ADOBE Flash Lite-Based Online Laboratory for Mobile Phones

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Abstract—**Recently, development of "Microelectronics and VLSI Engineering" Laboratory at IIT Kharagpur (http://lod.iitkgp.ernet.in/netlab), an innovative remote microelectronics device characterization and parameter extraction laboratory has been reported. The laboratory enables students to measure different semiconductor device characteristics and extract device parameters at any time and from anywhere using a Java-enabled web browser. Having pioneered the PC-based online laboratory to enhance microelectronics education, feasibility of use of mobile devices for hardware-based remote experimentation is explored. The work introduced in this paper is a prototype of the use of mobile devices in laboratory education.**

Index Terms—**m-learning, laboratory education, flash lite, online laboratory**

I. INTRODUCTION

Laboratory courses on hands-on experiments are an integral part of engineering education. The use of new teaching and learning technologies is central to the distance education academic programmes. With the advancements in computer technologies to high-speed processors, the World Wide Web (WWW) and wireless communication, it is now possible to execute hardware-based engineering laboratories from a remote personal computer (PC) [1]. Recently, the convergence of mobile phones and personal digital assistants (PDAs) into smart phones has taken place. New technologies (such as the internet, wireless communication and other systems) offer further new possibilities to provide access to experimental setup without using a conventional PC. Various types of teaching/learning activities using mobile devices, where students can access information through the internet have been reported [2]. However, despite the significant potential of mobile technologies for possible use as learning tools in higher education, its use currently appears to be very limited. To the best of our knowledge the use of mobile devices in performing hands-on remote-controlled experiments for laboratory teaching has so far not been reported. It seems now possible to implement experimental online laboratories in more advanced, efficient, highly interactive and very user-friendly mobile phones.

Adobe Flash Lite is a highly optimized implementation of the Flash runtime for mobile phones, consumer electronic devices, and Internet-connected digital home devices. Flash Lite 2.0, based on Flash Player 7, supports Flash 7's newer ActionScript 2.0. According to Strategy Analytics, the number of Flash Lite enabled devices will reach more than 2.5 billion by the end of 2010. Thus mobile devices will provide greater flexibility in students' laboratory education in future.

The goal of this paper is to develop a hardware-based laboratory for microelectronics education and assess whether these laboratories performed at home or elsewhere are effective supplement for traditional laboratory courses. This paper explores ways to implement online hardware-based laboratories in mobile phones. Design and implementation of the online laboratory system in flash-enabled mobile platform such as pocket PC, smart phone, PDA etc. using FLASH Lite 2.0 are described.

II. MOBILE TECHNOLOGY: ROLE IN LABORATORY EDUCATION

Information technology (IT) applications offer important potentials to education, allowing a possibility of continuous enrichment of the learning material. Education and learning system need to be redirected along the development of the new technologies. The mobile devices technology appeared in the 90s. In the beginning, it was used as electronic note book and calculator. With the advances in mobile technology, they are now almost similar to personal computers, as far as hardware such as boards, memory and processor. It is expected that the mobile technology will be implemented in a big way in technical education due to its potential for accessing information anytime from anywhere. Specific software is being developed for these devices to perform the same activities such as accessing a text editor, data base, e-mail etc. Mobile devices are also capable of accessing the internet with an easy reading screen and folding keyboards making the viewing easier. Advances in the wireless technology will also make the mobile learning more user-friendly and mobile learning will become the most used system as the expense for the mobile devices is much less than a PC or a notebook. The use of mobile technology will complement the electronic portal in terms of learning activity and experiences as the students can communicate and interact with other students and also the teachers in real-time. Integration of mobile technology in remote online laboratory design is described below.

III. SERVER AND CLIENT CONNECTIVITY

The communication between the server and client is based on direct TCP/IP programming with the API for HTTP communication with LabVIEW [1]. As the server is started, it keeps listening on a specified port (HTTP 80). When it detects a connection from a client, it first reads from the socket the parameters for a signal generation and acquisition. The server then runs a RESTful web service which performs the experiment using signal generation

and acquisition operations. As a voltage is applied to the experimental setup and the responses are measured and stored to be sent back to the client. A response in XML format is sent back and the client converts the data and displays it to the user.

IV. THE CLIENT – ADOBE FLASH LITE 2.0

The client side of the application is built using Flash lite 2.0. The Flash lite program is designed to look simple and fits within a small display area. The program developed basically has two parts:

1. Logging in and booking: The user uses this interface to enter the login credentials. All data are exchanged in XML. The server side consists of java servlets and java server pages and oracle as database. The mobile virtual laboratory client application will parse XML file, if the login is valid and then it will display the list of experiments according to the student's user group. Then the student shall have to choose a date from Date combobox and press GET button to get the available time slot on the date in time combobox. After that the user may book the time for an experiment which is then stored in the data base. Additionally a 'CHECK NOW' facility is provided to check and book the current time slot, if available (see Figure 1).

2. Experimental part: The student chooses an experiment from the list of experiments to perform. Then (s)he can either download the Shockwave flash file and run it in the flash lite standalone player or run it using the browser, if available and inputs a valid login and password and requests access to the laboratory instrument server. The server validates and allows the user to run the experiment. Otherwise, the RUN button remains disabled and the user cannot perform the experiment (see Figure 4).

While performing the experiment, the user enters input parameter values and submits them to the server. The server performs the task using the hardware with the input parameters and generates results. The results are then sent back to the user's mobile. The student can rerun (with different parameter values and after a waiting period) the experiment, if desired, during the time slot after which the application will automatically close. Once satisfied, the student can ask the server to save the measured data which is then saved in the server and can be downloaded later.

V. CASE STUDY: MICROELECTRONICS AND VLSI ENGINEERING LABORATORY

The purpose of using the mobile devices for accessing online laboratory is to allow a higher mobility than that offered by PCs, and also making possible for the students to work together (cooperative learning). The students should use the mobile devices to access the website http://lod.iitkgp.ernet.in/netlab. The home page of the Microelectronics and VLSI Engineering laboratory as seen in the mobile device (HTC HD2) is shown in Figure 2. However, the developed webpage when accessed through the mobile devices has a different look (layout) from the one when accessed through a browser PC, due to screen and other limitations in the mobile devices. The information is the same but only change is in the arrangement and size. Screen limitations do not prevent the activities from happening, because the goal is to access the experimental

Figure 1. The Flash Lite simulation in Adobe Device Central CS5.

setup for conducting the experiments. The SMS function can also be utilized for communication with a student and/or teacher facilitating a better learning environment.

The learners will receive messages upon registration via the mobile using their respective mobile numbers. Each user need to register to get a username and a password as well as a profile stored in the database. After login the student has to select a particular experiment and proceed. Each experiment has the following features: a laboratory manual (see Figure 3), description of the experiment, experimental procedure etc. As the laboratory management system works in a batch mode, it distributes the time in slots and each user has to select and choose a particular time slot for performing the experiment. However, the experiment manuals etc. are available all the time. Only after students log on (during booked time), they can access the experiment pages. The html pages contains embedded object which are basically created using the LabVIEW Web development tool. The html files are hosted and distributed by an in-built LabVIEW web Server. The interface in derived from the VI files created in the LabVIEW 2009. During the experiment, the student takes over the control of all the equipments and can set the necessary experimental conditions from the mobile device. The measurements are made and the data are transferred. The html pages also contain learner information and display the time left during experimentation. Once the time is over, a JavaScript function displays a warning and then closes the window. As the time slot or the duration of experiment is over, the link is broken with a warning. The user has limited number of chances to book and perform the experiment. This is done to optimize the use of the resources.
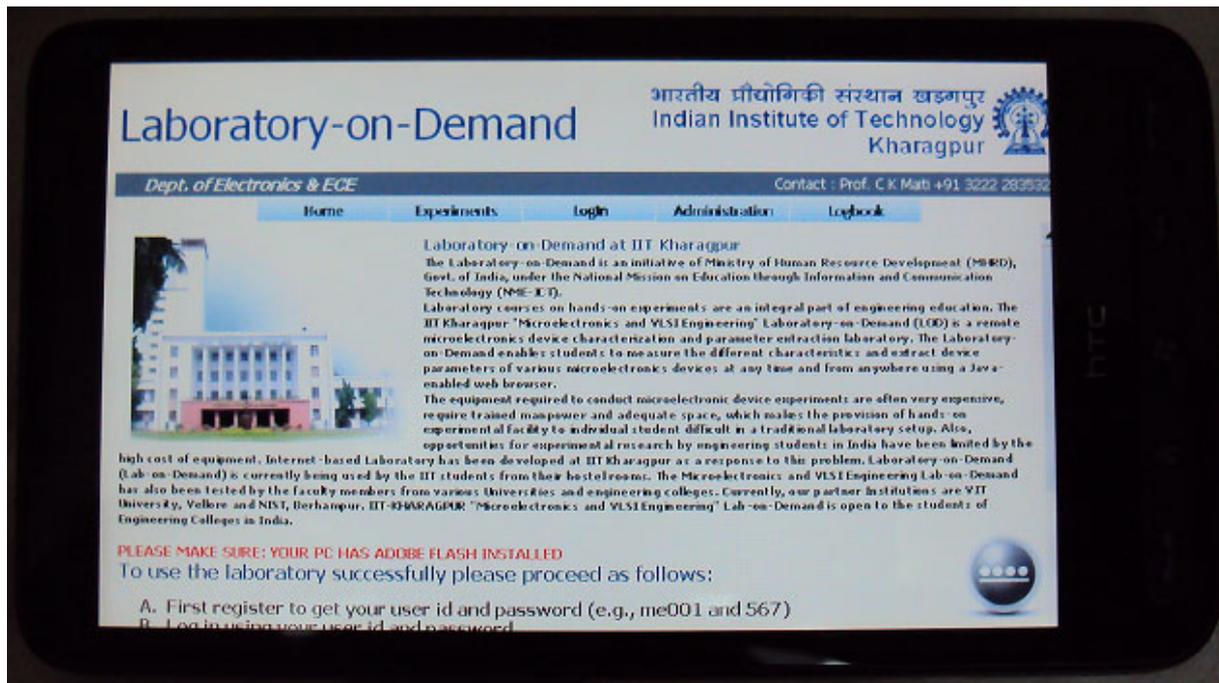
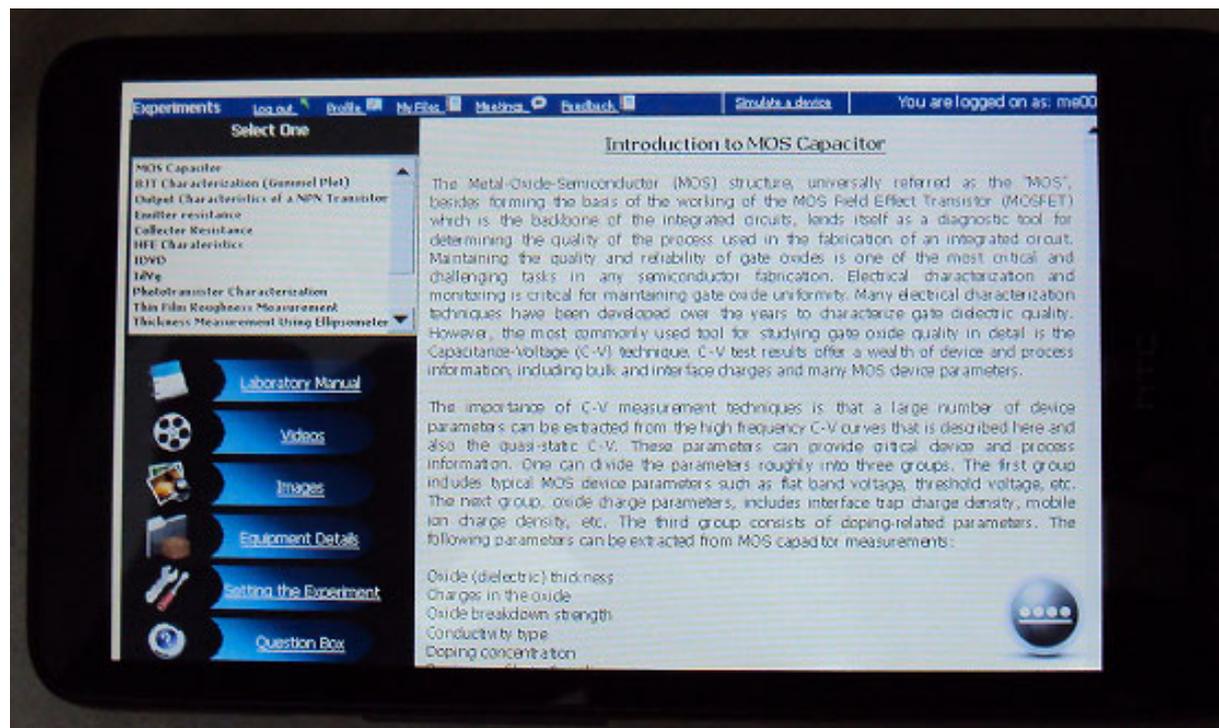Figure 2.   Home page of Microelectronics and VLSI Engineering Laboratory (in HTC HD2).

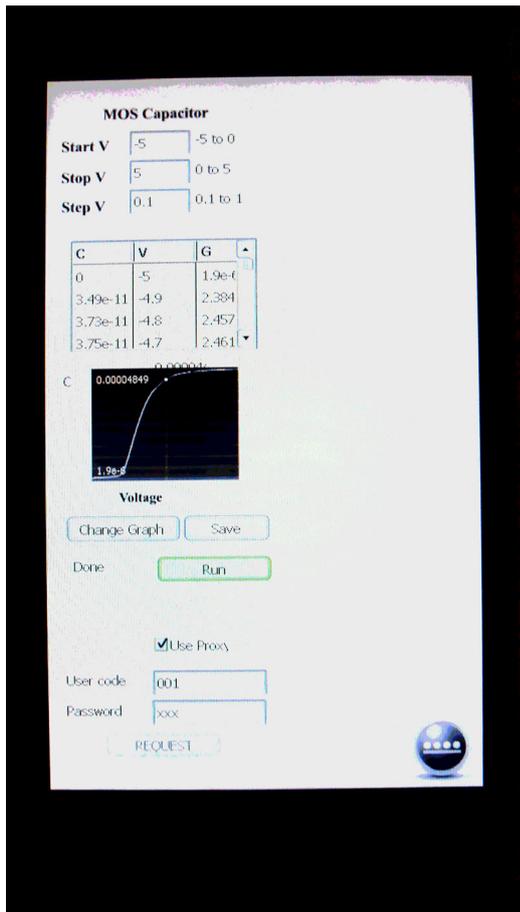Figure 3.   Online laboratory manual page (in HTC HD2)

Figure 4. Microelectronics and VLSI Engineering Laboratory: Experiment RUN file run in Flash Lite Stand Alone Player (in HTC HD2).
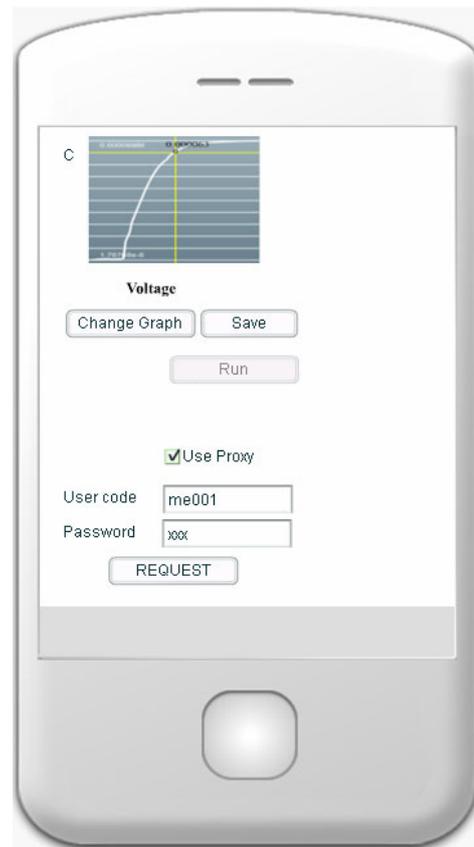

Figure 4.   The Flash Lite simulation, in execution after the student has run the experiment, in Adobe Device Central CS5 and now the student has to wait for a definite time interval

VI.   CONCLUSION

Applications of mobile technology using Adobe Flash Lite in remote online laboratory design are reported. The main goal of this paper has been to use new techniques of information and communication technologies, specifically the use of mobile devices and demonstrate its usefulness in remote hardware-based laboratory teaching. It is shown that the use of mobile devices in online laboratory provides greater flexibility in student learning as one need not to be at home or laboratory to perform the experiments. We expect that the successful demonstration of using mobile devices in engineering laboratory education may also be implemented in other laboratories and will be accepted by the scientific community involved in development of laboratory education.

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