Implementation of a Low Cost Pedagogical Virtual Simulation Tool for Project Based Learning

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Abstract: Here a project-based learning strategy is proposed as a pedagogical tool for embedded system education targeting for undergraduate engineering students. It's possible applications has been discussed in the educational process for the students of embedded systems and for all other students. An acute need of some specialized education in the field of the embedded system is required in order to let students be work-ready engineers in various industrial fields. It is believed that the updating of our courses will provide better education for tomorrow's engineers who will design and build complex embedded systems. There is a need to reform existing experimental teaching models, methods and laboratory platform to improve system level innovation practice for undergraduate students.

Key-Words: Embedded Systems, Microcontroller, Virtual Simulation, Proteus

INTRODUCTION

Although most students are familiar with computers, very few of them know that they are meeting with embedded computers daily. Embedded system is a cross-disciplinary field, requiring an engineer to have the attributes of both a hardware engineer and a software engineer. However, most of us come at it from computer science or electrical engineering, so we have to learn the other half of the job. It makes for some interesting compromises. Embedded systems are applied in various products and the demand for them is very high. However, there is shortfall in human resources of embedded system engineers in India. Embedded System is unique for its close association with actual application, thus an effective laboratory education is of great importance for embedded system curriculum. As far as the Traditional Learning Methods are concerned we have some following limitations. First of all we need to have separate hardware modules to perform individual on board experiments, microcontroller specific kits and programmers like for 8051, AVR, PIC, Arduino, etc. We need to procure specific ICs, sensor modules, actuators, motors and other components each time when developing a new hardware. The hardware development cycle is a costly and time-consuming process. There is a limitation to upgrade or make alterations in the existing embedded hardware design. Also this bulky hardware possesses low portability. We need a proper workshop/ lab set-up to start working on embedded system design even if you are a beginner. Establishment, maintenance and up-gradation of embedded system design lab is a costly method to start.

PROPOSED METHODOLOGY

Using a Virtual Simulation Package you can access most of the hardware modules and components from its vast library. So using this virtual platform one can perform a large number of experiments. It's a portable virtual workshop as no discrete components like resistors, capacitors, diodes, transistors, relays, integrated chips and programmers are required while using this platform. So procurement of hardware modules and components is not required. What you need, you will get from library itself. It provides comparatively low cost hardware development with less time consumption. There is no limitation to upgrade or make alterations in the existing embedded hardware design. Source Code Editor, Compiler, Simulator and PCB Schematic & Layout Editor are all in the same package. Free of cost student version is available for beginners for development. So no lab set-up is required before starting. Establishment, maintenance and up-gradation of embedded lab using this Virtual Simulation Package is a low cost solution. The participants can check own software design and digital hardware designs using this system. It Provides a more interactive and illustrative way of performing lab experiments. It promises to provide simulation results in real-time. It's a low cost solution for embedded laboratory education. The tutorials and full technical support is ready available on the internet.

IMPLEMENTED METHODOLOGY

The Proteus Design Suite is an Electronic Design Automation (EDA) tool including schematic capture, simulation and PCB Layout modules. The software runs on the Windows operating system and is available in English, French, Spanish and Chinese languages. The Proteus Design Suite is a Windows application for schematic capture, simulation, and PCB layout design. It can be purchased in many configurations, depending on the size of designs being produced and the requirements for microcontroller simulation. The system has been implemented around an eight bit microcontroller i.e. AT89S52 supporting the following features 40MHz, 5 Volt 8051-based Microcontroller with 32 I/O lines, 3 Timers/Counters, 9 Interrupts/4 priority levels, 64K+8K FLASH, 1K on-chip RAM, SPI, Dual Data Pointers, WDT, 5-channel PCA, built-in UART module. The implemented education package can be used to train students in Embedded System courses for topics such as assembly and C/C++ programming, processor architecture, memory system handling, peripheral control, system performance, real-time operating system, and development environment with overcoming the demerits of hardware-based kits. The design pay more attention on developing student's professional skills that will serve students well in their careers besides the requisite related basic theory.

EXPERIMENTAL RESULTS

By conducting these experiments, students learn system modeling, hardware/software trade-off and development of software and hardware modules in a more easy way.

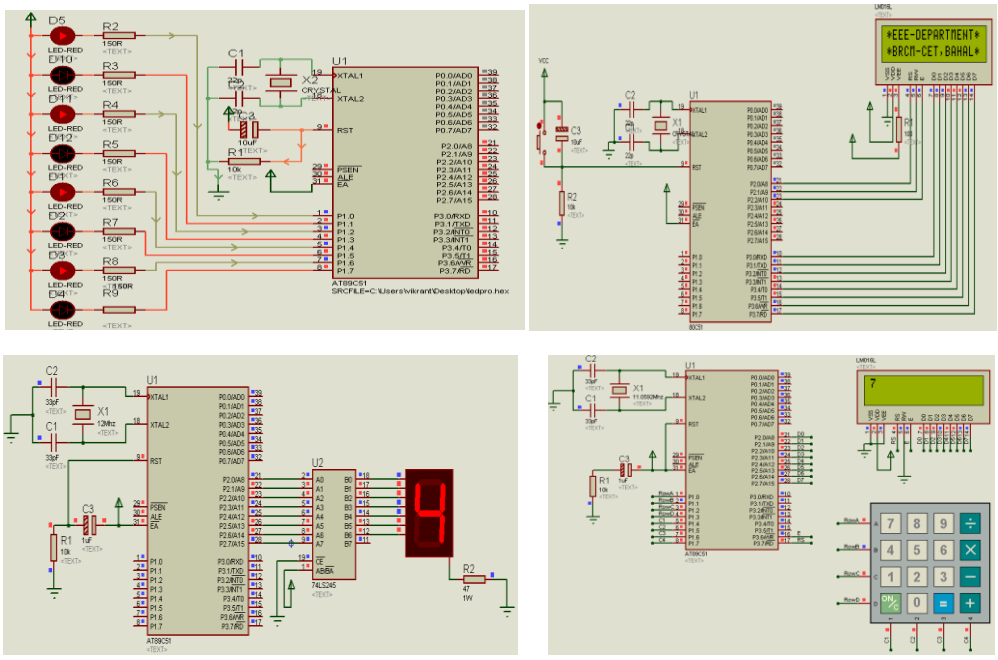

Figure-1: Interfacing of 8051 microcontroller with LEDs, LCD, 7-Segment & Keypad

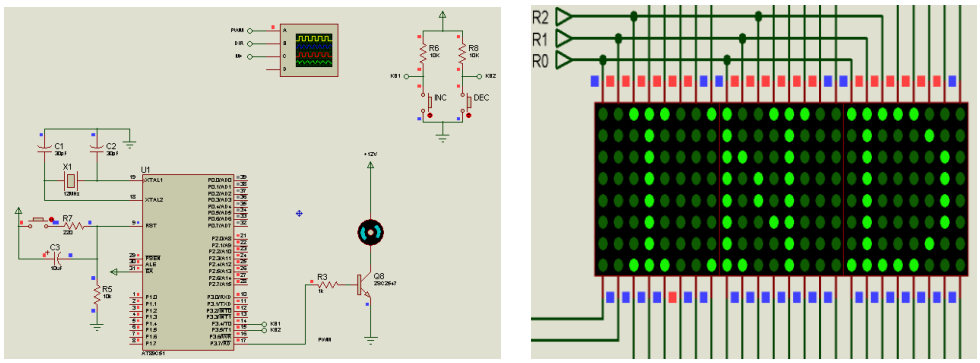

Figure-2: Implementation of 8051 microcontroller based DC motor control & LED Display

CONCLUSION AND FUTURE WORK

A project-based learning strategy is proposed as a pedagogical tool for embedded system education targeting for undergraduate engineering students. The presented model of learning has a potential of being highly motivating for younger students and highly educational for the embedded systems students. The aim of this work is to utilize an embedded system that is compelling for students with various interests. This work deals with a simulation-based education package for laboratory works in Embedded System courses. The education package (Proteus) can be used to train students in Embedded System courses for topics such as assembly and C/C++ programming, processor architecture, memory system handling, PCB designing, system performance, real-time simulations, and development environment with overcoming the demerits of hardware-based kits. The participants of the training course can do maximum self-learning. The participants can check their own software design and digital hardware designs using this platform. In this work, dedication is shown to reform existing experimental teaching models, methods and laboratory platform to improve system level innovation practice for undergraduate students.

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