Arduino Based Microcontroller Learning Media on Improving Electrical Engineering Student Skills

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ABSTRACT

In learning activities, teachers are required to be able to carry out an effective knowledge transfer process. Teachers are expected to be able to map what abilities must be mastered by electrical engineering students in a particular course. With the development of technology, lecturers and students are required to be able to follow every development that occurs, especially in the field of industrial automation technology so that the learning process can provide positive outcomes for students and able to apply their expertise outside the campus, especially in the field of industrial automation. One of the courses related to industrial automation technology is microcontrollers. Microcontroller is an electronic device that can perform certain tasks automatically. There are certain peripherals in microcontrollers that are used to perform certain tasks in industrial automation systems such as ADC, digital input output, PWM, serial communication, interfaces, and others. The problem that occurs in lectures is the lack of learning media that can accommodate students to learn microcontrollers and the learning media used is not well integrated and the media dimensions are too large. The purpose of this research is to develop and create Project-based Learning (PBL) media in microcontroller courses in improving student abilities with portable media dimensions but still able to facilitate students in learning peripherals of microcontrollers, especially Arduino-based microcontrollers. The results obtained from this study are the prototype of portable microcontroller learning media and increased student understanding of microcontrollers peripherals and their applications in certain automation systems.

Keywords: *Arduino, Learning media, Microcontroller, Project-based Learning.*

1. INTRODUCTIONS

Technological development is a real form of the implementation of human thought that is increasingly advanced and developing. Currently the development of technology is running rapidly and this condition indicates that human thinking is able to adapt to developments that are happening around us. We can see technological development all around us, starting from communication technology, transportation technology, manufacturing technology, security technology, and others. The rapid development of technology, science and art has consequences where these conditions must be seriously accommodated [1].

This research takes topics related to the progress and use of technology in the world of education. With technology that is always developing, it also provides a challenge for the education sector to continue to innovate in the process of learning activities so that students can gain knowledge and competencies that are in line with the world of work one day, especially in universities with engineering competencies.

The Engineering Department of an institution expected to be able to produce human resources who can compete in the industrial sector where the industrial sector requires competent resources in the field it occupies. With the high demand from the industrial sector, the task of institutions is to facilitate students with learning materials that are in accordance with the curriculum, adequate infrastructure, and a comprehensive learning process with innovative changes. The changes that occur in the learning process that are so fast are to meet the requirements of the conditions in today's digital era [2].

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One of the innovations that can be developed in an education sector is an innovative learning media that will be used by electrical engineering students. There are several studies that take the topic of learning media ranging from application-based learning media, simulations to trainer kits. As an example of research conducted by [3] creating an IoT-based learning media to increase students' understanding and skills in the field of IoT. In research conducted by [4] has created an Arduino uno-based learning media platform for physics subjects related to uniform circular motion. Research conducted by [5] created a learning media for physics subjects related to the topic of collisions using the Arduino microcontroller. Research conducted by [6] created a microcontroller-based robot trainer learning media where this trainer focuses on the use of microcontrollers in robots. The latest research conducted by [7] is a portable microcontroller-based trainer learning media that aims to find out the functions and peripherals of the microcontroller.

In this article research has been carried out by making research based on [6] and [7] as the references in the making of microcontroller-based trainer as learning media where the learning media offered in this study has advantages in terms of trainer dimensions which when compared to the two studies above have the advantage of small dimensions so that they can be carried anywhere easily when compared to previous studies using suitcases. With a small and practical trainer dimension, it is expected to be able to become an advantage of the trainer developed in this study so that it is expected to be able to attract students' attention to be able to study anywhere.

The learning media made in this study is based on the Arduino microcontroller, but the main purpose of making this trainer is to help students know and understand the peripherals contained in the microcontroller. Students are expected to be able to understand some basic things on microcontrollers such as analog peripherals, digital input output, pulse width modulation (PWM), serial communication and others. With the basic knowledge and understanding possessed by students regarding the functions and uses of each peripheral on the microcontroller, it is hoped that it can be applied and developed in any plant or system according to industry needs one day based on the problems and needs that exist in real problems.

2. METHOD

The method used in this study uses the Research and Development method. The 4D method can be divided into 4 parts to create a product including Define, Design, Develop, and Disseminate as has been done by [8].

2.1. Define

The define stage is the initial stage in determining what material is needed in making an Arduino-based microcontroller trainer product and what competencies are expected to be mastered by electrical engineering students after studying or using an Arduino-based microcontroller trainer. At the define stage, several activities are carried out to support the product manufacturing process, for example, a discussion process is carried out with several teaching parties to find out what things are needed by students in learning the microcontroller and studying the curriculum used in the learning process so that with these activities it is able to fulfill understanding and student knowledge.

2.2. Design

At the design stage, the process of designing the electronic schematic of the microcontroller trainer is carried out according to the parameters that have been obtained at the define stage. In the design process, it is also necessary to determine which devices or components will be used in the microcontroller trainer. In this process everything is considered, especially the availability aspect of the components used so that if there is damage it can be resolved quickly and easily. At this stage also uses references from previous research to get results or products that are different and are expected to be better than previous studies so that the products created have their own advantages. For pictures of the Arduino-based microcontroller trainer design can be seen in Figure 1.

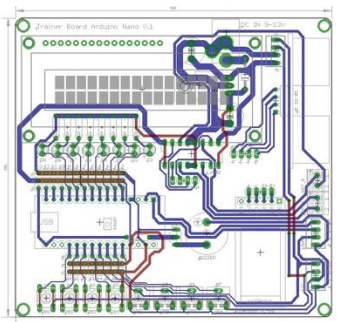

Figure 1. PCB Layout of arduino-based microcontroller trainer board.

2.3. Develop

The activities carried out at the develop stage are conducting experiments and development on the software or program side in accessing existing peripherals on the Arduino-based trainer. This is done to ensure that the peripherals on the microcontroller can be used optimally so that the microcontroller trainer can be used properly. At this stage a syntax program was also developed to assist students in understanding the programming language to access peripherals on the microcontroller and it is hoped that students can develop

programs that have been made in accordance with predetermined projects or real problems being faced.

2.4. Disseminate

The disseminate stage is the final stage of a series of 4D models where at this stage an experiment is carried out by demonstrating to students regarding the use of an Arduino-based microcontroller trainer. At this stage, it is also explained how to use the peripherals on the microcontroller with the programming language that has been designed at the develop stage.

3. RESULT AND DISCUSSION

In this research, a process of planning, designing, and applying Arduino-based microcontroller trainer boards has been carried out in an effort to improve students' skills and competencies. A microcontroller board has been produced to understand the basic workings of peripherals on a microcontroller such as analog to digital converter (ADC), digital input, digital output, timer counter, pulse width modulation (PWM), and its applications. The microcontroller trainer board can be seen in Figure 2.

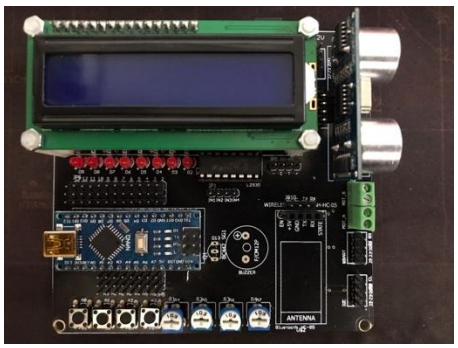

Figure 2. Realization of arduino-based microcontroller trainer board.

The trainer board that has been made has 4 push buttons connected to pins A0 to A3 which function as digital inputs, 4 10k ohm potentiometers connected to pins A4 to A7 which function as analog inputs, 8 3mm LEDs connected to pins D2 to D9. On the trainer board there is also 1 L293D motor driver connected to the Arduino PWM pin, 1 16x2 character LCD as a display connected to the Arduino I2C pin, and 1 HC-SR04 ultrasonic sensor as a distance detection sensor. The microcontroller board has been tested on 15 students by conducting several experiments on analog input, digital input, digital output, and the process of reading several sensors such as light sensors, fire detection sensors, and other sensors.

4. CONCLUSION

Experiments were carried out by demonstrating the workings and use of the microcontroller board trainer to 15 students based on the material previously presented. Students have tested the trainer board by making programs according to the assignments that have been given and uploaded to the trainer board for observation. Based on the demonstrations that have been carried out, it can be concluded that the trainer board can be used properly and easily and, in the future, it can be used as a learning medium to support the learning process and is expected to help hone and improve students' competencies.

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