An Agent-based Personalized Distance Learning System

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Abstract

The Internet has becoming very popular and many education learning systems which use the Internet are proposed. Now exist many stand alone education systems. But, the use of computer networks make possible distance learning which will be a more effective learning process. To build distance learning systems agent-based systems can be an effective way. An agent can examine learner’s information from learning history. This information is used to provide the right teaching materials. In this paper, we propose an agent based personalized distance learning system which can deliver the learning materials and test the learner’s understanding.

1 Introduction

Recently, the study of distance learning has become more popular. Due to the appearance of the Internet, many people have been able to use computer networks. Now, Internet is being used in various fields. A wide application the Internet has in education field, especially for distance learning. In the distance learning systems, a person can receive education materials by using computer networks. Also, due to the progress of computer devices and network technology, it is possible to handle transmission of image and voice.

So far, broadcasting method has been used for the remote education. In this system, the lectures are delivered in the form of a TV program. But, the use of computer networks has the advantage that it is not restricted to the time and place as happens with broadcasting. People can study at any time and any place as they wish. Therefore, education over computer networks is very useful.

The education systems proposed so far for distance learning can not get appropriate materials for remote learners. Therefore, in this work, we propose a personalized distance learning system which is based on agent technology. An agent is able to deliver appropriate materials to learners by collecting and evaluating the previous information of learners.

This paper is organized as follows. In Section 2, we will introduce the system design. In Section 3, we will treat the data handling. In Section 4, we will discuss the experimental results. Finally, the conclusions will be given in Section 5.

2 System Design

The learners can access the system in any place where they can be connected to the network and they can use the system. To build the proposed system, we use World Wide Web (WWW) technology which we think is very suitable for building distance learning systems. However, the present web browsers have different functions and implementation extensions, so the system is subject to restriction on using different functions. But, if we use only text and image, almost all web browsers can meet the requirements of the proposed distance learning system. In order to have
a wide range application, in our system, we use only standard functions. So, the system can be used easily without depending on computer environment.

2.1 System Structure

This system is build on WWW and the agent is established on the web server. The learners can access the server to refer to the teaching materials from a client as shown in Figure 1.

The agent can grasp the learner’s information and the relevance of the materials to each learner by checking the learner’s network access. The agent also manages the teaching materials. The teaching materials are prepared on the same server where the agent is established, or they are distributed in different servers and can be accessed when needed. After the learning session, a confirmation test is performed to check the learner’s degree of understanding. The confirmation test is carried out by using choice-type forms and description-type forms.

The collection of learner’s information is necessary to provide appropriate teaching materials to each learner. In order to make a right judgment about the appropriate degree of delivered materials, we try to collect a large amount of information about the learner as possible and analyze the collected information. From this point of view, a direct test on learner’s information is an important element. Furthermore, how to combine the test result with indirect information such as learning personal history is another important element on the system design.

2.2 Teaching Materials

In this research, we use “network programming” teaching materials. They consist of HTML text, GIF image and JPEG image. The system treats one page of teaching materials as an item and manages the access information item by item. In order to avoid the dependency on computer environment, we do not use materials such as moving picture, voice, etc.

In the page of teaching materials, the buttons such as “NEXT”, “DETAIL”, “SEARCH”, and “EXIT” are prepared as shown in Figure 2. The “NEXT” button sends a request to proceed the next teaching material. The “DETAIL” button requires more details about teaching materials. The “SEARCH” button searches the words and phrases in the teaching materials. The “EXIT” button stops learning. When learning is stopped, total learning time is calculated. The index shows the items which were learned and it is possible to refer to them later if it is necessary.

The teaching materials have more than one content and are prepared to cope with various learners. An agent chooses a teaching material which is appropriate for a learner and provides the teaching material to him.

2.3 Agent

The agent is the main part of the proposed distance learning system. The agent does the following procedures:

- collection of learner’s information;
- management;
- information analysis;
- learners’ understanding judgment;
- teaching materials handling;
communication with learners.

The agent is implemented with Perl language and the CGI technology is used for agent organization. The Perl language is adopted for the following reasons.

- Perl language is very good for text processing, therefore will have good processing results for teaching materials in HTML format.
- Perl is a script language, so the compilation is easy.

When CGI technology is used to build a system on WWW, the agent can not keep conditions in the program [4]. To solve this problem, the agent must put all necessary information in a file and then read the learner’s information when it is necessary.

2.4 Processing Flow

As shown Figure 3, the processing flow is showing in following.

1. First, a learner accesses the system and tries the authentication.
2. Next, the learner requires a teaching material.
3. The agent receives the learner’s requirement.
4. The agent reads the information of the learner who has a request.
5. A teaching material provided for the learner is judged from the learner’s information.
6. Decision for the next teaching material and the access of the teaching material.
7. Output of a teaching material and give to the learner.
8. Renewal information.
9. The learner starts studying.

In the processing flow, the judgment is most important part. Explanation about the judgment is explained in following.

2.5 Judgment Algorithm

Judgment algorithm is as follows.

1. Check the progress and learning time and compare with the standard time.
2. If exceed the standard time, a confirmation test is performed.
3. Otherwise, check re-learning item whether exists or not.
4. If re-learning item exists, then this item is decided, if not, go to the next item.
5. Based on the decision, a teaching material is decided and the agent can access the teaching material.
6. Read the object file from server and provide to the learner.
7. Renew information, reference time of the item, the number of reference, reference time of previous item, learning processing time.
8. Calculate the average of reference time and total learning time.
9. Examine the learner’s information. Make question list of a confirmation test.
10. Information is renewed and the procedure is finished.

The test for a learner is carried out as following.

1. A question decided from the question list is sent to the learner.
2. The learner answers the question.
3. Return the result to the system.
4. Mark and record the results.
5. Examination of the learner’s information.
6. Send the next question.
7. If the question list is empty, test is finished. Return to provide teaching materials.
The learner’s examination is based on the information which the agent has collected. The system utilization is examined from learning personal history.

The learning time is predicted from the comparison of the average reference time and average standard time (the standard time is set up when the teaching materials are prepared, and will be modified by considering the learner information). Considering the time which a learner uses the system and the degree of learner’s understanding, the learning time is measured.

Based on the above analysis, a teaching material is decided for each learner. It should be noted that, it is difficult to do an accurate expectation, because there is little information for decision. However, the learning tendency can be found by taking statistics from many examples.

### 3 Data Handling

As learner’s information, the agent collects the system access information and after that the information analysis is carried out. By using CGI technology, the referred time of teaching material, the host name which a learner uses, the browser, and the last page referred information can be obtained. The reference time of a teaching material, the number of reference, and the referred sequence information is known from the previous access information. The agent analyzes the above information to know learner’s characteristics and judges the teaching material which is appropriate for each learner.

We use the following information as learner’s information.

- **Learning Progress** — The progress of learning. The item which was learned.
- **Total Learning Time** — The total of all learning time on the system.
- **Average of Reference Time** — The average of the reference time for each item.
- **Tested Time** — The time until the test finished. After the test is finished this value is registered.

For each item we use the following information.

- **Referred time** — The time when the agent delivered a teaching material.
- **Reference time** — The time until a request for the next teaching material is sent.
- **Number of Reference** — The frequency that a teaching material was referred to.

<table>
<thead>
<tr>
<th>Item</th>
<th>RT(min)</th>
<th>NR</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>1</td>
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<tr>
<td>2</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
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<td>1</td>
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<tr>
<td>4</td>
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<td>1</td>
</tr>
<tr>
<td>7</td>
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<td>1</td>
</tr>
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</table>

- **Testing Time** — The time when a learner answers the test.
- **Test Result** — The result of the test.
- **Re-learning Item** — The item that learner does not understand.

After we know the above information, the degree of understanding is examined.

The item information is recorded and renewed by the agent when a request comes. The learner’s information and item’s information for each learner is saved in different files.

### 4 Experimental Results

In order to verify the system performance, we examined the user’s learning behavior. In this experiment, the learner is a 1-st year undergraduate student. Therefore, he has a few preliminary knowledge. In Table 1 are shown the data collected by agent while using the system. Based on the data of Reference Time (RT) and Number of Reference (NR), the learner’s understanding is judged.

When an item has a long RT and a big NR, it is presumed that the teaching material has been difficult for understanding. For example, in this experiment, item 9 was referred
Table 2. ART and AS.

<table>
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<th>Item</th>
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<td>66</td>
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</tbody>
</table>

for 6 minutes and the NR is 4. This means, this item was more difficult to understand comparing with the other items. Based on the learner’s data the agent is able to judge the learner’s understanding and deliver appropriate materials to learners.

The proposed agent is able to record the RT of learners for the teaching material and test the learner’s understanding. Using this agent, the Average Reference Time (ART) and Average Score (AS) for 5 learners are shown in Table 2.

From the learning behavior results, we conclude:

- the learners which refer the teaching material for a long time have a low score;
- the learners which progressed to the next item understood all item contents or a part of item contents;
- the learner’s access time for teaching material is different, this is because of reading speed, interest on the material, preliminary knowledge and study desire.

The test results show:

- the learner’s understanding can be judged;
- except the learner’s understanding the personal difference should be considered;
- when the learner’s preliminary knowledge is low, the agent should provide an easy teaching material in advance;
- when the learner’s study desire is low, the agent should provide an interesting material such as animations or images.

5 Conclusion

The education systems proposed so far for distance learning can not get appropriate materials for remote learners. Therefore, in this paper, we proposed an agent-based personalized distance learning system which can deliver the learning materials and test the learner’s understanding. The agent is able to deliver appropriate materials to learners by collecting and evaluating the previous learner’s information. The agent is also able to judge the learner’s ability. The judgment part is very important parameter to realize a reliable system. In the proposed system, the judgment is based on the RT, NR and score. In the future, we plan to built a more accurate judgment algorithm.

References