Modeling and Design of Intelligent Agent System

Dae Su Kim, Chang Suk Kim, and Kee Wook Rim

Abstract: In this study, we investigated the modeling and design of an Intelligent Agent System (IAS). To achieve this goal, we introduced several kinds of agents that exhibit intelligent features. These are the main agent, management agent, watcher agent, report agent and application agent. We applied the intelligent agent concept to two different application fields, i.e. the intelligent agent system for pattern classification and the intelligent agent system for bank asset management modeling.

Keywords: Intelligent, agent, management agent, pattern classification, bank asset management system.

1. INTRODUCTION

Recently, a more intelligent and user-friendly interface system has been introduced, in the form of an agent that can act in the place of a human being. An agent is an information processing I assumed that this was meant to be a general introductory statement program that can be applied to numerous fields.

Intelligent agents can be classified into several different categories [13]. Firstly, they can be divided into non-cooperative and cooperative intelligent agents, depending on their ability to cooperate with each other for the execution of their tasks. The second category is referred to as rational intelligent agents and comprises agents that are utilitarian in an economic sense. They act and collaborate to maximize their profit and can be applied to automated trading and electronic commerce. The third class of intelligent agents comprises adaptive intelligent agents that are able to adapt themselves and can be applied to learning personal assistants on the Web. Fourthly, mobile intelligent agents are a particular category of agents, which can travel autonomously through the Internet, and can be applied to such tasks as dynamic load balancing among information servers and reducing the volume of data transfers.

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Dae Su Kim is with the Department of Computer Science, Hanshin University, Yangsan-dong, Osan, Kyunggi, Korea. (e-mail: daekim@hanshin.ac.kr).

Chang Suk Kim is with the Department of Computer Education, Kongju National University, 182 Shinkwan-dong, Kongju, Chungnam, Korea. (e-mail: csk@kongju.ac.kr).

Kee Wook Rim is with the Department of Knowledg e Information Industrial Engineering, Sun Moon University, Tangjung-myun, Asan, Chungnam, Korea. (e-mail: rim@omega.sunmoon.ac.kr).

The field of intelligent agents has seen rapid growth over the last decade and such agents now constitute powerful tools that are utilized in most industrial applications. Recently, the use of intelligent agents has been applied to such applications as intelligent user interfaces [12, 13], autonomous agents [10, 11], vision systems [1], knowledge discovery and data mining [4], information retrieval [3, 8], electronic commerce [2], personal assistants used on the web [10], fuzzy decisions, and decision making in complex environments [14].

An intelligent agent is generally considered to be an autonomous system that can obtain synergy effects by combining a practical user interface, on the one hand, and an intelligent system based on Artificial Intelligence, Neural Networks and fuzzy theory, on the other hand.

At present, however, intelligent agents are still in their infancy, merely providing a user interface, while the implementation of intelligent agent theory and the practical application of intelligent fusion technology are still on the starting blocks.

Moreover, the problems related to the establishment of efficient connections between agents, job distribution between agents, and the handling of conflicts and errors between agents have not yet been solved. However, this kind of problem can arise in any kind of application that is based on intelligent agents.

In this paper, we investigated a model and design for an intelligent agent system, which helps the user in a user-friendly fashion. This intelligent agent system was modeled in two different applications.

2. INTELLIGENT AGENT SYSTEM (IAS)

2.1. Modeling of the IAS

The intelligent agent system described in this paper hereafter referred to as IAS, consists of 5 agents, the

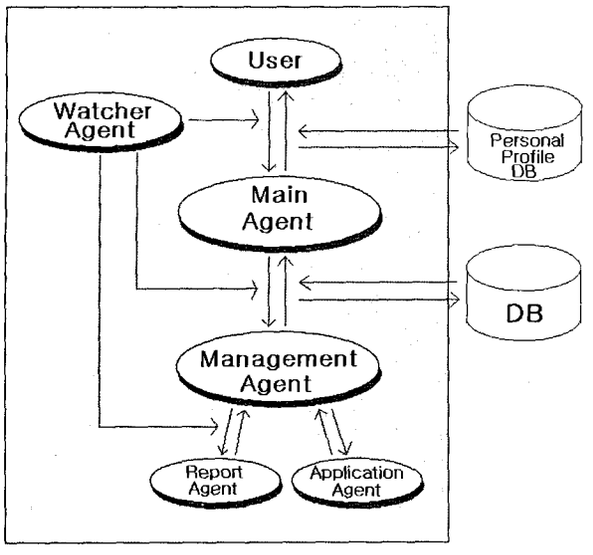

Fig. 1. Basic architecture of IAS.

main agent, management agent, application agent, watcher agent and report agent [6]. The basic architecture of IAS is illustrated in Fig. 1.

2.2. Major role of each agent

Main agent: The main agent operates in a manner designed to be very friendly to the user, by adapting itself to the situation with which it is confronted. It maintains the agent list, remembers the role of each agent and controls all of the agents. When the user first addresses the system, it explains the necessary operating procedures. It allows the user's personal profile to be input and stores it in the personal profile database. The interactions between the User and the Main Agent are illustrated in Fig. 2.

1) User interacts with main agent

2) Main agent responds in a user friendly fashion and searches for the job that the user wants to execute.

Management agent: This agent has overall control over the other agents. If it receives a message from another agent, it selects a suitable agent for the message and activates this agent. In this particular system, it acts as a fuzzy converting system, when ambiguous requests are given, and returns a tuple of fuzzy values to the next step, the banking agent.

Application agent: The application agent receives information from the management agent and performs the requested task. It also recovers information from the Goods DB.

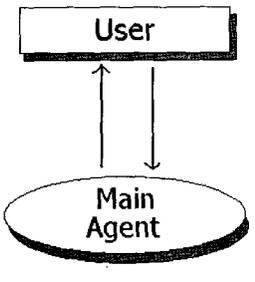

Fig. 2. Interactions between user and main agent.

Watcher agent: This agent watches for messages between agents and keeps track of which agent is currently activated. If there is a conflict between agents or if events do not occur in the right order, it sends a warning message to the user by means of a pop up window. If a fatal error occurs, it terminates the operation of the currently activated agent and returns to the previous step. It operates using a stack structure, that is, LIFO (Last In First Out).

Report agent: This agent shows the final results to the user in a very friendly way, by means of a list, graph or diagram.

3. IAS APPLICATIONS – INTELLIGENT AGENT SYSTEM FOR PATTERN CLASSIFICATION

The conceptual model of the Intelligent Agent system for pattern classification is as follows [7]. The Intelligent Pattern Classification Agent System consists of main agent and the Management Agent that has overall control over the other agents. As shown in Fig. 3, the Management Agent interacts with 4 pattern agents and one graphic agent.

Every agent has its own role and the overall control of the system is handled by the Management Agent.

3.1. Modeling of intelligent pattern classification agent system

The intelligent pattern classification system is modeled as in Fig 3. The user interacts with the main agent. The main agent, in turn, sends messages to the management agent.

The management agent interacts with several different pattern classification agents, such as those which are based on the k-means clustering algorithm, fuzzy c-means clustering algorithm, SONN clustering algorithm[5], and other clustering algorithms. The graphic agent is used to represent the graphical outputs to the user.

3.2. The role and function of the intelligent agent system for pattern classification

Several kinds of agents are required to implement the Intelligent agent system. Here, we define and implement the main agent, management agent, pattern classification agent and graphic agent as shown in Fig. 3. The roles and functions of the major agents are as follows.

Main agent : This agent helps the user to use the system more easily and efficiently. It is a kind of user interface agent, and it receives the requirement specification from the user and makes it easy for the user to access the system. It acts as an interface between the user and the management agent.

Management agent: This agent inferences the pattern class method that the user wants to use, and decides which agent to execute in which order. It handles any errors which arise between the different agents.

1) The management agent calls the pattern classification agent and orders it to perform what the user requested.

2) The pattern classification agent calls the management agent once it has completed its task, in order to inform it that the requested job is finished.

3) The management agent calls the graphic agent and displays the results.

Pattern Classification Agent: This agent receives data from the main agent and applies the pattern classification algorithm to it, in order to classify the data and the cluster center values. It sends the cluster center information to the management agent, which in turn sends the original data and the cluster center information to the graphic agent.

Graphic Agent: This agent displays the data in an appropriate graphic fashion. If the data is 2-dimensional, it displays a 2-dimensional graphic and cluster center. However, if the data it receives is 3-dimensional, it should recognize this fact, and display a 3-dimensional graphic which the user can clearly understand. If the user tried several Pattern classification methods for a given set of data, it should display several graphic results corresponding to each method which was used.

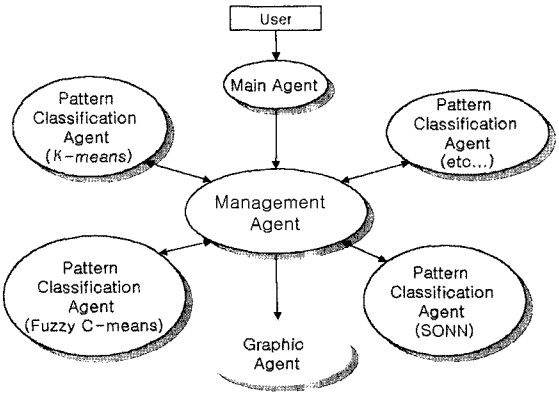

Fig. 3. Intelligent pattern classification system.

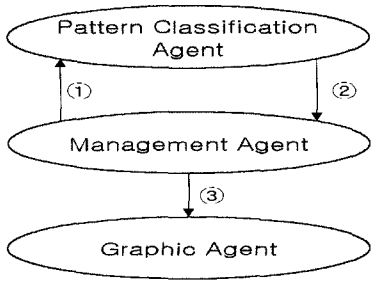

Fig. 4. Management Agent.

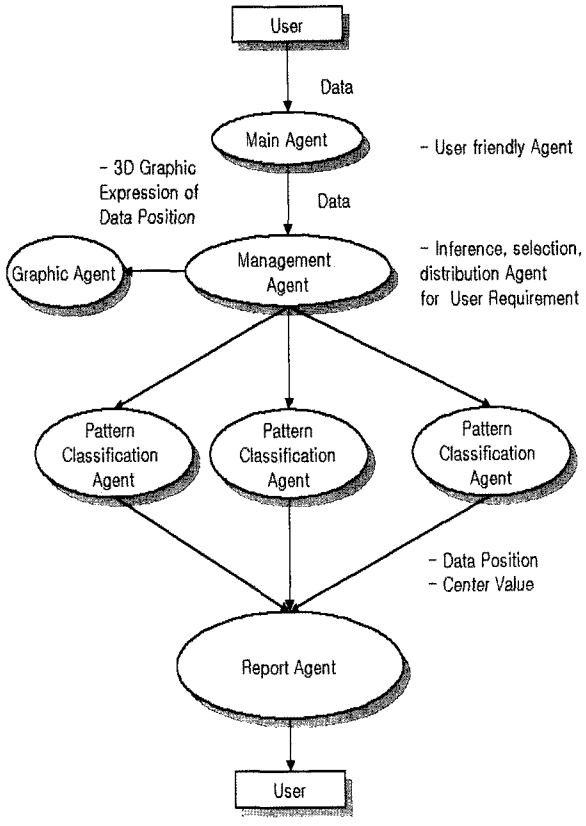

Fig. 5. Block diagram of intelligent pattern classification agent system.

3.3 Block diagram of intelligent pattern classification agent system

A block diagram of the Intelligent Pattern Classification Agent System is shown in Fig. 5.

4. MODELING OF BANK ASSET MANAGEMENT SYSTEM

4.1. System operation procedure

The sequence of operations pertaining to the bank asset management system is as follows:

1) The user logs into/addresses/enters into communication with the main interface agent.

2) The main agent calls the management agent.

At this point, ambiguous requests are converted to fuzzy measure values. Next, the main agent calls the banking agent.

3) The banking agent recovers the fuzzy table from the Goods DB. It calculates the proximity measures in the fuzzy matching system.

4) An optimal tuple list is generated in a sorted form.

5) The report agent receives the result and displays it in a user friendly fashion(list, graph, diagram, etc.).

6) If the job being processed by the report agent is completed, it sends messages to the management agent and the management agent decides whether or

not control is to be returned to the main agent, depending on whether the entire job is finished or not.

4.2. Flow diagram of bank asset management system

The overall flow diagram for the bank asset management system is depicted in Fig. 6. The major intelligent features of this system are as follows. Firstly, it operates in a very user-friendly manner. It provides overall guidance to the user as it looks like system level. Secondly, the use of a knowledge based system is adopted, and the management agent plays the key role and manages the other I wasn't sure what you meant by "it can adopt knowledge base system" and I don't see the relation with the second part of the sentence about the management agent. Thirdly, the use of a fuzzy converting system is adopted, and the fuzzy matching system provides acceptable best case matching in a reasonable way.

5. CONCLUSION

In this paper, we described the modeling and design of an intelligent agent system. We employed several different kinds of agents, each of which exhibits intelligent features.

We applied the intelligent agent concept to two different application fields, i.e. the intelligent agent system for pattern classification and the intelligent agent system for bank asset management modeling. In both cases, quite promising intermediate results were obtained.

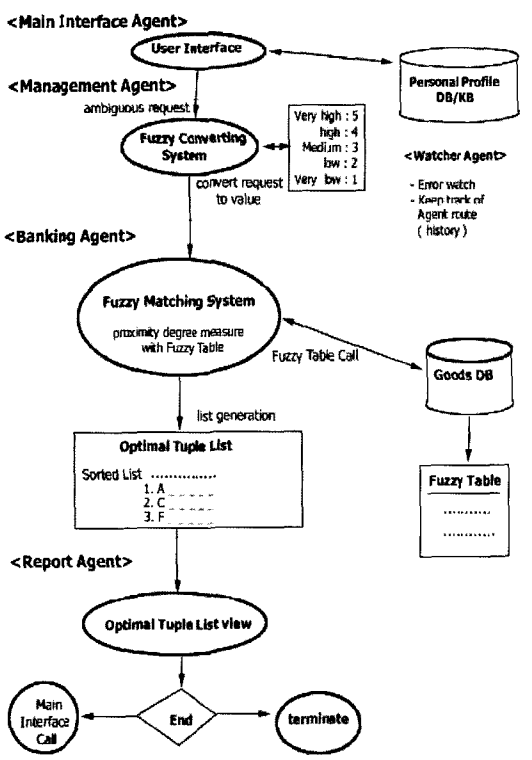

Fig. 6. Flow diagram of bank asset management system.

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Dae Su Kim received the B. S. degree from Seoul National University, Seoul, Korea in 1977, the M. S. degree in Computer Science from the University of Mississippi, in 1986, and the Ph. D. degree in Computer Science from the University of South Carolina in 1990. He was a researcher at the Intelligent lab. in U. S. A. He worked as a Senior Researcher at the Electronics and Telecommunications Research Institute in Korea from 1991 to 1993. From 1996 to date, he has been a member of the Trustee Board of the Korea Fuzzy Logic and Intelligent Systems Society. He has been an Associate Professor at the Department of Computer Science, Hanshin University, since 1993. His current research interests include Neural Networks, Fuzzy Theory, Artificial Intelligence, Intelligent Systems, Agent Modeling and Evolutionary Computing.

Chang Suk Kim received the B.S., M.S. and Ph. D. degrees in Computer Engineering from Kyungpook National University, Daegu, South Korea, in 1983, 1990 and 1994, respectively. He was a post-doctoral researcher. at University of California, San Diego. He worked for ETRI from 1983 to 1994. At present, he is an Associate Professor at the Department of Computer Education, Kongju National University, since 1998. His research interests include intelligent databases, fuzzy theory and XML based information integration.

Kee Wook Rim received the B.S. degree from Inha University, the M.S. degree from Hanyang University, and the Ph. D. degree in Computer Science from Inha University. He worked as a senior researcher at ETRI and as a TICOM development manager from 1977 to 1999. He was a visiting professor at the University of California, Irvine, U. S. A. At present, he is a Professor at the Dept. of Knowledge Information Industry, Sunmoon University and also a vice president of the Computer Software Technology Laboratory. His research interests include Real-time Database Systems, Operating Systems and System.