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Modeling of Bank Asset Management System based on Intelligent Agent

Dae-Su Kim* and Chang-Suk Kim**

*Department of Computer Science, Hanshin University
**Department of Computer Education, Kongju National University

Abstract

In this paper, we investigated the modeling of Bank Asset Management System(BAMS) based on intelligent agent. To achieve this goal, we introduced several kinds of agents that show intelligent features. BAMS is a user friendly system and adopts fuzzy converting system and fuzzy matching system that returns reasonable similarity matching results. Generation function of the proximity degree is suggested. Fuzzification of investment type categories and feature values are defined, and generation of proximity degree is also derived. An example of bank asset management system is introduced and simulated. Investment type matching utilizing fuzzy measure is tested and it showed quite reasonable similarity matching results.

Key Words: Intelligent Agent, Fuzzy Converting, Proximity Degree, Bank Asset Management System.

I. Introduction

Intelligent agents are generally considered as computational software systems that can act autonomously, and are often able to learn, react, adapt, infer, and recognize. They sometimes help their users in finding useful information and in determining reasonable decision even in the ambiguous situations[7, 10].

The field of intelligent agent has been a rapid growth last decade and now is a powerful tool in most industrial applications, Recently, it is applied to intelligent user interface[13, 14], autonomous agent[11, 12], vision system[1], knowledge discovery and data mining[4], information retrieval[3, 8], electronic commerce[2], a personal assistant of web[9], fuzzy decisions, and decision making in complex environments[15].

Intelligent agent can be classified into the following categories[14]. First, non-cooperative or cooperative intelligent agents, depending on their ability to cooperate with each other for the execution of their tasks. Second, rational intelligent agents are utilitarian in an economic sense. They act and collaborate to maximize their profit and can be applied to automated trading and electronic commerce. Third, adaptive intelligent agents are able to adapt themselves and can be applied to learning personal assistants on the Web. Fourth, mobile intelligent agents travel autonomously through the internet, and can be applied to dynamic load balancing among information servers and reduction of data transfer.

In this paper, we utilize intelligent agent as a tool for the intelligent user interface between user and computer, and it provides a systematic flow of bank asset management system.

We adopted several kinds of agents. The key point of intelligent feature of this paper is intelligent agent modeling and fuzzy matching method. We generated the proximity degree function based on the measurement theory of fuzziness[5]. The fuzzification of investment type categories and feature values are defined, and the generation function of proximity degree is also derived.

To validate the effectiveness of our model and proximity measure, we adopted an example and simulated.

II. Modeling of the BAMS

Intelligent agent based BAMS consists of 5 agents, main interface agent, management agent, banking agent, watch agent, and report agent. The basic architecture of BAMS is illustrated in <Fig. 1>.

2.1 Major role of each agent

Main interface agent : Main interface agent operates very friendly to the users depending on the situations. It maintains the agent list and remembers each role of agent and controls all the agents. When the user enters,

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it explains the necessary procedures to use the system. It receives user's personal profile and stores it to the personal profile database.

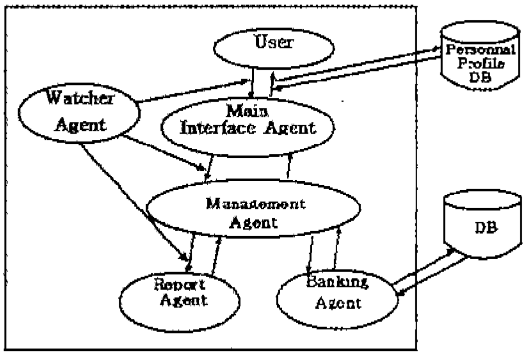

Fig. 1. Basic architecture of BAMS architecture

Management agent : It controls the overall agents. If it receives a message from other agents, it selects a suitable agent for the message and activates its operation. 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, banking agent.

Banking agent : Banking agent receives the quadruple from the management agent and does the fuzzy matching. It takes the fuzzy table list from the Goods DB and compares it with the given quadruple. The proximity degree is measured and an optimal tuple list is produced.

Watch agent : It watches messages between agents and remembers which agent is currently activated. If there is a conflict between agents or not in the right order, it sends a warning message to the user by means of pop up window. If there is a problem, it finishes the operation of the currently activated agent and returns to the previous step. It operates as a stack structure, that is, LIFO(Last In First Out).

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

2.2 System operation procedure

[1] User enters to the main interface agent.

[2] Main interface agent calls management agent. Here ambiguous requests are converted to fuzzy measure values. Next it calls banking agent.

[3] Banking agent take fuzzy table from the Goods DB. It calculates proximity measure in the fuzzy matching system.

[4] An optimal tuple list are generated in a sorted form.

[5] Report agent receives the result and show it in a user friendly fashion(list, graph, diagram etc.)

[6] If the job of report agent is completed, it sends messages to the management agent and management agent decides whether control is returned to the main agent or finishes all the job.

Major intelligent features of our system is as follows. First, Our system operates very user friendly. It provides an overall guidance to the user as it looks like system level. Second, it can adopt knowledge base system and management agent takes the key role and manages the other agents. Third, fuzzy converting system is adopted and fuzzy matching system finds best similarity matching in a reasonable way.

III. Generation function of the Proximity degree

The proximity degree is a quantitative value of “closeness” or “similarity” between two data objects of a scalar domain. We derive a generation function of the proximity degree based on the measurement theory of fuzziness[5].

3.1 Fuzzification of investment type categories and feature values

Data in investment type table have some properties such as safety, deposit rate, cancellability and long-term prime rate. To compare a given requirement with the reserved investment types, we should assign membership values of the property values. Two definitions are needed to derive a generation function of the proximity degree.

Definition 3.1 An aspect of an investment type domain can be decomposed into properties. Category is a property of the aspect and it is represented as xi (where, $1 \le i \le l$, l is finite integer).

Definition 3.2 A feature value is constant which can be assigned in a category. A feature value is represented as $\mu(xi) \in [0, 1]$.

In order to get the degree of closeness between given requirement and reserved investment types, we should assign a set of feature values to each category. We can discriminate a given requirement $\theta 1$ and a reserved investment type $\theta 2$ by its feature values. Prior to assigning feature values on the investment types, a domain Θ should be divided into categories in an aspect. Categories and feature values of the "MMF" investment are depicted in <Fig. 2>. The investment type is defined as follows

$$\theta = \sum_{i=1}^{l} \mu(xi)/xi$$

where xi is a sequence of categories and μ(xi) is feature values. The l is the number of fixed length of categories. In the case of non-ambiguous situation, the choice will be either 1.0 or 0.2 depending on 'yes' or 'no'. An example of categories and feature values of MMF investment type is in <Fig. 2>.

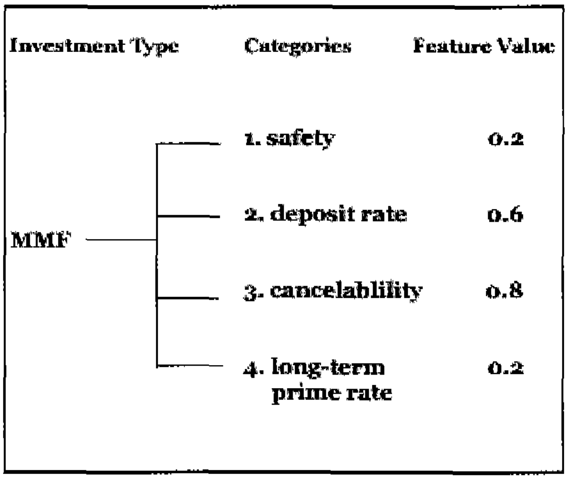

Fig. 2. An example of categories and feature values of MMF investment type

For example, there are four distinct properties in a investment type in a bank. Various proximity degrees exist between pairs of investment type which is included in the set of Θ.

Θ= {A, B, C, D, E, F, G}

(A means investment type A)

xi = {safety, deposit rate, cancellability, long-term prime rate}

θ 1(MMF) = μ 1(x1) + μ 2(x2) + μ 3(x3) + μ 4(x4)

The acquisition method of feature values is similar to that of fuzzy set. It is not described here because it is out of scope in this paper.

3.2 Derivation of the generation function of proximity degree

The principle of measure of fuzziness is applied to measure a proximity degree. First of all, a domain Θ is extended to two dimensional relation $\Theta \times \Theta$. The generation function of proximity degree P is defined as follows.

$$P: \Theta \times \Theta \rightarrow [0, 1].$$

The proximity degree is large if sum of the distances of feature values of two data items is small. In this paper, we use Kim's[6], one of our author, proposed proximity degree generation function.

$$P(\theta i, \theta j) = 1 - \frac{[\sum_{x \in X} |\mu\theta i(x) - \mu\theta j(x)|]}{|X|}$$

(is membership value)

IV. Procedures of Bank Asset Management System

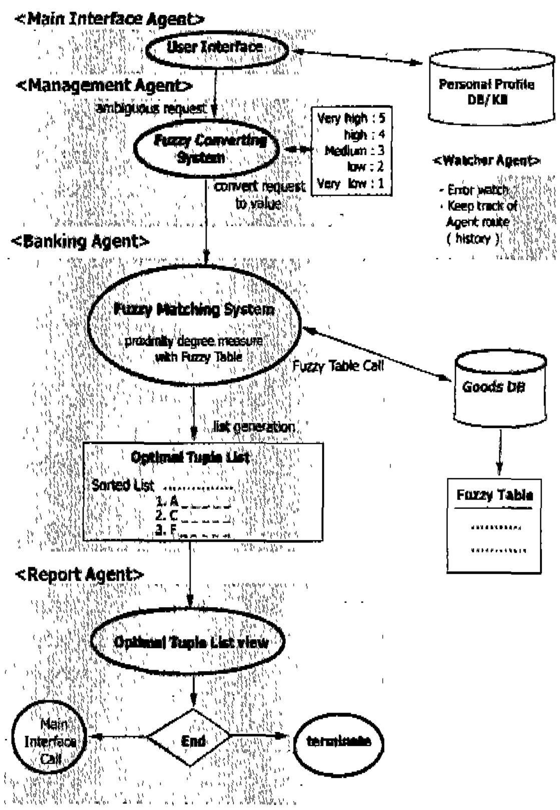

Fig. 3. Flow diagram of BAMS

The goal of the BAMS is to tell how to manage user's bank asset efficiently in the short/long term according to user's preference. BAMS can manage a user's total asset and can be extended to real estate agent and stock market agent later. The flow diagram of BAMS is depicted in <Fig. 3>. The detailed procedure of the BAMS is as follows.

[step 1] Main interface agent of BAMS is a user interface which communicates with users. In the menu driven way, users can look their own asset information and store it in the personal profile knowledge base/database.

[step 2] Main interface agent receives requirement specifications for the bank asset management from the user. User inputs the amount of investment(for example, 100,000$). User can divide the total amount of asset into several categories. Requirement specification consists of safety, deposit rate, cancellability, long-term prime rate. One sample user's request is as follows. Safety is high, deposit rate is medium, cancellability is low, long-term prime rate is very high.

[step 3] Requirement specification is summarized in the main interface agent and it is transferred to the Management agent. Management agent converts requirement specification to values. That is, very is 5, high is 4, medium is 3, low is 2, very low is 1 respectively. For example, safety is medium, deposit rate is medium, cancellability is low, and long-term prime rate is high, is converted to quadruple (3, 3, 2, 4).

[step 4] Banking agent utilizes fuzzy matching system and produce optimized tuple list. The procedures are as follows. If requirement specification is coming in, fuzzy matching system calls fuzzy table from Goods Database. The system does proximity matching with the called fuzzy table and requirement specification quadruple (3, 3, 2, 4).

[step 5] Banking agent calls report agent. Report agent shows the transferred results to the users. Depending on the user's preference, some graphic or diagram information are also illustrated.

[step 6] During the whole procedures, watch agent watches any message causing errors and remembers the currently activating agent lists. Watch agent maintains route information by using stack. If the agent activates the job that does not match user's request, it reconfirms it to the user.

[step 7] If the result in the report agent is not considered to be useful to the users, watch agent ask users whether to restart the system or call a certain agent. User can return to the main interface agent from the report agent.

V. Simulation and Results

The procedure to match the given requirement of user with reserved investment type is as follows. Assuming that the input is domain Θ of the ordinary relation which has $\theta i (1 \leq i \leq l)$. The proximity degree between each feature value θi and θj $(1 \leq j \leq l)$ is calculated. Results of the procedure are proximity degrees between user's requirement specification and reserved investment type membership values. The investment type table and its membership value is shown in Table 1. and Table 2. respectively.

Table 1. The investment type

Investment type	Safety	Deposit rate	Cancell ability	Long-term prime rate
A	5	2	2	4
B	4	3	3	3
C	1	5	5	5
D	2	4	4	3
E	3	2	3	3
F	4	3	2	2
G	5	1	3	3

Table 2. The investment type membership value

Investment type	Safety	Deposit rate	Cancellability	Long-term prime rate
A	1.0	0.4	0.4	0.8
B	0.8	0.6	0.6	0.6
C	0.2	1.0	1.0	1.0
D	0.4	0.8	0.8	0.6
E	0.6	0.4	0.6	0.6
F	0.8	0.6	0.4	0.4
G	1.0	0.2	0.6	0.6

If users want to invest some investment types, they have to select one of the investment type from A to G. Consider the case which one would like to invest the following tuple style.

(Safety=very high, Deposit rate=high, Cancellability= low, Long-term prime rate=high).

Above query type means very high safety, high deposit rate, low cancellability type, and long-term prime rate is high type investment. The fuzzy constants can be converted to membership values. So it can be rewritten as follows.

(Safety=1.0, Deposit rate=0.8, Cancellability=0.4, Long-term prime rate=0.8).

We can measure the proximity degree using the proposed proximity degree generation function. Consider the tuning parameter q is 1 to simplify calculation of fuzzy matching[6].

$$P(\theta i, \theta j) = 1 - \frac{[\sum_{x \in X} |\mu\theta i(x) - \mu\theta j(x)|]}{|X|}$$

Consider user query as θi and one of investment types of [Table 2] as θj. The first type of [Table 1] can be calculated as follows.

$$P(\theta i, \theta A) = 1 - \frac{[|1.0-1.0|+|0.8-0.4|+|0.4-0.4|+|0.8-0.8|]}{|4|} = 0.90$$

We also calculated the measurement user query to the second type or more type.

$$P(\theta i, \theta B) = 1 - \frac{[|1.0-0.8|+|0.8-0.6|+|0.4-0.6|+|0.8-0.6|]}{|4|} = 0.80$$

$$P(\theta i, \theta F) = 1 - \frac{[|1.0-0.8|+|0.8-0.6|+|0.4-0.4|+|0.8-0.4|]}{|4|} = 0.80$$

$$P(\theta i, \theta G) = 1 - \frac{[|1.0-1.0|+|0.8-0.2|+|0.4-0.6|+|0.8-0.6|]}{|4|} = 0.75$$

$$P(\theta i, \theta E) = 1 - \frac{[|1.0-0.6|+|0.8-0.4|+|0.4-0.6|+|0.8-0.6|]}{|4|} = 0.70$$

$$P(\theta i, \theta D) = 1 - \frac{[|1.0-0.4|+|0.8-0.8|+|0.4-0.8|+|0.8-0.6|]}{|4|} = 0.70$$

$$P(\theta i, \theta C) = 1 - \frac{[|1.0-0.2|+|0.8-1.0|+|0.4-1.0|+|0.8-1.0|]}{|4|} = 0.55$$

Fuzzy matching system produces the investment type A as the best choice for the user requirement because it has the highest proximity degree 0.90. The second and the third are the investment type B(0.80) and F(0.80) with the same value.

Other user would like to invest a very low safety, very high deposit rate, low cancellability, and very high long-term prime rate investment type. So one requests a query as the following tuple style.

(Safety=very low, Deposit rate=very high, Cancellability=low, Long-term prime rate=very high).

Above query type can be converted to the following fuzzy membership tuple values.

(Safety=0.2, Deposit rate=1.0, Cancellability=0.4, Long-term prime rate=1.0).

The proximity degree can be measured using the proposed generalized proximity degree generation function.

$$P(\theta i, \theta C) = 1 - \frac{[|0.2-0.2|+|1.0-1.0|+|0.4-1.0|+|1.0-1.0|]}{|4|} = 0.85$$

$$P(\theta i, \theta D) = 1 - \frac{[|0.2-0.4|+|1.0-0.8|+|0.4-0.8|+|1.0-0.6|]}{|4|} = 0.70$$

$$P(\theta i, \theta A) = 1 - \frac{[|0.2-1.0|+|1.0-0.4|+|0.4-0.4|+|1.0-0.8|]}{|4|} = 0.60$$

$$P(\theta i, \theta B) = 1 - \frac{[|0.2-0.8|+|1.0-0.6|+|0.4-0.6|+|1.0-0.6|]}{|4|} = 0.60$$

$$P(\theta i, \theta E) = 1 - \frac{[|0.2-0.6|+|1.0-0.4|+|0.4-0.6|+|1.0-0.6|]}{|4|} = 0.60$$

$$P(\theta i, \theta F) = 1 - \frac{[|0.2-0.8|+|1.0-0.6|+|0.4-0.4|+|1.0-0.4|]}{|4|} = 0.60$$

$$P(\theta i, \theta G) = 1 - \frac{[|0.2-1.0|+|1.0-0.2|+|0.4-0.6|+|1.0-0.6|]}{|4|} = 0.45$$

The results of fuzzy matching show that the investment type C(0.85) is the best choice for the user requirement and D(0.70) is the second.

Display Agent reports the above results in a sorted order. It asks the user whether to return to the main interface agent or to quit the procedure and terminates.

Ⅵ. Conclusion

In this paper, we studied the modeling of bank asset management system based on intelligent agent. we introduced 5 kinds of agents and it worked in a user friendly fashion. Fuzzy converting system is adopted by the main interface agent and fuzzy matching system was implemented by the banking agent. It produced quite reasonable similarity matching result. Our further research will be concentrated on the more intelligent knowledge base system that will give us optimal bank asset management system solution.

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Dae-Su Kim

Dae Su Kim received the B. S. degree from the Seoul National Univ. Seoul, Korea in 1977, and M. S. degree in Computer Science from the Univ. of Mississipi, in 1986, and the Ph. D. degree in Computer Science from the Univ. of South Carolina in 1990. He was a researcher of the Intelligent lab. in U. S. A.

He worked as a Senior Researcher in Electronics and Telecommunications Research Institute in Korea from 1991 to 1993. From 1996 to present, he is a Trustee Board of Korea Fuzzy Logic and Intelligent Systems Society. From 1993 to present, he is an Associate Professor, Department of Computer Science, Hanshin Univ. in Korea.

His current research area includes Neural Networks, Fuzzy Theory, Artificial Intelligence, Intelligent Systems, Agent Modeling, Evolutionary Computing etc.

Phone : +82-031-370-6784
Fax : +82-031-372-3343
E-mail : daekim@hanshin.ac.kr

Chang-Suk Kim

Chang Suk Kim received the B.S., M.S. and Ph. D. degrees in Computer Engineering Dept. from Kyungpook National University, Daegu, South Korea, in 1983, 1990 and 1994, respectively. He was post-doc. at Univ. of California, San Diego. He worked for ETRI from 1983 to 1994.

At present, he is an Assistant Professor at the Dept. of Computer Education, Kongju National University. South Korea. His research interests are intelligent databases, fuzzy theory, XML based information integration etc.

Phone : +82-041-850-8822
Fax : +82-041-850-9388
E-mail : csk@kongju.ac.kr