ISSN 1598-0170 (Print)
ISSN 2287-1136 (Online)
http://www.jksii.or.kr

디지털 논리회로의 개념학습을 위한 웹기반 교육용 자바 애플릿의 설계와 만족도 조사☆

Design of a Web-based Java Applet for Conceptual Learning in Digital Logic Circuits and its Student Satisfaction Survey

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요 약

본 논문에서는 디지털 논리회로의 개념학습을 위한 교육용 자바 애플릿을 설계방법을 제안하고 그에 대한 교육적인 유효성을 입증하기 위하여 학생 만족도 조사를 실시하였다. 제안된 교육용 자바 애플릿을 통하여 학습자들은 디지털 논리회로 실험과 관련된 개념과 원리, 가상실험장비, 그리고 가상 브레드 보드의 동작방법을 학습할 수 있다. 제안된 교육용 자바애플릿은 5개의 주요한 요소 즉, 디지털 논리회로의 동작에 대한 개념과 원리를 설명하는 원리학습실, 학습자들에게 웹기반 시뮬레이터를 제공하는 시뮬레이션 학습실, 오프라인 실험교육의 강의계획서에 대한 상호작용성이 있는 자바 애플릿을 제공하는 가상실험 학습실, 평가와 관리시스템으로 구성되어 있다. 모든 학습실은 학습효율의 극대화를 위하여 서로 유기적으로 결합되어 있다. 마지막으로 높은 학습에 대한 기준, 전체 실험시간의 단축, 실험장비의 손상율의 감소와 같은 긍정적인 결과를 얻었다.

☞ 주제어 : 교육용 자바 애플릿, 디지털 논리회로, 웹기반 가상학습, 학생만족도 조사

ABSTRACT

This paper presents a web-based Java applet for understanding the concepts in digital logic circuits and student satisfaction survey was carried out in order to show its educational validity. Through our educational Java applet, the learners will be capable of learning the concepts and principles related to digital logic circuit experiments and how to operate virtual experimental equipments and virtual bread board. The proposed educational Java applet is composed of five important components: Principle Classroom to explain the concepts and principles for digital logic circuit operations, Simulation Classroom to provide a web-based simulator to the learners, Virtual Experiment Classroom to provide interactive Java applet about the syllabus of off-line laboratory class, Assessment Classroom, and Management System. With the aid of the Management System every classroom is organically tied together collaborating to achieve maximum learning efficiency. Finally, we have obtained several affirmative effects such as high learning standard, reducing the total experimental hours and the damage rate for experimental equipments.

☞ keyword : Educational Java Applet, Digital Logic Circuits, Web-based Virtual Learning, Student Satisfaction Survey

1. Introduction

Recently, much interest has been drawn on the web-based solution for the experiments at universities with large number of students due to low cost. This interest is mainly due to the cost of the experimental laboratories at universities with a large number of students. In addition to enhancing traditional educational methods, information technology can also enable new ways of education delivery and innovative pedagogic strategies. Teaching is no longer confined to a time and a place. The time and physical boundaries of the traditional classroom are stretched to a learning space. A growing number of universities worldwide are now offering virtual education problems[1-4]. Electrical and electronic experimental study is a very important component in engineering education. It not only acts as a bridge between theory and practice, but also solidifies the theoretical concepts presented in the classroom.

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[Received 5 February 2015, Reviewed 10 April 2015(R2 29 May 2015), Accepted 24 June 2015]
☆ This research was supported by the Soonchunhyang University Research Fund.

http://dx.doi.org/10.7472/jksii.2015.16.4.61

Before the laboratory session, the learners should re-enforce basic concepts, prepare some design and simulation steps, and acquire a clear idea on what they should expect from the experimental work they will be carrying out in the laboratory. At the laboratory session, the learners are required to assemble the circuits, connect the equipment, make the measurements, compare the data to the expected behavior, and deliver a partial or complete report to the professor at the end of the session. This classical way of experimenting clearly has the following shortcomings[5-7].

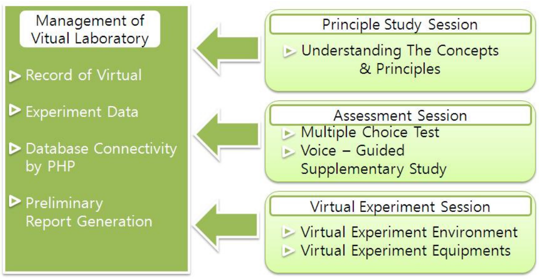
- The classroom lectures or the handouts are generally not sufficient for the learners to be fully prepared for a hands-on experiment or to appreciate the significance of the previously explained theory in the experiment to be performed.
- When the learners are passive observers or a semi-active part of an experiment, they will understand neither the correspondence nor the difference between theory and practice.

To cope with these difficulties, this paper presents web-based educational Java applet which can easily be used on the worldwide web. The proposed educational applet provides improved learning methods which can enhance the multimedia capabilities of world-wide web. If the learners have access to the proposed Java applet through a typical web browser such as Internet Explorer, they can make experiment on basic digital logic circuits by simple mouse clicks. Since this interactive educational Java applet is implemented to describe the actual on- campus laboratory, the learners can obtain similar experimental data through it.

The proposed Java applet for digital logic circuit is composed of five important components: *Principle Classroom, Simulation Classroom, Virtual Experiment Classroom, Assessment Classroom and Management System*. Our educational Java applet supports from basic digital circuit experiments to advanced digital circuits experiments included in the curriculum of the college of engineering. It has interactive and innovative multimedia contents to get the learners exact understanding of the concepts and theories of digital circuit operations, and the learners can build and simulate their own circuits and measure all information about the status of the circuits on the virtual space by simple mouse clicks. Every activity done in the educational Java applet is recorded on database and provided to the learners as a printout form including experimental information and results. The educators check the submitted printout form to estimate how well the learners understand the experimental contents. Our system provides 2 courses and each course needs one semester (15 weeks). The implemented Java applet can be used in stand-alone fashion, but using as assistants of the actual on-campus laboratory class shows more encouraging results.

2. Configuration of our Educational Java Applet

We have 2 virtual laboratory courses for undergraduate. The material in first course is appropriate for elementary courses on combinational logic circuit experiments and the material in second course for advanced courses on sequential logic circuit experiments. Each course consists of 15 chapters and each chapter comprises *the Principle Classroom* to explain the concepts and theories of circuit operations, *the Simulation Classroom* to provide a web-based simulator to the learners, *the Virtual Experiment Classroom* which provides interactive and innovative multimedia contents to build and test several circuits. *The Management System* gives the learners and the educators their ID and password and provides printout services for all information about experiment done *in the Virtual Experiment Classroom* [8-9]. In Fig. 1, the structure diagram of our educational Java applet is shown. All of this can be achieved by the aid of the Management System. The database connectivity is made by Professional HTML Preprocessor (PHP) and the virtual laboratory environment is set up slightly differently for each learner.



(Fig. 1) Configuration of our Educational Java Applet

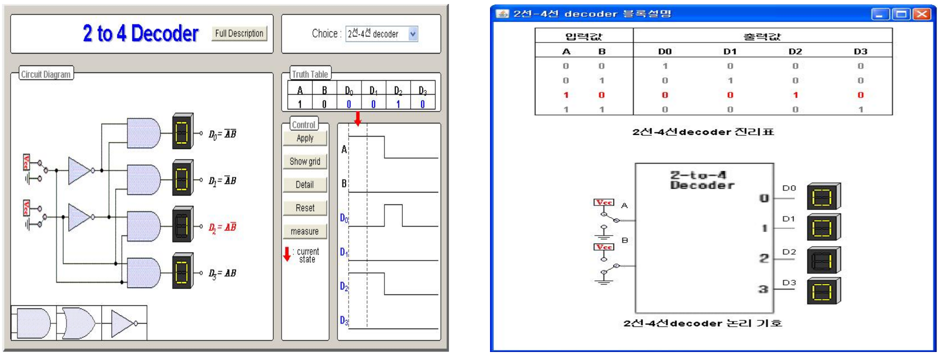
2.1 Principle Classroom

The Principal Classroom is responsible for making the learners understand the concepts and theories of the circuit operations included in each chapter. Interactive Java applet with creative and intuitive ideas for each subject leads the learners to easily understand their operations.

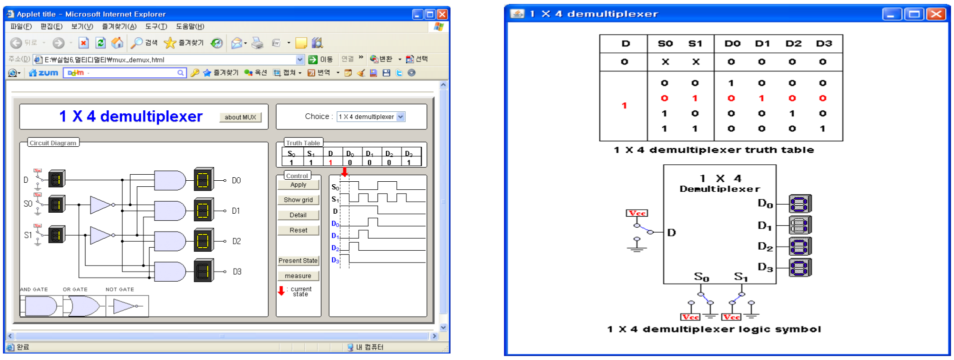
Fig. 2 shows several important procedures from the educational Java applet for explaining the concepts of 2 to 4 decoder. The conceptual Java applet in the left hand side of Fig. 2 is authored to let the learners easily understand the principle of decoder by clicking the several buttons such as 'Apply', 'Show grid', 'Detail', 'Reset' and 'Measure'. When the learners clicks the button labeled 'Detail', the pop-up frame as shown in the right hand side of Fig. 2 will be displayed. They can understand the circuit operation under a variety of digital input conditions by clicking two switches.

The left hand side of Fig. 3 shows a Java applet for understanding the concepts of 1x4 demultiplexer(DEMUX). Using this Java applet, the learners can understand the wholes procedure that shows how the 1x4 DEMUX works. When the learners clicks the button labeled 'Detail', the pop-up frame as shown in the right hand side of Fig. 3 will be displayed. They can understand the circuit operation under a variety of digital input conditions by clicking two switches.

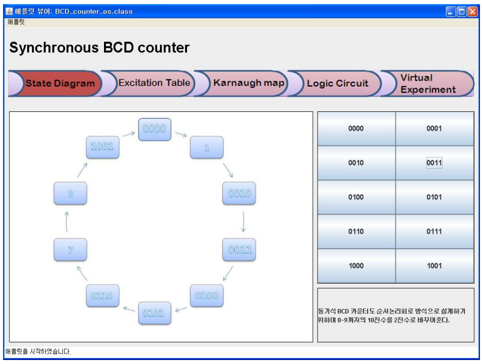
Fig. 4-Fig. 6 show learning process of an educational Java applet for understanding the concepts of asynchronous BCD counter. Using this Java applet, the learners can understand the wholes procedure that shows how the asynchronous BCD counter will be designed. Fig. 4 shows the generation of initial and final state diagram for asynchronous BCD counter. When the learners click the decimal buttons, the corresponding binary codes will be displayed as shown in Fig. 4.



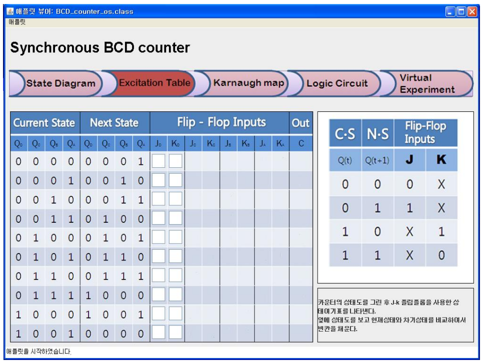
(Fig. 2) A conceptual Java applet for 2 to 4 decoder



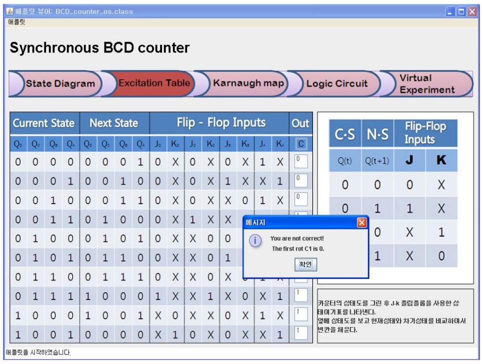
(Fig. 3) A conceptual Java applet for 1x4 DEMUX



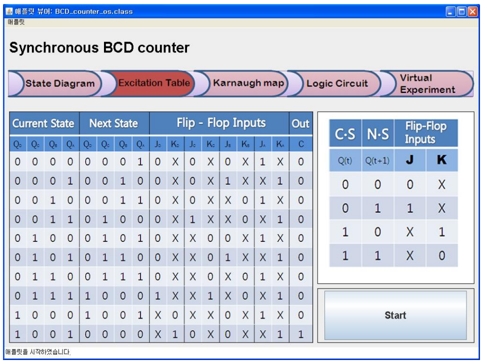
(Fig. 4) The generation of initial sate diagram



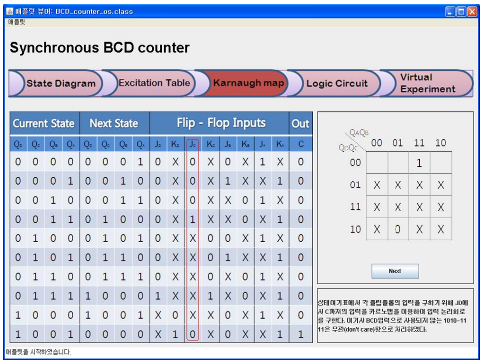
(Fig. 5a) Blank text fields for the inputs of JK flip-flops



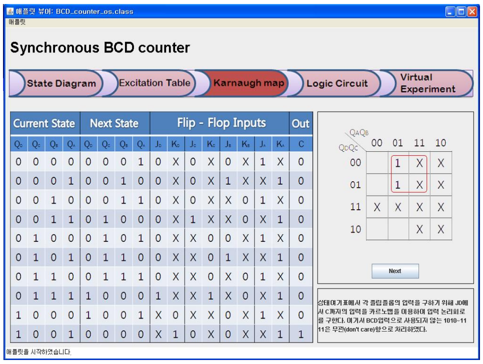
(Fig. 5b) Pop-up message



(Fig. 5c) Complete text fields

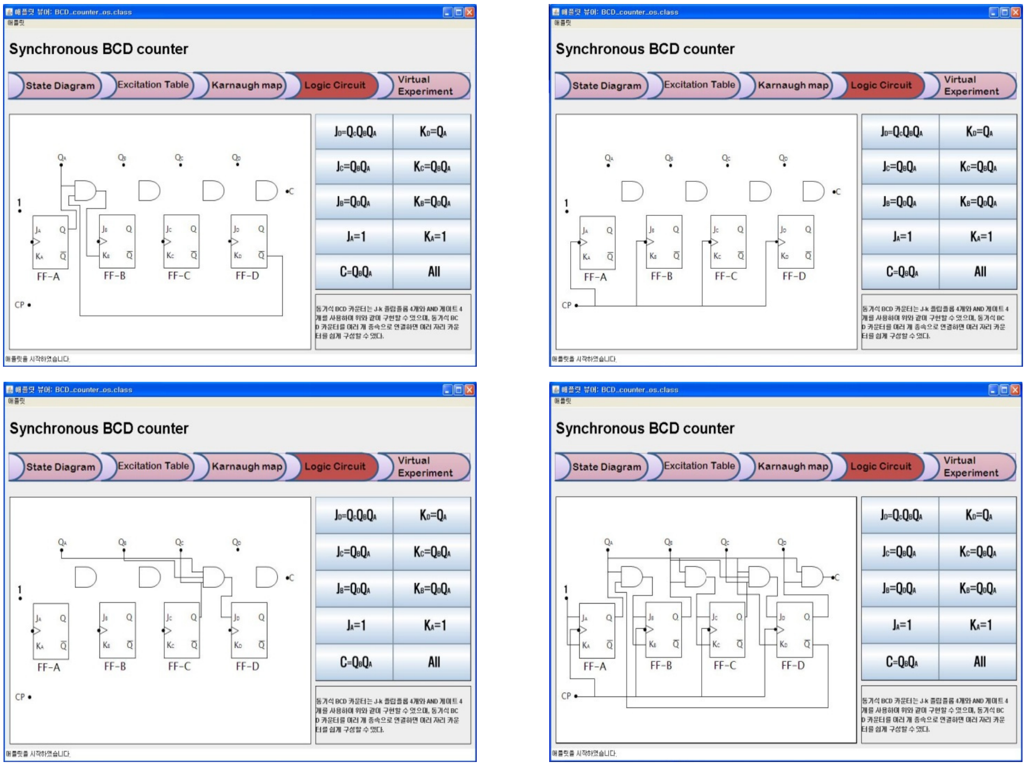


(Fig. 6a) The Karnaugh map



(Fig. 6b) The simplification process

Fig. 5a-Fig. 5c show the process that fills out the given text fields according to the excitation table of JK flip-flop. If the learners make mistakes when filling out text fields, the pop up message will be displayed promptly as shown in Fig. 5b. Fig. 6a-Fig. 6b show the Karnaugh map that simplifies the Boolean algebra for each JK flip-flop. For example, if the third input of JK flip-flop is selected, corresponding Karnaugh map will be displayed in the right-hand side. The Karnaugh map simplifies the Boolean algebra when the learners clicks the button labeled 'next' as shown in Fig. 6b. Therefore, they can easily understand the simplification process of Boolean algebra.

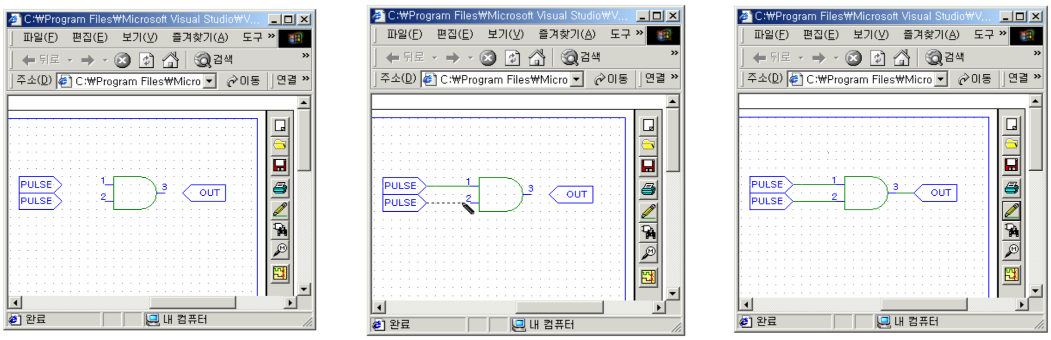


(Fig. 7) Circuit connection for each input of JK flip-flops

Fig. 7 shows circuit connection process after simplification by Karnaugh map. For example, if the learners click each input button of JK flip-flops, corresponding digital logic circuit will be displayed in the left-hand side. When they clicks all of the buttons, overall digital circuit for asynchronous BCD counter will be displayed as shown in Fig. 7, respectively.

2.2 Simulation Classroom

The Simulation Classroom provides a web-based digital simulator to the learners, from which they can simulate several digital circuits for various input conditions. The proposed digital simulator is implemented to have several simplified functions which are essential to the learning process of digital logic circuits. The learners by themselves

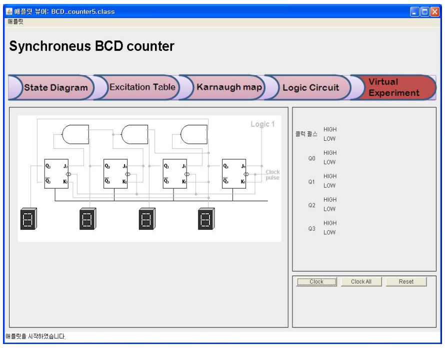


(Fig. 8) Simulation procedure for digital circuits simulate several digital logic circuits on the web for specific input conditions and the design/analysis of digital logic circuits can be available[10-11]. Furthermore, two or more different digital circuits can be simulated simultaneously for different input conditions. The proposed simulator, combined with multimedia contents, can be used as an auxiliary educational tool and can enhance the improved learning efficiency. Fig. 8 shows a web-based digital simulator which is performing simulation for logic gates. The simulation shown in Fig. 8 is performed according to the following procedure: (1) Circuit connection on the layout grid (2) Applying digital Inputs (3) Output measurements.

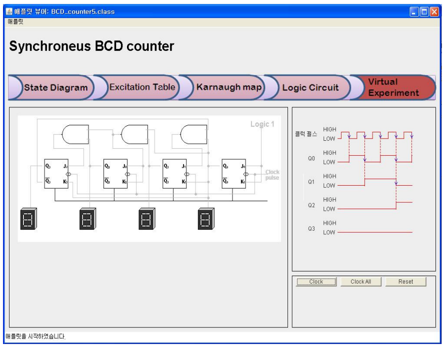
2.3 Virtual Experiment Classroom

The Virtual Experiment Classroom provides virtual experimental environment to the learners. In this classroom, the learners can build circuits for each subject, set the values for each circuit element, and measure several digital outputs using the experimental equipments. When finishing the virtual experiment on the web, the learners can print out the all information related to the experiment which can be used as preliminary report for on-campus laboratory class.

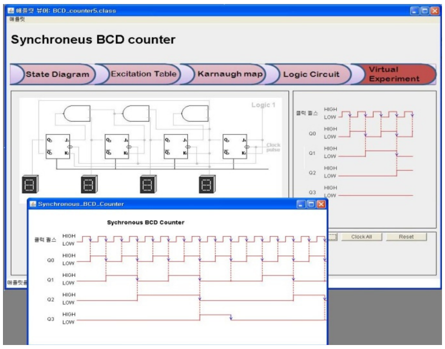
For example, Fig.9 shows virtual experiment process for synchronous BCD counter. To make virtual experiments for the synchronous BCD counter, the learners can observe the virtual experimental results when clicking the button labeled 'start'. In addition, they can make a variety of virtual experiments by changing initial states of each JK flip-flop. Therefore, the proposed educational Java applet is composed of five important steps to explain the concepts and design procedures of asynchronous BCD counter. The 1st step provides the learner with state diagram and the 2nd step provides them with excitation table of JK flip-flop. The 3rd step provides them with Karnaugh map which corresponds to the excitation table and the 4th step provides them with the related circuit connection. Finally, they can observe the output waveforms of the synchronous BCD counter for a variety of input conditions.



(Fig. 9a) Circuit connection

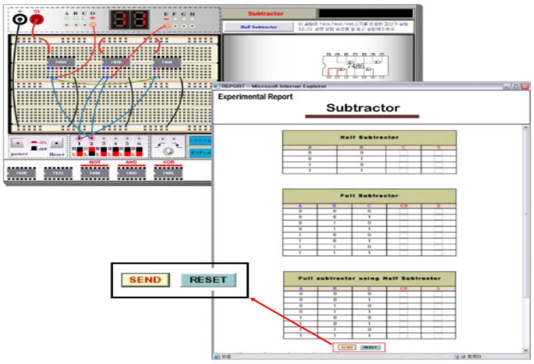


(Fig. 9b) Applying clock pulse



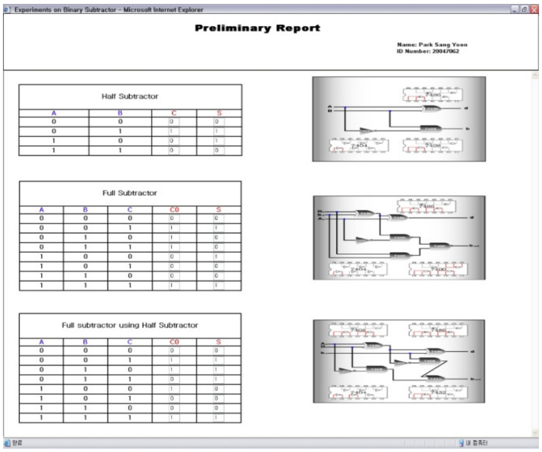
(Fig. 9c) Output measurements

In the virtual experiment classroom, every activity done there will be recorded on database and printed out as a preliminary report form. Once students fill in the text fields with the virtual experimental data and click the button 'SEND', the experimental data will be transmitted and recorded on the database as shown in Fig. 10. The virtual experimental data recorded on the database can be retrieved to generate a preliminary report form by PHP module program. Since the virtual experiment classroom is designed to provide students with slightly different environments, their preliminary reports will not be shared each other. If a student performs the same virtual experiments twice at different time, two experimental results might be different each other. Note that these situations in the virtual experiment classroom are similar to those in the on-campus laboratory. During the virtual experiment session, students obtain several virtual experimental data from their own circuits. They are required to fill in the truth tables with their own data they got from the virtual laboratory. And then they need to press the button 'SEND' provided on the bottom to submit their experimental results to the database. Also, they press the button 'RESET' and restart if there are some mistakes with filling out the truth tables. Fig. 10 shows a captured image which describes the procedure for submitting the virtual experiment results on the binary subtractor.



(Fig. 10) Submitting virtual experiment results

After pressing the button 'SEND', students obtain their own report as shown in Fig. 11. They can submit the generated report to their professor as a preliminary report before on-campus laboratory session.

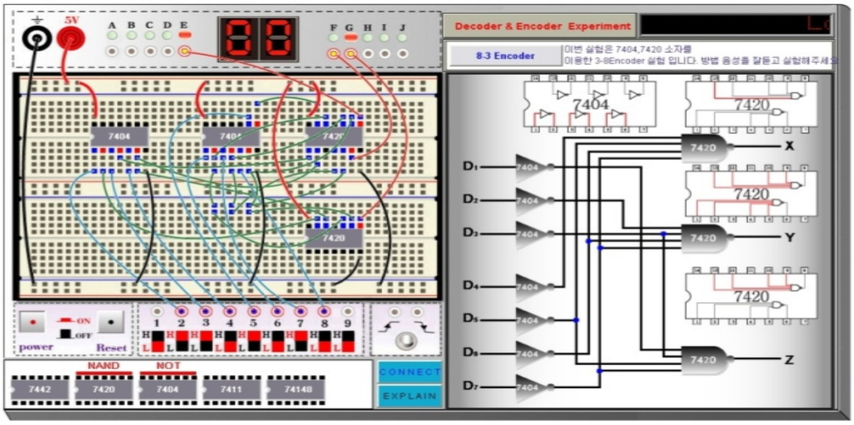


(Fig. 11) A preliminary report form

The Virtual Experiment Classroom also has an efficient virtual experiment applet with interactive and innovative multimedia contents, which can be used to enhance the quality of education in the area of digital logic circuits. An educational Java applet for virtual experiment on decoder/encoder is illustrated in Fig. 12. Note that the circuit connections on the virtual bread board(VBB) and its corresponding online schematic diagrams are displayed together on the virtual experiment applet for the learner's convenience.

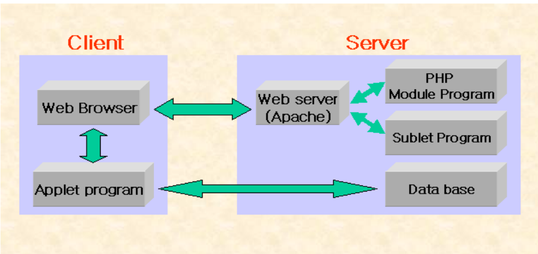
2.4 Assessment and Management System

Good instructional development is an iterative process by which the educators and learners perform formative assessments and summative evaluations to continually improve a course[12-14]. Effective instructors use a variety of means, some formal and others informal, to determine how much and how well their students are learning. In the proposed virtual laboratory system, every activity occurred in the virtual laboratory will be recorded on database and printed out on the preliminary report form. All of this can be achieved by the aid of the Management System. The database connectivity is made by Professional HTML Preprocessor(PHP) and the virtual laboratory environment is set up slightly differently for each learner. Our virtual



(Fig. 12) Virtual experiment for decoder/encoder

laboratory system, based on client/server architecture, uses none of the commercial software package. Fig. 13 shows database connectivity of the Management System using PHP.



(Fig. 13) Database connectivity of virtual laboratory

2.5 Analysis for the Educational Validity

In addition, in order to show the validity of our virtual experiment applet we investigated the damage rate of real experimental equipment during class and assessed student performance on ten quizzes for one semester. The students were divided into two groups: Group1(G1) not using the virtual experimental applet, Group2(G2) using the virtual experiment applet. The students also were asked to evaluate the virtual laboratory environment in terms of process effectiveness, degree of interactivity, and enjoyment. More specifically, for our virtual laboratory environment the students in Group2 had to rate on a 5-point Likert scale their level of agreement with the following statements.

- The virtual experiment applet was effective in supporting my learning method.
- I can obtain the appropriate level of interactivity in the real experiment through the virtual experiment applet.
- I enjoyed using the virtual experiment applet to learn.

As shown in Table 1 we have obtained several affirmative effects such as reducing the damage rate of real experimental equipment, and increasing learning efficiency. The results of our survey show strong evidence of the superiority of the virtual laboratory environment over the classical on-campus laboratory environment. In addition, we can conclude that the

Table 1. Between-group comparisons on the virtual experiment applet

	Damage Rate of Real Equipment	Average Score of Five Quizzes	Process Effectiveness	Degree of Interactivity	Enjoyment
G1	20.5%	60.5%	N/A	N/A	N/A
G2	3.8%	85.5%	4.23	4.03	4.27

Group1 : The students not using the virtual experimental applet
Group2 : The students using the virtual experimental applet
Scale: Strongly disagree 1 2 3 4 5 Strongly agree

virtual laboratory environment enables the learners to interact not only with the learning material but also with the educators.

3. Conclusions

We implemented an efficient educational Java applet for understanding the concepts of digital logic circuits, which can be used to enhance the quality of education in the area of digital circuit experiments.

Our educational Java applet shows that the difficult concepts, principles and theories related to the digital experiments can be conveyed to the learners effectively by interactive and innovative multimedia contents.

The proposed virtual experiment applet has brought several affirmative effects such as reducing the waste time and labor of both the educators and the learners, and the damage rate of real equipments, and increasing learning efficiency as well as faculty productivity. The implemented educational Java applet can be used in stand-alone fashion, but using as auxiliary learning material of the actual on-campus laboratory class is strongly recommended. The proposed educational Java applet for digital circuits can be proved a viable, effective and cost-effective aid to the educational activities both for classes and for continuous education.

The simulator proposed in this paper is available only under limited number of digital logic components, which makes the learners lose their simulation flexibility. We will challenge the advanced researches on the digital simulator with flexibility in the near future.

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ISSN 1598-0170 (Print)
ISSN 2287-1136 (Online)
http://www.jksii.or.kr

실시간으로 악성 스크립트를 탐지하는 기술☆

The Real-Time Detection of the Malicious JavaScript

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요 약

자바 스크립트는 정적인 HTML 문서에 동적인 기능을 제공하기 위해 자주 사용되는 언어이며, 최근에 HTML5 표준이 발표됨으로써 더욱더 관심 받고 있다. 이렇게 자바 스크립트의 중요도가 커짐에 따라, 자바 스크립트를 사용하는 공격(DDos 공격, 개인 정보 유출 등)이 더욱 더 위협적으로 다가오고 있다. 이 악성 자바 스크립트는 흔적을 남기지 않기 때문에, 자바 스크립트 코드만으로 악성 유무를 판단해야 하며, 실제 악성 행위가 브라우저에서 자바 스크립트가 실행될 때 발생되기 때문에, 실시간으로 그 행위를 분석해야만 한다. 이러한 이유로 본 논문은 위 요구사항을 만족하는 분석 엔진을 소개하려 한다. 이 분석 엔진은 시그니쳐 기반의 정적 분석으로 스크립트 코드의 악성을 탐지하고, 행위 기반의 동적 분석으로 스크립트의 행위를 분석하여 악성을 판별하는 실시간 분석 기술이다.

☞ 주제어 : 악성 자바 스크립트, 분석 엔진, 정적 분석, 동적 분석, 스크립트 기반 사이버 공격

ABSTRACT

JavaScript is a popular technique for activating static HTML. JavaScript has drawn more attention following the introduction of HTML5 Standard. In proportion to JavaScript's growing importance, attacks (ex. DDos, Information leak using its function) become more dangerous. Since these attacks do not create a trail, whether the JavaScript code is malicious or not must be decided. The real attack action is completed while the browser runs the JavaScript code. For these reasons, there is a need for a real-time classification and determination technique for malicious JavaScript. This paper proposes the Analysis Engine for detecting malicious JavaScript by adopting the requirements above. The analysis engine performs static analysis using signature-based detection and dynamic analysis using behavior-based detection. Static analysis can detect malicious JavaScript code, whereas dynamic analysis can detect the action of the JavaScript code.

☞ Keywords: Malicious JavaScript, Analysis Engine, Static Analysis, Dynamic Analysis, Script-Based Cyber Attack

1. Introduction

Existing web attacks are mostly of the drive-by-download type. This type of attack induces users to install the malware and execute the attack using the malware. Note, however, that a script-based cyber-attack is different because it can execute an attack only with a user accessing a particular page with a browser. The reason such attack is dangerous can be briefly described as follows:

- A script-based attack is not generated by an executable file such as malware. Since the attack is executed with the running of a script by a browser, it can easily bypass the existing intrusion detection system (IDS) and intrusion prevention system (IPS), which are used to detect the malware.
- An obfuscation method is a technology that is often used to protect the source in JavaScript; it is used by most script-based attacks to bypass the code detecting systems.
- In HTML5, JavaScript supports so many functions that it can replace ActiveX. They include not only audio, video, and other media management functions but also

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[Received 15 April 2015, Reviewed 22 April 2015, Accepted 11 June 2015]
☆ This work was supported by the ICT R&D Program of MSIP/IITP. [14-912-06-002, The Development of Script-based Cyber Attack Protection Technology]
☆ A preliminary version of this paper was presented at ICONI 2014 and was selected as an outstanding paper.

http://dx.doi.org/10.7472/jksii.2015.16.4.51