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Development of Atmega328 Microcontroller Based Hydroponic Plant Watering Automation Tools

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Abstract

The development of electronic technology in the era of globalization is very rapid. Utilization of this technology as a means to monitor soil conditions for agriculture, especially hydroponic plantations which are currently developing, to obtain optimal results it is necessary to monitor humidity and temperature conditions. This research will create a system that can maintain humidity and air temperature according to what plants need. The tools made consist of a temperature sensor, humidity sensor, ATMega328 microcontroller, ADC and water pump. Temperature and humidity sensors function to detect air temperature and humidity. The ADC functions to convert the voltage measurement results from temperature and humidity measurements into digital quantities which are then forwarded to the ATMega328 microcontroller to be processed into a digital display on the LCD. The ATMega328 microcontroller also regulates the ON and OFF of the water pump machine.

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1 Introduction

Agriculture has now shifted from outdoor farming to the hydroponic model. Several things affect plant growth in hydroponic plant systems including: environmental conditions, water, nutrient solutions, light, nurseries, plant media, and measuring instruments (Fisher & Kebede, 2010; Frankowiak et al., 2005). Water functions as a nutrient solvent as well as an important substance needed by hydroponic plants, water conditions must be very concerned because excess and dirty water can interfere with the plant growth process. When plants grow in soil media. The soil functions to filter out substances that are not needed by plants so if you do not use soil in growing plants, pay close attention to the condition and quality of the water (Sharma et al., 2021). Hydroponic plants require the right amount of water according to the environmental conditions of the day, therefore proper watering controls are needed (Fatoni et al., 2015; Rainaldo & Prakoso, 2015). So in this research, a system was created "Making a Hydroponic Plant Watering Automation Tool Based on ATmega328 Microcontroller".

2 Materials and Methods

This research will make a tool that can water the plants when needed (when set). The working process of this tool in general is that the temperature and humidity sensor (DHT11) is plugged in where the hydroponic plants are planted (Akkaya & Kulaksiz, 2004), this sensor will provide information on the temperature and humidity of the soil, the results of this information will be forwarded to the ADC to be converted to digital voltage, the conversion results from The ADC is processed in the ATMega328 microcontroller, the results of the process carried out by the ATMega328 microcontroller will be compared with the temperature and soil moisture set in the microcontroller memory, the comparison results obtained will be a reference for the ATMega328 microcontroller to execute whether the pump is ON or OFF. The circuit of this system is shown in Figure 1.

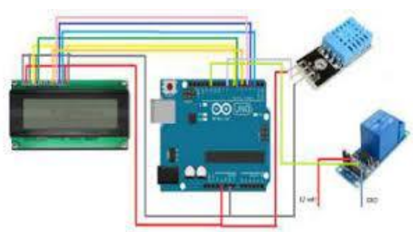

Figure 1. A series of hydroponic plant control systems

3 Results and Discussions

The results obtained from this study are an ATMega328 microcontroller-based hydroponic plant watering automation tool (Clark et al., 2020; Gyori et al., 2014). This measuring instrument which consists of the main parts is shown in Figure 2.

Figure 2. The main parts of the Research tool

A brief explanation of the function of each main part of the monitoring tool shown in Figure 4.1 is as follows: 1. Adapter, which serves as a voltage source 2. DHT11 sensor serves to measure temperature and humidity 3. The minimum circuit of the Atmega328 system functions as processing incoming data from sensors and controlling the system 4. LCD functions to display temperature and humidity data 5. The relay functions as an ON/OF switch for the water pump 6. The pump functions to drain the water 7. BOX functions to hold water 8. Place hydroponic plants. After the design has been completed, the next step is to calibrate the temperature and humidity. The results of the temperature calibration between the design tool and the reference device are shown in Figure 3.

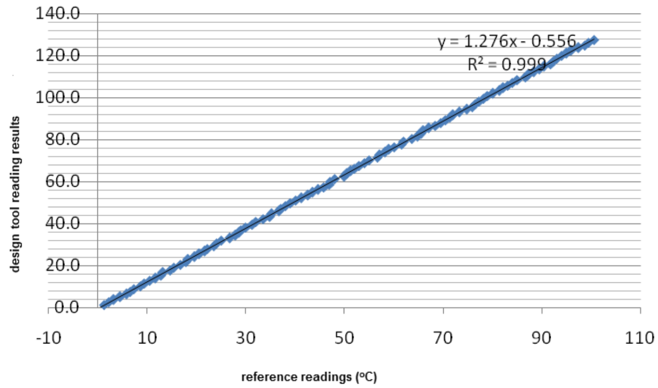

Figure 3. Graph of temperature data for comparison tools vs DHT11

The results of the Humidity calibration between the design tool and the reference tool are shown in Figure 4.

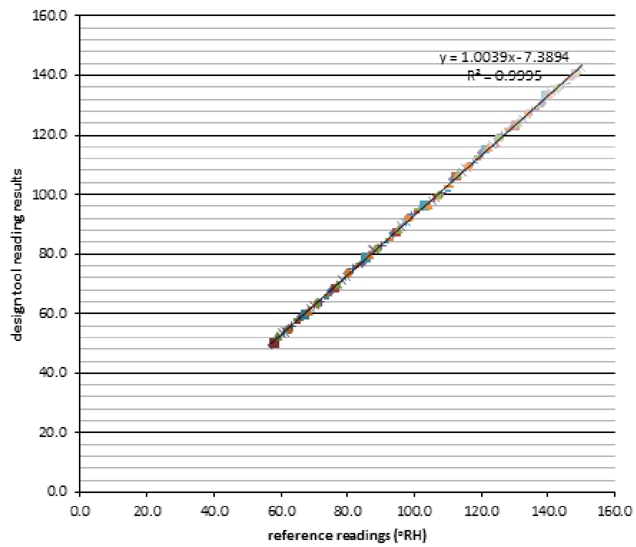

Figure 4. Graph of air humidity data for comparator vs DHT11

Figure 3. Shows that the change in the response of the output voltage of the comparator with the DHT11 sensor increases as the measured temperature increases (Rimawan et al., 2018). So the response of the DHT11 sensor to the ambient temperature when collecting data is almost the same as the comparison tool (Rangkuti, 2016). Linear graph of temperature measurement results measured by the DHT11 sensor with a comparison device. The coefficient of determination r^2 obtained from the analysis of the design tool test data is 0.999. The coefficient states that the suitability of the DHT11 sensor with the comparator is 99.9% while the rest is a discrepancy. The discrepancy that occurs in the measurement results may be caused by the response to temperature captured by the DHT11 sensor which is different from the comparison device (Utama, 2016).

Figure 4 shows that the change in the output voltage response of the comparator device with the DHT11 sensor has increased as the measured temperature rises. So that the response of the DHT11 sensor to the ambient temperature when collecting data is almost the same as the comparison tool. Linear graph of temperature measurement results measured by the DHT11 sensor with a comparison device (Pasika & Gandla, 2020; Vij et al., 2020). The coefficient of determination r^2 obtained from the analysis of the design tool test data is 0.999. The coefficient states that the suitability of the DHT11 sensor with the comparator is 99.9% while the rest is a discrepancy. The discrepancy that occurs in the measurement results may be caused by the response to temperature captured by the DHT11 sensor which is different from the comparison device (Sawita et al., 2017; Supardi et al., 2019).

4 Conclusion

The conclusions from the research that has been carried out are as follows: 1. An ATMega328 microcontroller-based hydroponic plant watering automation tool has been successfully created with an accuracy of 99.9%; 2. The workflow of this tool started with the temperature and humidity sensor function to detect the temperature and humidity of the air. The ADC functions to convert the voltage measurement results from temperature and humidity measurements into digital quantities which are then forwarded to the ATMega328 microcontroller to be processed into a digital display on the LCD. The ATMega328 microcontroller also regulates the ON and OFF of the water pump machine.

Conflict of interest statement
The authors declared that they have no competing interests.

Statement of authorship
The authors have a responsibility for the conception and design of the study. The authors have approved the final article.

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