Intelligent Automatic Community Grouping System by Multiagents

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Abstract

We developed an intelligent ubiquitous web based e-learning system based on multi agents. The proposed system, Intelligent Ubiquitous Web based e-learning Multi Agent System, is used the new distributed multi agent framework and neural network for e-learning grouping. The proposed system implements user's individual satisfaction network from analyzing the satisfaction degree among learners in groups on web environment. The satisfaction network is personalized by providing weights to the learners' satisfaction degree on e-learning grouping. So, it constructs the learners' satisfaction network model about the e-learning grouping. Based on this network model, the proposed system can decide if the group is remained or reorganized or break down for next time, and the system learn about the above states.

Keywords: multiagents, e-learning, community

1. Introduction

The dropout rate in e-learning is higher than that in traditional face-to- face learning due to its low degree of continuity. In order to lower this dropout rate, many researches have been done to heighten the degree of learners' satisfaction and to provide them with motivation [1,2,3,4,5].

The agent system, which began to appear in the 1990s, is a system that is automatically managed and self-operative. It is a very intelligent concept that can manage the information of each learner in the e-learning system, and recommend and search information that fits the inclination of each individual [6,7]. By applying the concept of the agent to the e-learning system, we can develop the next generation's technology which will contribute to the increase of the degree of satisfaction of learners, as well as the degree of learning achievement, by analyzing the inclination of each individual learner and reflecting its result in each group.

In this paper, as we recognize the importance of a learning community and intend to form a learning community which is strong and at the same time, the most feasible, we will develop an intelligent web based e-learning multi agent system through the questionnaire called the inclination test with the method of intelligence based agent which will reflect the inclination and characteristic of an individual learner.

This paper is consisted of the followings. Chapter 2 will explain the proposed system's overview, module specification and the algorithm of the proposed system. Chapter 3 will evaluate the proposed system. And finally a conclusion is in chapter 4.

2. The Proposed System

2.1 System Structure

On the basis of the above researches, firstly we present a list of homogeneity and heterogeneous items for inclination testing for the effectiveness of online e-learning community.

As for a questionnaire, 10 items are included which are considered to be adequate for grouping, according to the characteristics of each category.

Information from individual learners through security and certification procedure as seen in Figure 1 is inputted to the system, Intelligent Ubiquitous Web based e-Learning Multi Agent System (IMAS), to be proposed in this paper, and IMAS creates each user's profile from the information. Based on it, learning community grouping suitable to each individual is automatically executed by using Self Organizing Feature Map (SOM) learning algorithm via multi agents.

In IMAS, the grouping and the learning is automatically performed on real time by multi agents, regardless of the number of learners. A new framework has been proposed to generate multi agents, and it is a feature that efficient multi agents can be executed by proposing a new negotiation mode between multi agents.

Overall structure is composed of the user information (user, learner), user profile in which user's tendency is saved, e-learning database,

which processes digitalized learning information and distributed multi agent framework (DIMAF), which generates multi agents, as well as multi agents that are comprised of grouping agent deciding a learner's group form DIMAF, user profile update agent who continuously updates learner's information continuously and learning evaluation agent who automatically informs learning evaluation as seen in Figure 1.

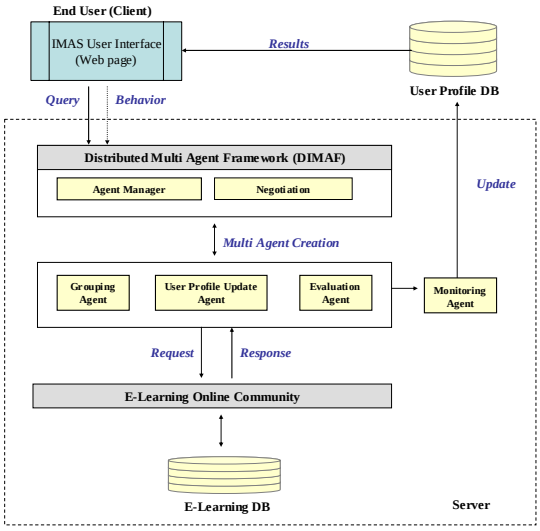

Figure 1. IMAS system configuration

2.2 Main Functions

2.2.1 User Profile Learning

On of multi agents in IMAS, Grouping agent is generated by learner's drawing up a distribution map related to items using Kohonen's SOM learning algorithm, based on inputted information for homogeneity and heterogeneity. When homogeneous and heterogeneous items are inputted respectively, input vector is generated in order pairs, each. Then, learning grouping is automatically executed with the weight provided by drawing up a categorization map on real time through SOM network [8].

The explanation of user profile drawing method regarding each number is as follows. ① Input vector is generated with regard to learner's input value for 1st (homogeneous) and 2nd (heterogeneous) categorization criteria. ② A distribution map is drawn up by providing weight to detailed homogeneous and heterogeneous items via SOM network.

2.2.2 Multi Agent Framework

When an agent is generated, DIMAF consists of the negotiation algorithm between the agent name server (ANS) providing agent ID, an agent manager controlling and monitoring generation, execution and movement of agent and multi agents.

The negotiation algorithm is greatly required for suitable grouping from grouping list by searching learned user profile with user input item inputted at an early stage in the grouping agent. In the grouping list, the user (ID), group number (G), satisfaction degree (SD) and team information (TI) are recorded. TI is recorded as a value among maintenance (M), don't care (D) and break (B). Maintenance (M) is the case where satisfaction degree of previous group members is very high, which means the value is required to be maintained constantly, not desiring to break. Don't care (D) is the value meaning that it may be changed, according to learners' responses in the normal position. Break (B) means the group to be regrouped, after breaking existing group, since satisfaction degree of the previous group members is very low.

The detailed negotiation process by negotiation algorithm proposed in this paper is as follows:

Step 1: Grouping agent searches concerned individual (ID), group number (G), satisfaction degree (SD) and team information (TI) from grouping list by inspecting user profile from the homogeneous items categorized primarily. If a concerned ID's TI value is M, the concerned grouping is maintained without executing 2nd step and you need to move to step 4. If TI value is D or B, you need to move to step 2 and continue.

Step 2: From the table saved in the temporary storage, grouping agent (GA) calculates G and SD which performed grouping by SOM learning algorithm by using user input homogeneous item. If TI value was B, you need to move to step 4, beyond step 3.

Step 3: When the grouping result value performed by GA in step 2 and the G value of grouping list are different, concerned grouping should be maintained in the user ID with priority in the result of grouping list in the user profile. However, concerned user should judge by showing the group member list to concerned user (ID).

Step 4: Show grouping information and member list to each learner.

Four multi agents are generated basically in the IMAS system. Grouping agent (GA) is the agent that generates user profile using 1st categorization criteria (homogeneous) and 2nd categorization criteria (heterogeneous). GA is in

charge of grouping. User profile update agent (UA) is the agent that saves user history and helps grouping performance, while consulting GA.

Evaluation agent (EA) evaluates learning satisfaction degree of user and grouping members and decides whether to maintain, don't care or break this group, according to satisfaction degree value.

Monitoring agent (MA) is the agent to identify state of a learner (user) by monitoring the number of grouping, number per group and satisfaction degree per group graphically through monitoring of learners' learning status.

In IMAS, grouping forms group via grouping agent. The grouping agent indicates homogeneous and heterogeneous distribution from homogeneous and heterogeneous items selected by a user through the use of SOM algorithm. Automatic grouping is made by learner's input with this distribution.

Among homogeneous items as you seen in section 2, a user selects detailed items (i.e. major subject is Korean) regarding each item. In the IMAS, 6 input nodes and random 10*10(=100) output nodes are provided for a learner to learn using learning algorithm of the SOM network regarding each detailed input value of the user-input homogeneous value. Here, the reason why 100 output nodes are provided is because maximum number of cases in which homogeneity can be generated is limited to 100.

With regard to input value, values were randomly generated in order of major subject, favorite sports, etc, giving priority to each item by valuing homogeneous values numerically. For example, ID: yicho1234, major subject: Korean, teaching experience: 1-5 years, favorite sport: swimming, hobby: movie, favorite food: Chinese food, favorite color: yellow were selected, they are expressed in the following data structure order by with priorities in order.

Among four heterogeneous items inputted by a user, nodes with regard to four detailed input values selected by the user and random 6*6(=36) output nodes are provided, and the user learned in the SOM network. Here, the reason why 36 nodes were provided is because maximum number of cases where heterogeneity can be generated was limited to 36. With regard to input values, they have been generated randomly with a priority in order of area and gender based on the priority of each item by valuation of heterogeneous values. The input values regarding four detailed items were generated randomly by valuing heterogeneous values numerically. Like homogeneity, each detailed item selected with regard to four items was valued numerically and then learned.

For example, if ID: yicho1234, area: Seoul/Kyeonggi-do, gender: female, computer using hours: 1-2 hours, online training experience: yes were selected, the data structure of input node of the concerned ID is as follows. Here, users can learn through 10,000 inputs in the input nodes. Like homogeneity, output group distribution is formed in relation to input node. The distribution formed like this forms heterogeneous categorization map as seen in Figure 2(right). In the figure, N=10,000, and a~d are the number of heterogeneous items and m is the group number in the heterogeneous categorization map. In this case, the number of group was 16. A user with ID 1 was categorized into heterogeneous group 4 in this instance.

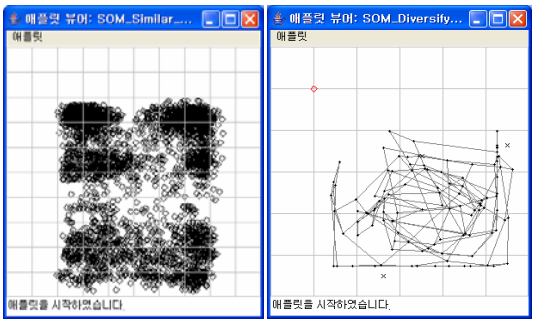

Figure 2. The process of group formation (left: Homogeneous, right: Heterogeneous)

Group is generated through input of learners with the distribution generated by homogeneous and heterogeneous SOM learning. The number of total group is decided by the number of people in a group, which is performed by manager's input. The input items of a learner are made by selecting 10 input items (homogeneous, heterogeneous). In order to meet homogeneity and heterogeneity with homogeneous and heterogeneous distributions learned through 10 input vectors, final learner's group meeting homogeneity and heterogeneity is generated by providing weight to each vector. The size of learning group (size of community) can be designated by manager randomly.

Finally, the homogeneous categorization map M generates the final group G for learning by randomly taking among groups excluding m to which concerned learner ID belongs in Figure 4.

3. Performance Evaluation

In this paper, a pilot test was conducted to evaluate actual users of the IMAS system. As a result, the evaluation of user satisfaction degree per group is seen in Figure 3. If the scale indicates 1 in satisfaction degree, it means very satisfactory, if the scale is 5, then it means very unsatisfactory. The scale from 1 to 5 with regard to 5 categories was expressed as value. Here, satisfactory means that members of a group or learning desire show a very positive result.

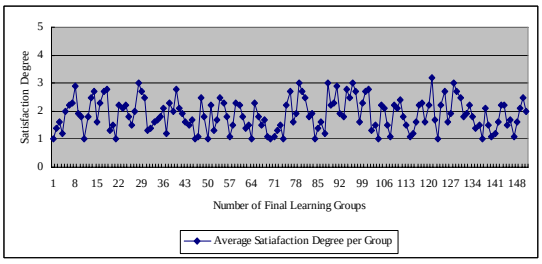

Figure 3. The satisfaction degree per group

As a result of surveying users' group satisfaction degree regarding 151 groups, we can see the average was distributed around scale value 2 of satisfaction degree. Accordingly, when automatic grouping was performed by agent, learners were generally satisfied. When they desired to maintain their group according to the value 2, around 51 groups of total 151 groups (34%) showed in favor of maintenance, while 61% showed don't care and less than 5% showed break.

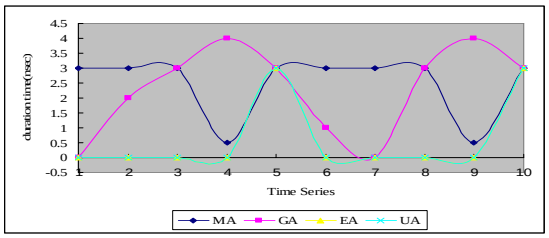

Figure 4. The average duration time and cycle in IMAS

The agent's duration (or activation) time by DIMAF framework on time slice in IMAS is drawn in Figure 6. In Figure 6, after GA is activated, UA is activated. But MA is activated all the way except the activation time of GA. EA is activated after GA's activation. This cycle is repeated in IMAS e-learning system. Owing to DIMAF, IMAS can activate intelligently among many users in ubiquitous environment.

4. Conclusions

To do development of e-learning community system, we have made an inclination test questionnaire for the formation of effective and efficient online learning community. And then, we have implemented and realized an automatic grouping system with information of learners that appear through the questionnaire and by using an intelligent agent.

The results of our experiment with 1,000 people in reality by means of developing the grouping system have shown that 151 groups are automatically formed.

In the future, it is necessary to improve services concerning the communication between users by supplementing the grouping system and to continue research on which multi agent system can be achieved effectively in automatic grouping.

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