MODULE-BASED EDUKIT FOR TEACHING AND LEARNING MICRO-CONTROLLER PROGRAMMING

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ABSTRACT

This paper describes a project where the aim is to develop an Educational Kit (EduKit) for teacher and student of different disciplines in science and engineering. The EduKit is module-based where the controller is on the main module or motherboard and each of other modules or daughter board relates to various types of engineering application. Motherboard and daughter board can easily be plugged in to run a specific application. It will help them for easy familiarizing and programming a micro-controller and then make them able to develop a real world application. It will also help the people from industries and research organizations to develop prototype of their micro-controller based applications in easy and fast way. The project is on-going and this paper will describe the intended directions and projected outcomes.

INTRODUCTION

Presently Micro-controller (MCU) is being widely used in virtually every field of science and engineering. Hundreds of electronic products are based on different types of MCU that simplifies the task of our daily life. The knowledge of MCU, which was once the monopoly of Electrical and Electronic Engineers, has now a demand for the people of all science and engineering disciplines. It is also the requirement of ABET that engineering students must demonstrate a knowledge of data acquisition and processing control in which use of computers, microcontrollers are essential [1-2]. Therefore, a strong curriculum surrounding MCUs at various levels of education are being introduced in different Universities, Colleges and Schools [3]. Educational theorists provide categorises learning on a scale from lowest to highest levels 5. Memorising facts occupies the lowest levels, while applying learned facts to practical situations occupies the middle ones, and analysis, design, and evaluation the highest ones. Although memorising facts and concept comprehension are unavoidable, in technological education emphasis on applications, analysis, and design is required. Moreover, application, analysis and evaluation give the students the real joy and excitement in learning. A course on microcontrollers should pay attention to all the learning levels, from the lowest to the highest ones.

Since people from different disciplines need to be familiar with MCU, the approach of teaching microcontroller courses are also being changed [4]. Many non-electronic engineers are easily confused by microprocessor and micro-controller. They often view it as a mysterious device which they think they will never understand at all. The new teaching approach is supposed to be appealing to the beginners of MCU and need to spark their interest easily so that they are not easily discouraged by the complexity of the MCU's architecture and software. Rather it is based on teaching micro-controller as a design tool and emphasizing its use in solving real world problems of science and engineering. It is accomplished through teaching students a minimum base of information which is essential to using microcontroller but more importantly teaching them a design methodology which they follow and build upon when they move on to industry.

For successful implementation of MCU courses in all required levels of education, it is essential to have suitable EduKits for teaching and learning micro-controller programming as well as for real time application development. It should be affordable, user friendly and flexible.The following sections describe the motivation of the proposed Edukit, conceptual design of the Edukit, use of the EduKit and its benefits, and finally concluding remarks.

MOTIVATION FOR THE PROPOSED EDUKIT

Different types of training tool for micro-controller teaching and learning are available in the market from different microcontroller manufacturing companies as well as from third party companies [5]. For example: Motorolla, Intel, microchip, Zilog, Atmel etc. offer microcontroller training board with different features. However the boards have been developed based on the concept that the users are having knowledge of Electronic or Computer Engineering. The applications that the boards can facilititate to implement are orieneted towards the said area of engineering which may not be suitable to explain to the users of other disciplines. The components required for the applications are assembled on a big size single PCB (printed circuit board). Microcontroller beginners can easily be panic and drowned into disappointment with the view of crowdy components on a single PCB.

A module-based EduKit for familiarizing and programming microcontroller has been proposed in this paper. The microcontroller and some very common components such as switches, power supply, connectors etc. will be mounted on the mother board. The components required to develop different applications will be mounted in the respective daughter board which can be plugged in with the mother board to run the application. The main objectives of this board is: (i) to take students from the basic principles to the practice of microcontroller programming (ii) to make suitable for the people from different discilplines of science and engineering. User can select and buy the application daughter boards based on their background and ability (iii) to make it simple and afforable at low cost.

CONCEPTUAL DESIGN OF THE EDUKIT

PIC16F84 microcontroller from microchip company has been chosen for the project due to its low cost, simplicity, availability and many other attractive features. It's low cost, low consumption, easy handling and flexibility make PIC16F84 applicable even in areas where microcontrollers had not previously been considered [6]. It is an 8-bit microcontroller of RISC architecture. It has reduced set of instructions, more precisely 35 instructions which is very helpful for the beginners of the microcontroller whereas Intel's and Motorola's microcontrollers have over hundred instructions. Some of the nice features of PIC16F84 are: (i) extremely well documented on the web that are available for download (ii) availability of good commercial and enthusiast sites (iii) Electrically Eraseable Programmable Read Only Memory" ("EEPROM") cells which can be serially programmed by the user (iv) In-Circuit Serial Programming ("ICSP") which offers the flexibility of a prototype development of a product (v) PIC16F84 perfectly fits many uses, from automotive industries and controlling home appliances to industrial instruments, remote sensors, electrical door locks and safety devices.

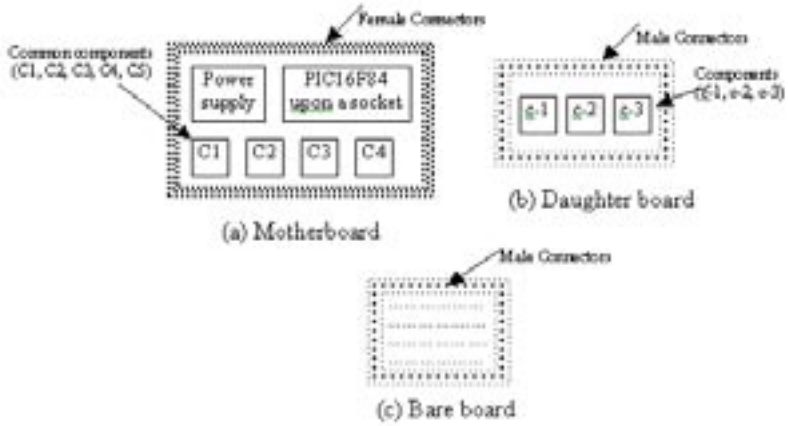

Figure 1: Conceptual motherboard and daughter board of the proposed EduKit

Figure 1 shows a conceptual design of the Edukit where 1(a), 1(b) and 1(c) indicates a sample of motherboard, daughterboard and bare board respectively. Motherboard will be equipped with PIC16F84 processor, power supply and usually used common components for different types of applications such as resistors, capacitors, switches, and diodes. Common components in the motherboard have been indicated by C1, C2, C3, C4 etc. There are female connectors around the periphery of the motherboard. Daughter board is equipped with components required to develop specific application as indicated by c-1, c-2, c-3 etc. It has male connector around the periphery. Motherboard and the daughter board can be easily plugged in and out through the connectors. The bare board is without any components. The students can use this board to implement their own idea.

USE OF THE EDUKIT AND IT'S BENEFITS

Earlier it has been pointed out that the objective of the proposed Edukit is to develop an educational facility for using microcontroller as a design tool rather than learning every detail about the microcontroller itself. To realize this goal, few daughter boards will be developed to make students familiar with the basic functions of the PIC. It will be demonstrated to them in such a way that highlights the basics of the PIC such as meaning of different assembly instructions, input/output, timing systems and interrupts. Once students have grasped the basics of PIC programming and are familiar with what microcontroller can do as a design tool, then they can move on to designing and modeling to specific applications. For this purpose, a number of daughter boards will be developed to implement specific applications related to the different disciplines of science and engineering. At the beginning, the problems and its relevance to the real world situation will be explained to the students to motivate as well as to create their interest in solving the given problems.

Students will be introduced with both assembly and C in developing the applications. In basic PIC programming, they will use assembly while C in complex applications. 'C' is an ideal and powerful high-level language to develop micro-controller applications [7]. It reduces the time required and complexity of coding; hence allow them to develop more complex and meaningful applications. However, assembly cannot be avoided by any means. Teaching assembly is an essential part of learning micro-controller. If programming is done using only high-level language, students will lose all sense of what is really going-on with micro-controller [7]. It is through assembly programming that the students learn the inner workings of the micro-controller. In fact, a student who knows assembly is better equipped to debug 'C' programs. Moreover, there are some cases where assembly language is the only option to develop the application.

The advantages from the proposed EduKit and its intended way of use are as follows:

- The EduKit will fit for students from any disciplines of science and engineering since it is module-based. They can choose the daughter board applications based on their background and financial ability
- It will take student from very basic of the microcontroller to the development of real-world application
- It will enable more able student to develop at their own pace while the less able student to catch up
- It will enhance their job opportunities since students will get hands-on experience using the EduKit
- It will open the opportunity of co-operative learning and positive teamwork since students from different background can acquire knowledge and skills in use of microcontroller

CONCLUSION

Knowledge and skill in micro-controller technology is a demand in this era. Suitable and affordable training tool in micro-controller programming is essential for this purpose. The proposed EduKit will be complementary of the new micro-controller curriculum. Its suggested use in this paper is expected to satisfy the needs of the students in the most effective way. The Edukit can also be used as a teaching tool for distance learning of micro-controller programming.

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