignments, and health care providers. Each GA is an active process that performs several important functions: it collects patient data; it checks, interprets, and explains to the subject medically-relevant facts and plans; it adapts its advice based on the subject's prior experiences and stated preferences; it performs sanity checks on both medical efficacy and cost-effectiveness of diagnostic conclusions and therapeutic plans; it monitors progress; it interfaces to software agents of providers, insurers, etc.; and it helps educate, encourage, and inform the patient. All this serves to improve the quality of medical decision-making, increase patient compliance, and minimize disease and medical errors.

Starting in April, 1995, the Guardian Angel project received funding from ARPA to work with about a dozen other efforts also funded under John Silva's Health Information Infrastructure Program (HIIP). The initial experimental focus of GA work within the HIIP is to develop a system to aid in management of high-risk pregnancy, specifically gestational diabetes, at the OB/GYN clinic at Bethesda Naval Hospital in Bethesda, Maryland.

The current plan is to place a small number of copies of an initial GA specializing in management of gestational diabetes with patients at Bethesda by the

end of 1995. This GA version aims to provide the patient with aids and analysis related to glucometer data and use, diet, communication with the OB clinic, pregnancy information, and other issues. The system is being designed to capture evaluation information to complement retrospective subjective evaluations from clinic personnel and patients. Work is also underway on broader and more elaborate GA versions, both for civilian and military medical applications.

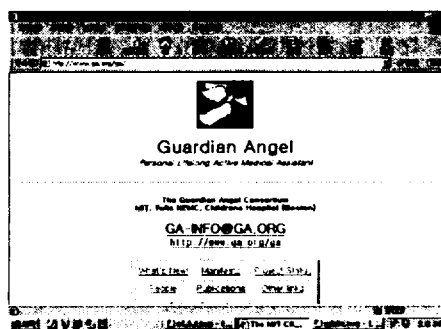


Figure 4. Guardian Angel Site  
(Source: <http://www.ga.org/ga/>)

### 3. Introduction of Interface agent named as Patientsolver

In this paper, the Interface agent, Patientsolver [[www.patientsolver.com](http://www.patientsolver.com)] for patient's guide role will be introduced. To create and develop the medical-related agent, it takes a lot of time and cost. Also, it seems too early to build the common software agent at this moment. On the other words, research on medical information agent has just started and it is very

difficult to provide the medical information to users without the actual processing steps though Internet. In addition, it is difficult to construct the agents for extensive purposes without the assistance of it.

In this study, it considers all of the limitations that we face in real world. We would hope to develop Patientsolver as an interface agent with easy-to-use functions.

The purpose of this agent is to provide medically-related information to the Internet users. Whenever the Internet users(or patients) have a question, the agent answers with a suitable medical information.

The functions of medical related interface agent are the followings:

First of all, since this agent is provided with easy-to-use process, the users won't have any problems in using the agent. What they have to do is just enter the question though this agent and the answer shows up on the monitor screen. This answer is from a specialized doctor who checks all the questions and provide answers in forms of real conversation, feeling as if he or she is discussing with a doctor in real.

Secondly, by using this agent, the background information about patients or users can be updated continuously. In this way, the doctors will be able to know their patient's health-related informations which makes it possible to take care of their health more effectively.

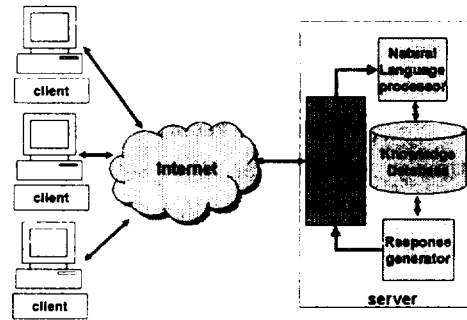


Figure 5. Relative process between client and server.

The following content is about relative process between client and server.

① Client

- Send Query presented by the natural language from server
- Show to user if receives response from server

② Server

- Input & Output module
  - : Receive the Query from Client and pass on Natural Language processor
  - : Send output by Response generator to Client
- Natural Language processor
  - : Part processing the natural language composed of Query
  - : Divide by token through parsing of Query
- Knowledge Database
  - : Database composed of the answer corresponding on the symptoms of the patient
- Response generator
  - : Form the new document sending to client in search of the relevant answer from Knowledge Database.

By adding all the functions that

mentioned before, this agent can be considered as multi-agent system. It is constructed with control agent, database management agent, and knowledge based agent. learning ability can be provided if each agent wants to have this ability.

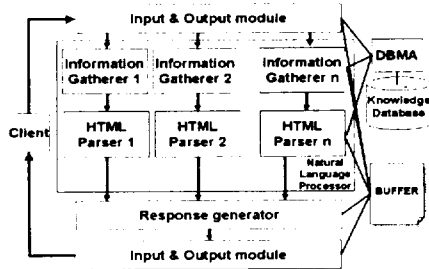


Figure 6. Architecture of Patientsolver

The function of Patientsolver agent is basically when users send a certain question concerning health, it gives medically-related information in forms of conversational language.

## RESULT

In U.S. one third of total costs in health care industry is information processing cost. Thus, Internet agent will help to decrease the cost. And IT fosters the shift from labor-intensified to capital-intensified in the health care service industry.

Since IT is essential for corporate strategy in service management, this section examines IT in health care service, especially from the view of 'Agent Technology' that has been recently issued.

This paper is about the pilot study of internet agent in health care service. Thus

this paper introduces a developing internet agent, Patientsolver, a guide for the customers. The purpose of this agent is to provide medically related information to the Internet users. Whenever the Internet users or patients have a question, it gives answers backed up with suitable and well-targeted medical information.

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