

The automatic response system for the remote logic circuit experiments system

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Abstract – This paper proposes the automatic response system for the remote logic circuit experiments system. The remote logic circuit experiments system was developed as a WBT system at our laboratory. However, there is a problem in instruction using the chat and FAQ. The students and the instructor have to share the time for chat instruction. In order to perform more efficient study, the WBT system needs the environment that students can progress study without the instructor. The automatic response system guides a student instead of the instructor by appropriate advice using a student's information of wiring on the workspace. There are two kinds of advices for the automatic response system, the advices prepared beforehand and the advices automatically generated from a chat log. The advices automatically generated from a chat log increases in proportion to the number of chat instructions. We implement the WBT system and the automatic response system, and evaluate the environments.

I. INTRODUCTION

In recent years, a lot of Web-Based Training (WBT) systems are proposed and developed by the progress of computer networks. However, there are a few WBT systems treating experiments and training. Then, our laboratory developed the WBT system for the logic circuit experiments [1]. In this system, the students experiment with the hardware training board. The hardware training board consists of PLD. The instructor provides contents and circuits data by reconfiguring the PLD. A chat with the instructor and FAQ are prepared as assistance of study in this content [2]. As the training board is implemented by JTAG device, the instructor can monitor the progress of the students using JTAG technology from the server (JTAG is the IEEE standard, IEEE1149.1, for debugging circuits). Thus, the instructor can instruct accurately to the student using the chat.

We confirmed that the WBT system for the logic circuit experiments is useful by the result of the evaluation.

However this WBT system has problems as follows.

- When the instructor instructs many students, the instructor's burden is heavy only at instruction by the chat.
- The students and the instructor have to share the time. When the instructor is absent, the students cannot progress experiment.

- In FAQ searched with a word, Students need to make an appropriate word from their question.

In this paper, we propose the automatic response system for the remote logic circuit experiments system. We solve the problems described above by using the automatic response system. The automatic response system advises students using the information of wiring on the workspace. There are two kinds of advices for the automatic response system, the advices prepared beforehand and the advices automatically generated from a chat log. The advices automatically generated from a chat log increases in proportion to the number of chat instructions.

We implement the WBT system and the automatic response system. Students learned logic circuits by the WBT system, and they filled out a questionnaire. We confirm that the automatic response system is useful for the remote logic circuit experiments by the result of the questionnaire.

In the remainder of this paper, the WBT system is described in Section2. In Section 3, the automatic response system is shown. We evaluate the WBT system in Section4. Section5 is the conclusion part of this paper.

II. WBT SYSTEM FOR THE LOGIC CIRCUIT EXPERIMENTS

A. Overview of the WBT System

The overview of the WBT system for the logic circuit experiments is shown in Fig.1.

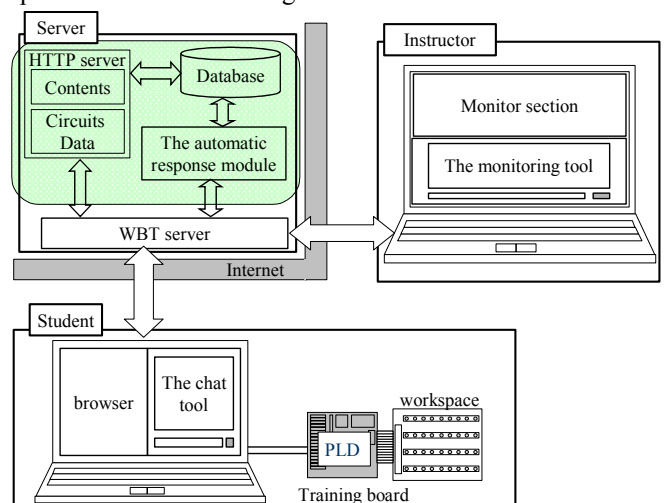


Fig.1 The WBT system for the logic circuit experiments

The student's computer with the hardware training board is connected to the server on Internet. Students use the training board for experiments or training. The training board consists of PLD and has a workspace for students to wire signal lines of PLD. Thus, students can connect logic circuit modules that are reconfigured in PLD, and complete a logic circuit on the workspace. The instructor can monitor the behavior of students by using of JTAG technology. Thus, the instructor can give timely advices to the student. The server provides contents and circuit designs by reconfiguring the PLD on the training board.

The server has the automatic response system. The automatic response system consists of a database, the automatic response module, and a HTTP server. A database manages login data and advices for the automatic response system. The automatic response module has same function as the general Learning Management System (LMS), such as user authentication and registration of the learning log (student's progress). In addition to those functions, the automatic response module also performs the Automatic response advice and the correction of experiments. A HTTP server displays the learning log for every student on a browser.

B. The experiment procedure

The experiment procedure using the WBT system for the logic circuit experiments is as follows.

- 1) The student's display shown in Fig.2. A student logs on to the server using the chat tool. The automatic response module performed user authentication. After user authentication finishes, a browser starts. The learning log and a contents list are displayed on a browser. Students choose a unit and starts study.

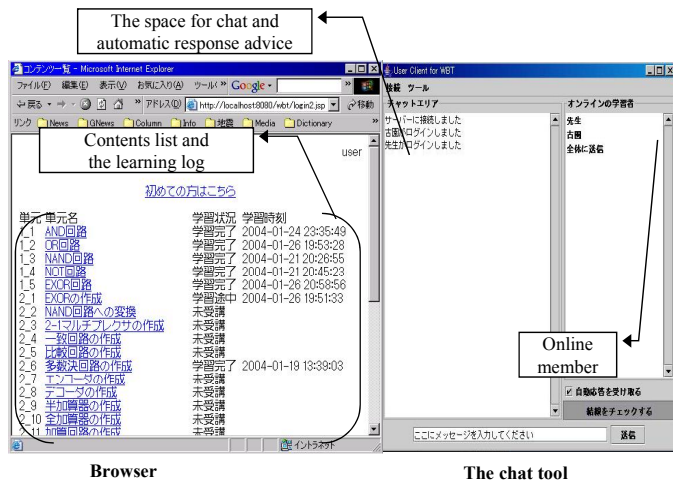


Fig.2 The student's display

- 2) The training board is shown in Fig.3. A start of an experiment writes circuit data in PLD. A student wires on the workspace. The information of wiring on the workspace is observed periodically. When wiring has change, wiring data is sent to the server.
- 3) In the server, the automatic response module searches appropriate advice from a database using a student's wiring state. When the appropriate advice is searched, the server sends the automatic response advice to a student.

- 4) When FAQ of word reference and the automatic response are inadequate, the student asks instructor by using the chat tool. The instructor is able to advice to the student appropriately by consulting with the Transition of wiring and the Automatic response advice referred to. A chat log is saved database at the server. The student monitor is shown in Fig.4.
- 5) When a student finishes the wiring on the workspace, a student asks a correct answer to the server. The server corrects the student's wiring state and sends a correction result to a student. When a correction result is a correct answer, a student ends study of the unit. A database stores a chat log, transition of a wiring state, and the learning log.

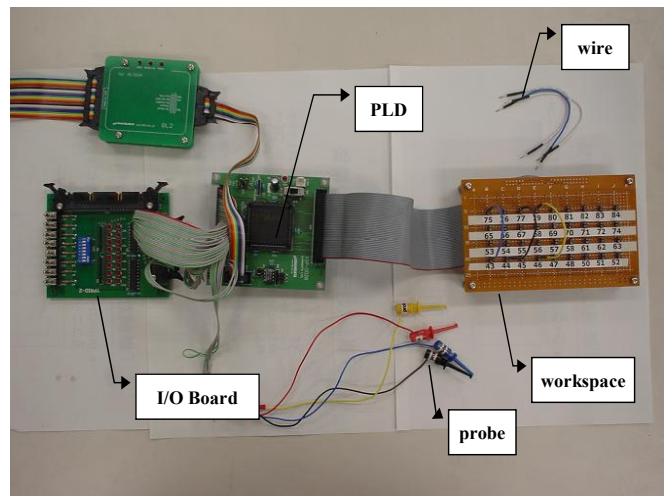


Fig.3. The training board

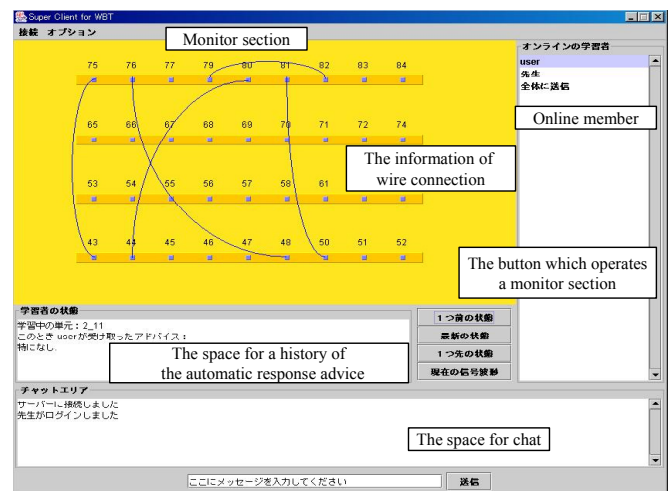


Fig.4 The student monitor

III. AUTOMATIC RESPONSE SYSTEM

The automatic response system sends appropriate advice for a student's wiring state to a student. The student's wiring state is periodically sent to a server using JTAG technology. Advices are searched from a database. The automatic response system is using not a word like FAQ but a student's wiring state for searching advices. For this reason, students do not need to change his question to an appropriate word and ask instructor questions.

A. The kind of advice for the automatic response

There are two kinds of advice for the automatic response system stored a database. The details of each advice are explained as follows.

- The advices prepared beforehand

Advice to the wiring mistaken well and Warning to the wiring that gives the damage to a device are beforehand store a database. An example of the wiring that gives the damage to a device is Outputs are connected.

- The advices automatically generated from a chat log

An example of the advices automatically generated from a chat log is shown in Fig.5. The messages exchanged between the instructor and the student at the time of chat instructions are stored a server (Fig.5 (a)). The transition of a wiring state is also saved (Fig.5 (b)). The log files are saved with the time as the Comma Separated Value (CSV). When the result that corrected a student's wiring state is a correct answer, transition of a wiring state and a chat log are sorted by the time (Fig.5 (c)). The messages are connected to a wiring state, and it stored a database as an advice (Fig.5 (d)).

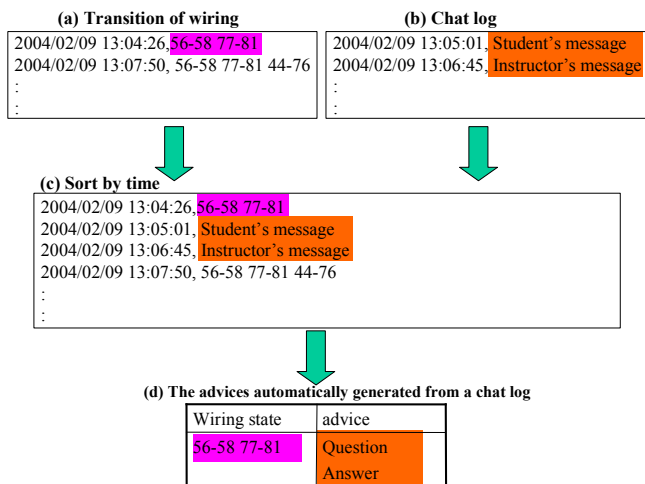


Fig.5 An example of the advices automatically generated from a chat log

When a student is not able to understand in the advices prepared beforehand, instruction by the chat is done. By the reason, the explanation of the advices automatically generated from a chat log is more detailed than the advices prepared beforehand. The advices automatically generated from a chat log increases in proportion to instruction by the number of chat instructions. It prevents that students ask instructor the same question by the chat, and ease the instructor's burden.

The advice prepared beforehand is stored in the database combining the mistake wirings. The advice automatically generated from a chat log is stored in the database combining all wirings including mistake wirings.

B. The reference procedure of the advice for the automatic response

The reference procedure of the advice for the automatic response is shown in Fig. 6, and explained below.

- A student's wiring state is periodically sent to a server.
- The advice automatically generated from a chat log is searched using the present student's wiring state.
- When an advice can not be searched, sort out the

mistaken wirings from the present wiring state. The mistaken wirings are part of the present wiring.

- The advice is searched using the mistake wiring from the advices prepared beforehand and the advices automatically generated from a chat log.
- The automatic response module chooses which advice to send after completing search of advices. When the advice is searched from the advices prepared beforehand, it confirms whether it is already sent. When the advice searched from the advices prepared beforehand is already sent, an advice searched from the advices automatically generated from a chat log is sent students.
- The searched advice is displayed on the chat tool.

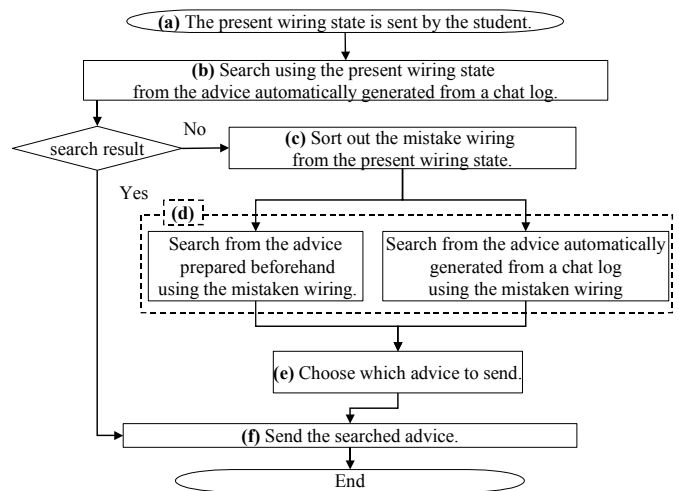


Fig.6 The reference procedure of the advice for the automatic response

C. Database

MYSQL is adopted as a database. The MySQL database server is the popular open source database. The tables created in a database as follows.

- Tables for personal information
 - User ID and login Password
 - Learning log (end unit and the time)
 - The number of advice sent already
 - Tables for the automatic response
 - Answer wirings of each unit
 - The advices prepared beforehand
 - The advices automatically generated from a chat log
- User ID and login password are registered in advance. Students are able to check the learning log using a browser.

Answer wirings have a maximum of 50 combinations per unit. The advices prepared beforehand are classified into advice and warning, advice is displayed on the space for the automatic response and warning is displayed on a dialog.

IV. EXPERIMENTAL RESULTS

15 students learned logic circuits by the WBT system for the logic circuit experiments. They are the students of Tokyo Metropolitan Institute of Technology and have experience in learning logic circuits and they filled out a questionnaire. The questionnaire has following 4 questions and free comments space.

- 1) Do advice of the automatic response become the guidance learned without asking the instructor?
(1:very bad, 2:bad, 3:fair, 4:good, 5:excellent)
- 2) Do advice of the automatic response suit your degree of comprehension?
(1:very easy, 2:easy, 3:suitable, 4:difficult, 5:very difficult)
- 3) Do advice of the automatic response suit your situation?
(1:very bad, 2:bad, 3:fair, 4:good, 5:excellent)
- 4) How was the frequency of the automatic response?
(1:very few, 2:few, 3:moderate, 4:much, 5:very much)

Table.1 The result of the questionnaire

Question No.	Average of results
1)	4.5
2)	3.4
3)	3.6
4)	2.0

The questionnaire result of a student is shown in Table 1. Table1 shows the average of the answer of 15 students. We could get the good result from the questionnaire. The result of a questionnaire showed that the automatic response system is effective in the remote logic circuit experiments system. There were many answers (on the question.4) that the frequency of the automatic response was low in early stages of the experiment. However, the advices automatically generated from a chat log increases in proportion to the number of chat instructions. Finally, the frequency of advice became good. The graph of Fig. 7 expresses that the increase in the number of experiments leads to reduction of the number of chat instructions. Since the number of chat instructions is decreasing, it can be said that the automatic response system was useful to ease the instructor's burden.

As the result of the questionnaire, we confirm that the automatic response system is useful for the remote logic circuit experiments system.

V. CONCLUSIONS

This paper proposed the automatic response system for the remote logic circuit experiments. The automatic response system advises students using a student's information of wiring on the workspace. The student's wiring state is sent periodically to a server. Advices of the automatic response are the advices prepared beforehand and the advices automatically generated from a chat log. The advices automatically generated from a chat log increases in proportion to instruction by the number of times students experiment. The automatic response system for a remote logic circuit experiments is implemented for evaluation. 15 students learned logic circuits by the WBT system, and they filled out a questionnaire. We confirm that the automatic response system is useful for ease the instructor's burden and study smooth by the result of the questionnaire.

The next challenges of our study are to develop of the automatic answer system, which can perform more appropriate advice in consideration of not only a wiring state but also a student's progress.

REFERENCES

- [1] H. Izumi, H. Murakoshi, et al : Proposal of the Web-based Training System for the Experiment of the Digital Circuit, Proc. IECON'01, pp.1766-1770 2001
- [2] H. Murakoshi : e-Learning Environments for Digital Circuit Experiments, Proc. International Symposium on Advanced Intelligent Systems, pp.58-61 2003

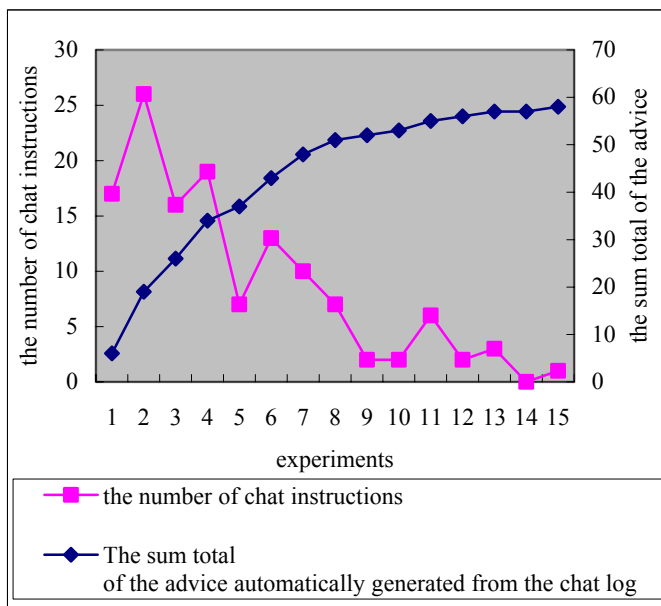


Fig.7 The number of chat instructions and The sum total of the advice automatically generated from the chat log