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Automatic Watering System in Plant House - Using Arduino

M Mediawan, M Yusro and J Bintoro

Department of Electronic Engineering, Faculty of Engineering, Universitas Negeri
Jakarta, Indonesia

*myusro@unj.ac.id

Abstract. The aim of this research is developing automatic watering and hydroponic nutrients. The purpose of this research is to design, build and test the system to be able to do the watering, hydroponic nutrients drain automatically, and to fog the plant environment, also to monitor the environmental temperature in the plant house. The method used in the research of Automatic Watering System in The Plant House - Using Arduino Board is experiment technique. Some of the steps that need to be considered, namely the design stage, the stage of development/manufacture, and installation phase. Next is the testing of the product that has been made by testing some variables that have been previously specified. As a result, the system can do the watering, drain hydroponic nutrients, and perform automatic misting with a working voltage of 208-214 VAC and 15 VDC, as well as a constant Arduino pin voltage of 4.8 VDC. The system can also display the current state of the soil moisture status and the temperature of the greenhouse. By performing tests on crops, showed growth of plants in the hydroponic method is faster than with conventional cultivation methods.

1. Introduction

It is known since the last 18 years the world population exceeding 6000 million. The result is increased life needs, particularly food so that agricultural expansion and utilization of agricultural technology is needed to meet the food needs. Greening the city may be regarded as the basis of sustainable solutions for urban, urban ecosystems provides vital goods and services for the residents of towns and cities [1-3]. In urban areas, agricultural land tends to diminish over time, along with high population growth and the increasingly high demand for land for non-agricultural purposes [4]. The tendency in urban development in the country, including Indonesia is the rapid population growth. As a result, the carrying capacity of urban areas can no longer sustain life for many urban communities deserve. Among other problems faced in terms of the provision of food [5] and decent living facilities especially for the medium.

Urban agriculture is food and fuel to grow in the midst of urban activities or town, to be marketed and often also processed and marketed [6]. So far the level of consumption of vegetables in urban areas is largely lacking [7]. Because the role of agriculture in urban and peri-urban in meeting the needs of these vegetables is very important because it concerns the continuity of supply that lasts throughout the year.

The development of plant house in Indonesia has not been so in the interest of many people, because the relevant knowledge that has not touched the plant house lay Indonesian society. Plant house concept appeared from the ancient to the modern age ages with a pristine ecological environment area and through sophisticated systems arrived to modern systems [8-10].



Application of multiple systems is also a very necessary thing to be noticed more [11, 12], an example, in this case, is the installation of irrigation systems are very influential in the growth of plants in the plant house [13]. Irrigation system on a home or plants greenhouse is important, with regard to the process of watering the plants. An automated system is allowing for a control of timely watering activity to support plant growth processes in plants [14, 15]. To create an automated system that required a control center from which will be used to control all the activities that will be processed by the system in general. A microcontroller system felt able to control the automated system designed to regulate the activities in the house plants with relatively low cost [16].

Arduino is one of the educational product microcontrollers as a licensed pilot project is open and can be enabled as the final product, the module is also accompanied by the electronic components [17, 18]. Thus, Arduino meets the criteria as a control system that allows managing all types of activities that are applied to the plants. Are not limited to the application method different crops it is possible to do inside the plant house. This means that plants must have the ability to apply different planting methods at once.

Hydroponics or foreign Hydroponics terms is a term used to describe several ways of farming without the use of land as a place to plant [19, 20]. An Arduino-based system that will function for activities on the plant watering plant house considered to be the latest breakthrough in the hope that the benefits will be felt by the manager.

2. Method

The methodology used by the researchers are experiment techniques. Research engineering is a type of research that is used to conduct research on a product-based approach to engineering. According to Amran (1997), namely research engineering designing activities (design) that are not routine, so that in it there is a new contribution in the form, process, and product. In conducting engineering studies there are several steps that need to be considered, namely the design stage, the stage of development/manufacture, and installation phase. Next is the testing of the product that has been made by testing a variable that has been set before.

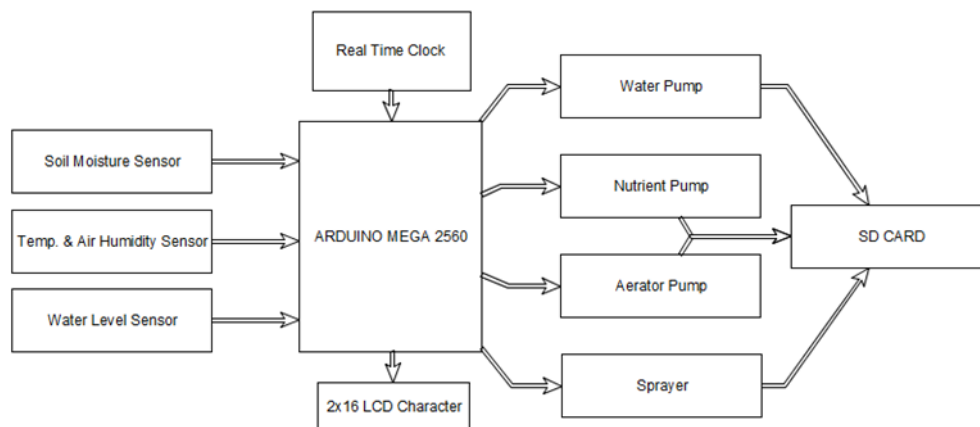


Figure 1. Block diagram system.

3. Results and discussion

3.1. Result of test systems

3.1.1. Soil moisture sensor test results

Table 1. Data testing soil moisture sensors.

Land Status	Sensor Readings (Decimal)	Vout S_{KT} (V)
Dry	10	0.035
Damp	563	2.43

3.1.2. Temperature sensor test results

Table 2. Temperature sensor test result.

Time	DHT22 Temp (°C)	Anemometer Temp (°C)	Error %
08.00	30,9	30,9	0
09.00	33,5	33,5	0
10.00	33,6	33,7	0,29
11.00	34,3	33,8	1,47
12.00	35,8	34,5	3,76

3.1.3. Testing result water pump

Table 3. Water pump testing results.

Condition	Testing Criteria	Testing Results	Vout System (VAC)	Pin Vout (VDC)
direct command	enables direct water pump	water pump off	209.9	4.8
soil condition	laundry wetlands	pump active	210.5	4.7
		water pump off	0	0
condition time	in the span of at 7:00 a.m. to 9:00 active water pump	water pump off	209.9	4.8
	in the span at 15:00 to 16:00 active water pumps	pumps active air	209.9	4.8

3.1.4. Pump test results nutrition

Table 4. Results of pump test nutrition.

Conditions	Criteria test	Results Testing	Vout System (VAC)	Pin Vout (VDC)
direct command	enable pump directly nutrition	pump nutrition active	213.8	4.8
time Conditions	at 08.00 pump active nutrition	pump active nutrition	213.4	4.8
	at 10:00 pump active nutrition	pump active nutrition	213.8	4.8
	at 12.00 pump active nutrition	pump active nutrition	213.8	4.8
	at 14.00 pump active nutrition	pump active nutrition	213.4	4.8
	at 15.00 pump active nutrition	pump active nutrition	213.4	4.8

3.1.5. Testing results nutrition aerator

Table 5. Nutritional testing results.

Condition	Testing Criteria	Testing Results	Vout System (VAC)	Pin Vout (VDC)
direct command	enables direct aerator nutrition	aerator nutrition active	214.0	4.8
time condition	at 08.00 aerator active nutrition	aerator nutrition active	213.8	4.8
	at 10:00 aerator active nutrition	aerator active nutrition	213.8	4.8
	at 12.00 aerator active nutrition	aerator active nutrition	214.0	4.8
	at 14.00 aerator active nutrition	aerator active nutrition	214.0	4, 8
	at 15.00 aerator active nutrition	aerator active nutrition	211.6	4.8

3.1.6. Pump sprayer testing.

Table 6. Pump testing results sprayer.

Condition	Testing Criteria	Testing Results	System Vout (VDC)	Pin Vout (VDC)
direct command	Enables pump sprayer directly	pump sprayer activated	15.0	4.8
temperature and humidity conditions air	temperature above 37°C or with a percentage of less than 55% humidity pump sprayer active	pump sprayer active	15.0	4.8
time conditions	In the span of 07.00 - 09.00, pump active sprayer	pump sprayer actively	15.12	4.8
	In the span of 15.00-16.00, pump the active player	pump sprayer active	15.12	4.8

3.2. Against plant testing result

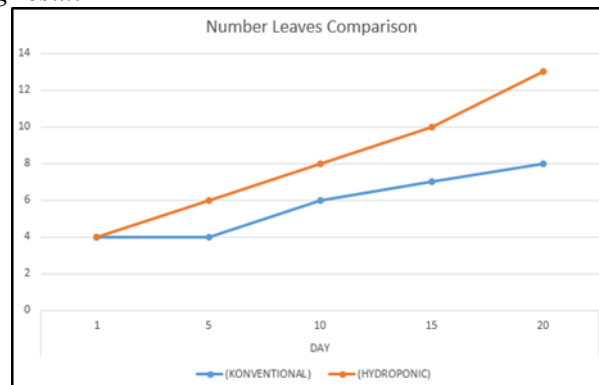


Figure 2. Number leaves comparison.

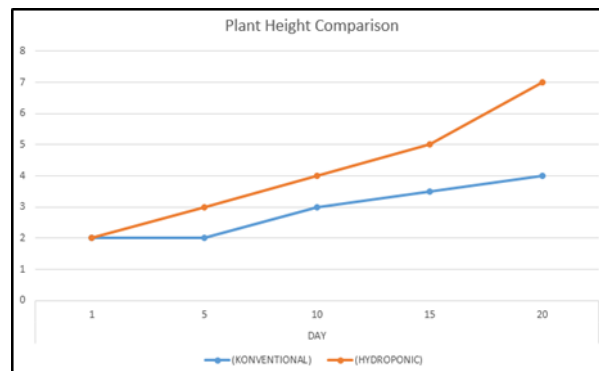


Figure 3. Plant height comparison.

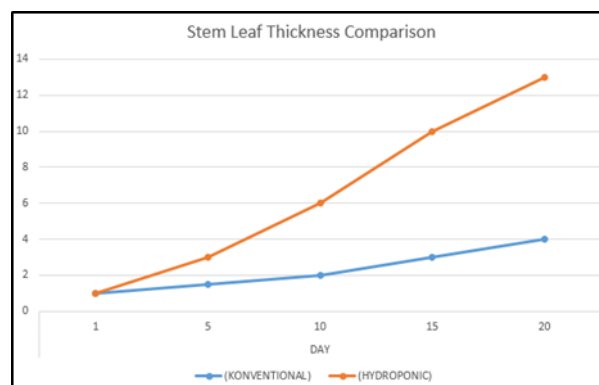


Figure 4. Stem leaf thickness comparison.

3.3. Result and discussion

Results of testing soil moisture sensor, the result the state of soil moisture used in conventional cropping systems. The results are influenced by the level of moisture or water content contained in the soil, the soil moist so the smaller the value of discrete ADC readings on the sensor, and vice versa.

Testing the temperature sensor, the comparison between the results obtained a DHT22 sensor with temperature gauges contained in the anemometer showed no difference. This is influenced by temperature sensor DHT22 laying on the system in a panel box.

Results of testing the water pump showed that the water pumps work according to the plan that has been made. Although work on the pump voltage is in the range 208-211 volts AC value, the pump is still working according to plan. Voltage is working on an Arduino pin is at a value of 4.8 volts that can activate a relay driver to perform activation on the water pump.

Aerator pump testing nutrients and nutrients showed that nutrition and aerator pump nutrients working accordance with the plan. Similarly, the water pump, although the working voltage in the range of 213-215 volts AC, nutrition, and aerator pumps nutrients can work according to plan. Voltage working on Arduino pin that is used on both is at a value of 4.8 volts, so as to regulate activation of nutrients and aerator pumps nutrients properly.

Results of testing the pump sprayer, pump showed that sprayer work according to plan. Voltage working on the pump sprayer which is equal to 15 volts DC, so that the pump works well, while the voltage on pin Arduino works at a value of 4.8 volts, so as to regulate activation pump sprayer either through with relay driver.

The test results of the plant system, in getting the results in the form of plant growth data on two different planting methods, namely planting methods hydroponics systems and conventional planting. In the hydroponic cultivation of faster growth compared to conventional, this happens because the hydroponic growing methods, plant nutrients already getting very fulfilled of nutrients hydroponic streaming system, whereas in conventional planting the plants get their nutrients from the soil only unknown quality.

4. Conclusions

- The system is an integrated part of the soil moisture, water level, temperature and air humidity sensors with Arduino MEGA2560 as the controller to do the watering, flowing nutrient (hydroponics), spraying/fogging, and monitoring plant house environment.
- The system will do the watering, nutrient flowing, and spraying/fogging if receive a direct command, sensors receive desire or time criteria according to the condition.
- Based on the test of the system work on the plants, it was found that on hydroponic planting method, the plant grows better than conventional cultivation method.

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