E-WATER LEVEL: EDUCATIONAL KIT FOR LEARNING CONTROL SYSTEM BY USING WATER LEVEL APPLICATION

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ABSTRACT

Control System subject is part of the syllabus in the diploma or degree in Electrical Engineering course where students is exposed to topics such as time response analysis. This paper proposed E-Water Level educational kit that can be used to understand transient response analysis by applying theory, calculate the delay time (Td), rise time (Tr), damping ratio and setting time(Ts). The system consists of Arduino Microcontroller, water tank, water pump, relay, ultrasonic sensor for water level sensor and LCD display to display the plotted graph. The results could help students to solve the questions base on the value given on the LCD hence provide more practical learning experience to students.

Keywords: *Educational kit; Control System, water level*

1. INTRODUCTION

The teaching of control engineering has many pedagogical methodologies over the years with the inclusion of educational platforms in order to motivate, to clarify the concepts, to decrease the abstraction level of the control theory and also to prepare the students for industrial world [1].
Daniel C. Jeronymo et. al [3] has discussed the potential of applying a final practical laboratory task into the Feedback systems course as a new approach to learning and teaching for educational purposes whereby they make case studies in modelling, calibration, sensor and actuator electronic circuits, simulation, PID tuning and real-time control code under a step by step collection schedule. As result of this laboratory activity, significant progress is observed in the quality, motivation and learning.
In year 2016, an educational kit to learn control system by using hot air blower application has been developed by Amar Faiz. This project has been designed base on the idea of the Control System. The controller system will control the temperature out from the hair dryer.

2. METHODOLOGY

This project use Arduino mega 2560 as a microcontroller. Arduino is a complete development platform with its own standards, integrated development environment and programming interface. E-Water Level use water tank as a plant that process happen. The water pump will produce the pump out and pump in through the pipe and the ultrasonic sensor will detect the water level. The water pump will pump out the water with 6V flow rate. When the water is achieved the set point the relay for the water flow in will turn off and the relay for water flow out will turn on. The process will repeat until 120 second. After 120 second the process will end.
This project use two relay as a switch on or off controller. Relay1 will turn off when the water

level achieved the set point and Relay2 will turn and the water will pump out. Relay1 will turn on when the level of water drop under the set point and Relay2 will turn off and the water will pump in. This project use ultrasonic sensor as a water level sensor, which can detect the water level from 2cm to 30cm which were compatible to the project. This project also use TFT LCD shield to display the result. The graph will be plot and display on TFT LCD and student can solve the question based on the value that given in the TFT LCD. Figure 1 show the project prototype.

Figure 1 Project prototype.

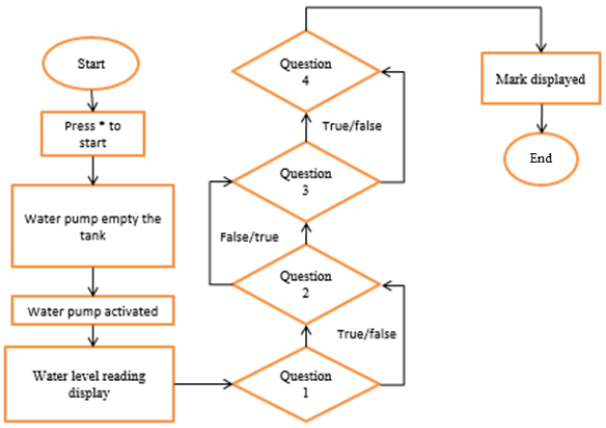
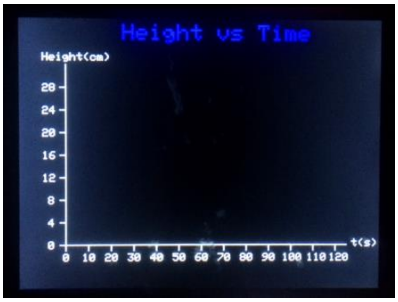


Figure 2 General flow of the educational kit.

Figure 2 shows the flowchart of E-Water Level operation. First, user must push button asterisk "*" in the keypad to start the process. After pushing it, the process will start empty the tank. After the tank empty, blue LED will turn on and water will pump in into the tank. When the water pump in into the tank, the transient response result is captured and the graph is plotted through TFT LCD. After 120 second the process will end and red LED will turn on. At the end of the process LCD will display the question to user with information given from the TFT LCD.

3. RESULT AND DISCUSSION

Figure 3 (a) shows the graph on TFT LCD with no plotted data while figure 3 (b) shows transient response graph with plotted data captured by using the educational kit.



(a)

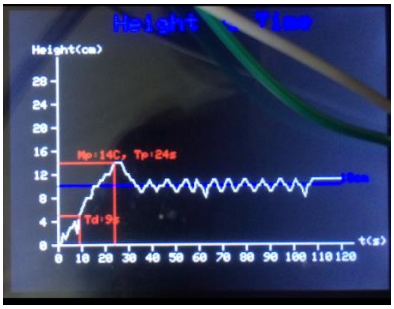
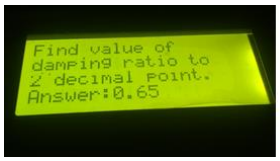


Figure 3 (a) TFT LCD show no graph before start the process. (b) TFT LCD show the plotted graph after complete water pump process.



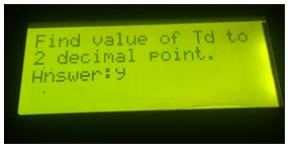


Figure 4 20x4 LCD shows the questions asked to find damping and Td value.

Figure 5 4 20x4 LCD shows the questions asked to find natural frequency and %0S value.

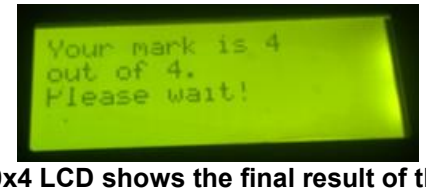


Figure 6 4 20x4 LCD shows the final result of the questions.

Figure 4 and 5 shows the questions asked to the students after the system finish plotting transient response curve. The students were asked to obtain delay time (Td), rise time (Tr), damping ratio and setting time (Ts). Student need to key in the value using the key pad to answer the questions. Once completing the task, mark were shown in 20x4 LCD at the end of the flow. One mark is given to each questions correctly answered.

4. SUMMARY

This paper present the development of an electronic-based educational kit for learning control system by using water level application. This e-water level kit will generate a few question related to transient response and user will test their understanding about control system. By having this application student will get more understanding and relate real application of transient response with theory learned from control system subject. Yet the author believe further analysis need to be done to measure the effectiveness of the prototype.

5. REFERENCES

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