Implementation of Digital Logic Virtual Lab for IT Student

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Abstract

Currently the virtual laboratory occasionally replaces traditional classrooms due to rapid advances in computer technologies. One of the engineering subjects, Digital Logic Design (DLD) course is regarded as an important core requirement in Information Technology (IT) department. This paper presents a Digital Logic Design Virtual Lab Application. The advantage of this application is that it can simulate lab tasks on personal computer. This application was built for the use of students from Faculty of Information Science and Technology (FTSM), Universiti Kebangsaan Malaysia (UKM) undertaking TTTK 1213 Electronic and Digital Logic Design subject. By using this application, students can perform their experiment via their personal computers anywhere and at anytime. Digital Logic Design Virtual Lab Application or known as DigiLab V run as an online application. Users need to have internet connection and user account before access to the application is granted. Due to costly physical laboratory especially for IT department, the DigiLab V is designed to fulfill the needs of the knowledge for students.

Introduction

Digital Logic Designs (DLD) [1] is one of subtopics in TTTK 1213 Basic electronics and Logic Designs subject. DLD contains topics that cover the used of basic gates such as OR gate, AND gate, NOT gate including combinational gates such as NOR gate, NAND gate, X-OR gate, X-NAND gate and FLIP- FLOP. Experimenting in labs effectively helps students understand the subject better. Those theories learned in lectures need to be practiced on hand so students would know exactly what they have learned. Normal experiments usually need students to attend to the lab and finish the tasks given using tools prepared by the lecturers or lab demonstrators. But as today, technologies have played an important part in the learning process. Multimedia material such as videos, animations and graphics can be used to help students understand on how the experiments need to be conducted.

Logic Design Virtual Lab Application is an application that can simulate lab tasks on personal computer. This application was built for the use of students from Information Science and Technology Faculty (FTSM) that take TTTK 1213 Electronic and Logic Design subject. By using this application, students can do their experiment via their personal computers. Logic Design Virtual Lab Application or better pronounced as DigiLab V run as an online application. Users need to have internet connection and user account before access to application is granted. Virtual labs have been in the past years meaningful and very popular for the tutorial in various fields of subjects making used of virtual lab increasing and help us to gain a lot of information for the DigiLab V development process.

Our aim is to propose a virtual lab application, which can be accessed online, easy to use and useful. This paper will explain the research background, system overview with architecture and its characteristics. Finally, conclusions and recommendations for further work are given in the last part.

Research Background

Conventional way of experiments includes preparation of suitable tools before any experiment can be conducted. Problems that usually happen were tools malfunction and sometimes tools were limited in quantity. Preparation of tools make we lose some valuable times. When problems like this occur, it will make the experiment less precise. Moreover, students will lose their focus in doing the experiment and do the lab tasks the way it should be done.

Those theories learned in class will not be able to be understood thoroughly. Traditional labs also focus on theories that need to be tested. In traditional lab limited time is placed for students to finish their experiments. This limitation prevents students to explore more on their lab tasks due to the time constraint. Moreover, all lab work needs to be done and completed only in the labs. Therefore we need to develop an application that can overcome those problems. This application is not meant to replace the traditional lab because we still need those on hand experience.

In [2], we reviewed and make comparison with other related work. Two applications namely Hamburg Design System (HADES) [3] and Circuit Building Application (CBA) [4] were reviewed. HADES was developed by Computer Science Department, Hamburg University, German, while CBA was designed by final year student from Engineering Faculty, John Hopkins University, America.

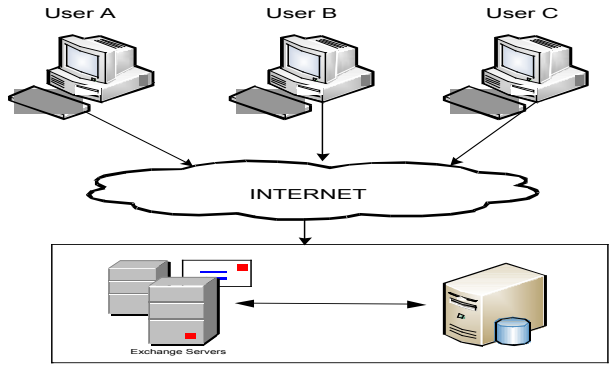
System Overview

DigiLab V is a web-based application. Students need to have user account that will give them access to the application. Virtual circuit, gates and truth table are displayed on web browser. For experimental methods, students need to enter the gate binary values on the given text area. The program will calculate the value entered and the output will be displayed.

System Architecture

The architecture for this application consists of components like user, server, databases and Internet connection. As shown in Figure 1, Internet is a connection medium between users and servers, so users need to have a web browser and internet connection to be able to use this application. A server is connected to database and only students or users who have an account can access the application.

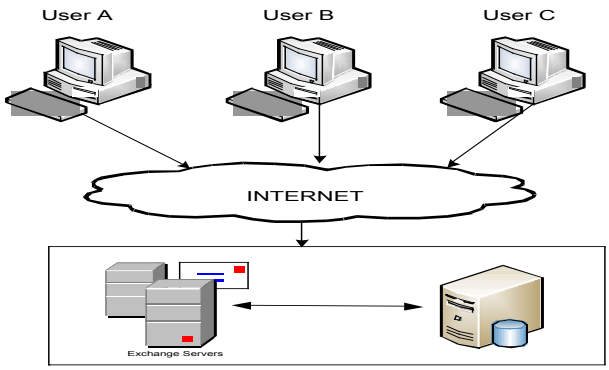
Figure 1: DigiLab V System Architecture



System Implementation

Function specification gives detailed description on the functionality of the system. It includes, building modules and sub modules that are required in the system as shown in Figure 2.

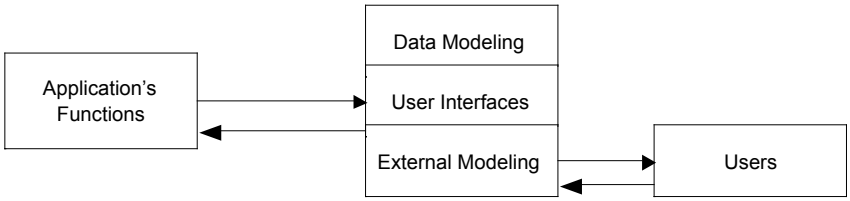
Figure 2: Functional Specification Modules



The user guide aims to provide an overview of DigiLab for the user, while the practical guide includes practical information for the system. The aim of the practical guide is to guide user with the relevant circuit component they need for the experiment. Experiment modules give a list of experiment for the lab session.

User and application can interact via the interfaces. From the interfaces, the system will perform what is desired by the user. It connects the system with the database, server and the application. Interface designs are important to determine system usability. Developing user friendly interfaces will make the application easier for user to use. This application is divided by two into sub-modules i.e. users and super users. Figure 3 illustrates the interaction between user and the application.

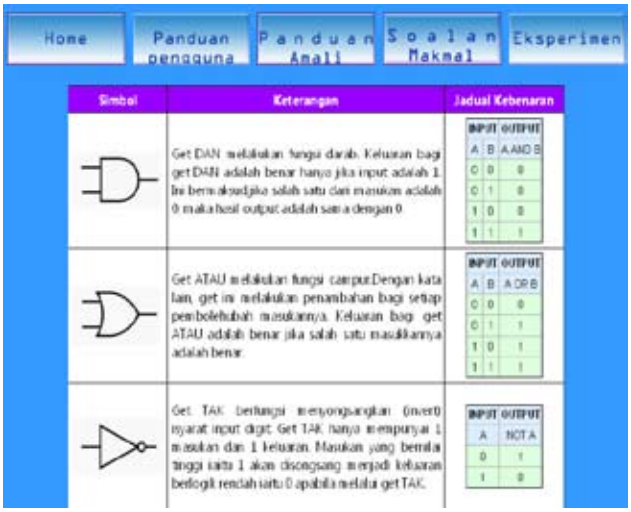
Figure 3: Interactions Between Application's Functions and Users



System Implementation of the virtual laboratory applications is developed using Java and Structured Query Language (SQL). The interface is designed with HyperText Markup Language (HTML) as the programming language with enclosed animation and also attractive graphic display. The target is to provide facility to student to study and understand digital logic design basic concept through virtual experiments without going to the lab and with the convenience of learning at their own pace. In the application development, the hardware and software requirements of the DigiLab V are determined. Both are very important to determine application development suitability so that the application can be developed perfectly to achieve the objective which has been prescribed. For experiment on this virtual circuit, student must connect each logic gate arranged based on the requirement or specification. The circuit components will be prepared on the tool where the students only need to drag and drop all the stated components on the circuit. Result of work from the circuits' extension will be broadcast through display bit 0 and 1 on the truth table. For display theory and experiment that need carried out, button theory and question will be prepared and will display on the toolbar. In order to display theory and question, new window will be appeared.

Figure 4: DigiLab V User Interface

Figure 5: Module Lab for DigiLab V



Conclusion

In this paper, an implementation of a virtual lab for logic design was presented. The components used in the application were discussed. Interaction between users and the application components is also shows in this paper. Moreover, students are able to select among various methods to perform the experiments. The virtual lab for digital logic has been used by various universities in many developed countries but in Malaysia, the use of this application by universities and colleges are still low. DigiLab V application will work as a starting point for further development in the future.

References

01. M. Morris Mano, Digital Design, 2nd edition, Prentice Hall, New Jersey, ISBN 0-13-212937-X.
02. Rosilah Hassan, Nazlia Omar, Haslina Arshad and Shahnorbanun Sahran (2008), A Design of Virtual Lab for Digital, WSEAS 7th International Conference On E-Activities 2008, Cairo, Egypt, Dec 29-3 2008.
03. Hamburg Design System (HADES) at http://tamswww.informatik.uni-hamburg.de/applets/hades/html/
04. Circuit Building Application at http://www.jhu.edu/virtlab/logic
05. Pisani, U., Cambiotti, F., Corinto, F and Romano, G. (2004), A fully simulated laboratory for instrumentation and electronic measurements, Proceedings of the 21st IEEE Instrumentation and Measurement Technology Conference, IMTC 04, Volume 2, 18-20 May 2004, pp 1277–1281.
06. Colace, F.; De Santo, M.; Pietrosanto A. (2004), Work in progress-Virtual Lab for Electronic Engineering, 4th

Annual 2004 Curricula Frontiers in Education, FIE 2004, pp: T3C/22 - T3C/24 Vol. 1.
07. Zysman, E (1997), Multimedia Virtual Lab in Electronics, IEEE International Conference on Microelectronic Systems Education MSE, 21 - 23 July 1997, pp.151– 152.