Smart green house's hydroponic with arduino uno

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Abstract. Hydroponic system is one of the solutions for planting systems in an area that has a narrow land and uses water media as a planting medium. Plant maintenance innovations are carried out automatically using Arduino uno for working systems of HC-SR04 Ultrasonic sensors, DHT11 and pH sensors to measure water level, acidity and humidity.From this research, testing of the sensors used, and the results obtained are accurate responses with the output for controlling the motor as a water refill pump, plant sprinkler pump and nutrition pump. For HC-SR04 Ultrasonic sensors work with an accuracy rate of 99.41%, for PH sensors with an average accuracy of 92.7%. When the water level is 5 cm from the sensor, the sensor will instruct the pump to replenish the nutrient "off". And when the water level is 34.5cm the sensor will order the "refill" nutrient pump motor. In addition, the nutrient refill pump will also be "on" if the acidity of the water drops from PH 6. And if the humidity reaches 65% band watering will be done. This hydroponics uses 50 WP solar sell as an energy source that will fill 50 AH battery and at 388 watts of load.

1. Introduction

1.1. Research background

In the last few years Indonesia has been faced with the problem of decreasing decent and productive agricultural land. The decline in productive agricultural land in Indonesia is due to several things such as agricultural land replaced with large-scale oil palm plantations, infrastructure development such as toll roads, malls and others. This has led to the reduction of decent and productive agricultural land, so farmers can not create large-scale agricultural land which results in a decrease in national food production which can threaten the balance of the ecosystem and higher food prices. The innovation that is now widely used by farmers in the world, especially countries that lack agricultural land, is to use water as agricultural land or in general is known as a hydroponic system. However, this system requires extra care such as regulating water filling, watering, and providing nutrition to plants that must be controlled periodically. Based on the problem, the researchers wanted to make a smart green hydroponics with new innovations related to the irrigation mechanism in hydroponic plants with a more complex automatic system including the circulation system of watering plants, levels of nutrient solution intake, watering plants and replenishing water tanks.

The use of electricity from PLN is a fundamental obstacle to the application of this hydroponic system. This is because if the power source is turned off, the hydroponic system will not be able to

operate as expected. To deal with these problems, the authors make a design of hydroponic irrigation systems automatically with solar energy sources.

1.2. Motivation

So that the condition of the community can live healthy and prosperous in the future, and also to increase food self-sufficiency and the call for food security, especially for people who do not have enough land, hydroponics is the right choice. Hydroponics is a solution in agriculture by using simple technology to facilitate the community in farming. Hydroponics can produce crop production that can guarantee that the plants are free from disease pests originating from the soil. Increasing the fulfillment of family and community nutrition resources, if done on a large scale can increase exports of fresh and high-quality horticultural production, so as to increase the country's foreign exchange. However, the application of this system is not easy to apply because it needs extra attention in the care of plants from nurseries to harvest. Until in the end, there were various innovations related to the treatment of hydroponic plants automatically, both water control systems, nutritional control and others. However, such a system is still considered not complex because the control system only covers a few aspects and is still separate.

1.3. Problems

Based on the diagram it can be described that the component that works as an input includes the start button which functions to turn on the system, an ultrasonic sensor as a trigger for the water pump in the water refill tank when water in reservoir 1 decreases. Water will fill the gutter in accordance with the desired capacity. When the ultrasonic sensor detects the level of the reservoir by 50% of its volume, the sensor will instruct the pump motor to refill the water to the reservoir. hydroponics decreases at a certain level and decides the source of voltage to the water pump engine when the water in the tub is almost full. The pH sensor as a detector controls the pH level of hydroponic liquids to keep them stable while controlling the pumping work of nutrient solutions in the system. The humidity sensor functions as a detector for the humidity of the plant environment and triggers the sprinkler pump to work under certain conditions. While the stop button system for turning off all of the system.

Components which perform as output include water circulation pumps, nutrient solution pumps, watering pumps and water pumps. All these components are connected to Arduino uno as input and output which will work according to the instructions given previously. The power source of the device comes from the grid of PLN which is connected to the power supply / supply and functions as a DC 5V voltage for Arduino uno devices and AC 220V voltage for output devices which are devices of electrical machines. This automatic hydroponic system device is presented in Figure 1.

Figure 1. Block system diagram.

1.4. Research scopes

The scope of this research was carried out the making of an NFT system hindoponic installation as a mustard vegetable garden experiment and the implementation of the use of a control system on a hydroponic planting system using a microcontroller. And also solar panels as an energy source in running the automation control system on the hydroponic planting system. The mechanism of action of irrigation control, nutrition, air humidity and PH levels automatically uses Arduino Uno R3 in a hydroponic farming system. The energy source used uses solarcell.

2. Literature review

The use of hydroponic systems adds to innovation in agricultural systems in Indonesia in particular and in the world at large. Several studies have been carried out by several researchers conducted in Thailand by proposing a Hydroponic Agricultural Ecosystem (HFE) using an IoT device in a hydroponic planting system. This system will be applied to monitor humidity, nutrient solution temperature, air temperature, PH and Electrical Conductivity (EC).

The use of NFT-based hydroponic plant systems based on wireless NFT uses nutrient solutions to flow in the root area with application to slada plants. With monitoring results for PH and EC for 24 hours during the growth period of lettuce, using a wireless network, the slada's PH is between 6.0-6.5, and Conductivity (EC) is between 0.8-1.2. [5]. Performance Test System for Control of Giving Nutrient Solution Hydroponic Method Based on Microcontrollers ", which analyzes the performance of the Arduino R3 microcontroller in controlling the pump's working time based on rockwool water content detected by the 76LM393 water content sensor [2]. Hydroponic planting systems have also begun to develop with aquoponic cultivation techniques by adding goldfish ponds at the bottom. By using a temperature sensor DS18B20 is able to do it to monitor variations in water temperature in the aquarium [3]. Water level control system for hydroponic cultivation or called the floating system method. This control system consists of an arduino uno microcontroller, hcsr04 ultrasonic sensor, lcd, relay, water pump, and aerator. Microcontroller system functions as a control center, where the microcontroller will take data sent by ultrasonic sensors as a gauge of water level [1]. On the Design of Hydroponic Automation Systems in Chaisim Mustard, Mustard Meat and Lettuce Based on Arduino Uno 328P ", describes the use of automatic control mechanisms for the cultivation of hydroponic plants. By using Arduino Uno 328P which is integrated with various sensors, the automation system for hydroponics includes regulating pumps, LED grow lights, fertilizing and watering systems as well as providing information on a situation to hydroponic owners.[4]

And in this research, a hydroponic irrigation system for solar energy will be designed automatically. This title was appointed to create a new innovation related to the irrigation mechanism in hydroponic plants with the concept of an automatic system. Not only that, the system that was made also covered the system regulation including the mechanism of the irrigation circulation, the provision of the nutrient content, the detection of the humidity of the air, and the regulation of the pH level..

2.1. Software and hardware testing

Software testing is performed on arduino program . Hardware testing performaed on each section according to the block diagram. This test aims to test whether each system block has been in according with the whole system planned. Testing conducted includes testing

- Solar cell Assesment
- Assesment of Ultrasonic Sensor
- PH Sensor Assesment
- DHT sensors 11

Following are excerpts from the Arduino program which controls the operation of the hydroponic system.

```
#include <LiquidCrystal.h>         //Library lcd
#define MAX_DISTANCE 50
LiquidCrystal lcd(12,11,5,4,3,2);  // pin(RS,E,D4,D5,D6,D7)
int trigpin= 8;    //
int echopin= 9;      //
int motorPompa_isiUlang = 6;   //
long duration, distance;          //
const int phSensorPin  = A1;
int motorPompa_nutrisi = 13;
float Po               = 0;
void setup() {
  // put your setup code here, to run once:
pinMode (phSensorPin, INPUT);
pinMode(recycle motor pump_,OUTPUT);   //
pinMode(trigpin,OUTPUT);    //
pinMode(echopin,INPUT);       //
lcd.begin(16,2);                    //
lcd.clear();                        //
Serial.begin(9600);
void loop() {
  // put your main code here, to run repeatedly:
double TeganganPh = 5 /
//Po = 7.00 + ((teganganPh7 - TeganganPh) / PhStep);
Po = 7.00 + ((2.6 - TeganganPh) / 0.17);
lcd.setCursor(0, 1);
lcd.print("Nilai pH = ");
lcd.print(Po);
delay(2000);
digitalWrite(trigpin,LOW);             //membaca pin trigpin Low
delayMicroseconds(2);
digitalWrite(trigpin,HIGH);            //pin trigpin mengirim sinyal
delayMicroseconds(100);
digitalWrite(trigpin,LOW);             //pin trigpin LOW
int duration = pulseIn(echopin,HIGH);   //pin echo membaca atau menerima sinyal
int distance = duration/58;            //rumus dalam cm
lcd.setCursor(0,0);     //text dimulai dari baris 1 dan kolom 1
lcd.print("Jarak = ");  //lcd menampilkan text Jarak =
lcd.print(distance);    //lcd menampilkan data nilai dari sensor
lcd.print(" Cm");       //lcd menampilkan text Cm
/* Kirim angka negatif ke komputer dan Turn LED ON
untuk menunjukkan "di luar jangkauan" */
if (Po >= 7)
lcd.setCursor(0,1);                    //text dimulai dari baris 0 dan kolom 0
lcd.print("POMPA PH ON         ");          //lcd menampilkan text POMPA ON
delay(1500);
digitalWrite(motorPompa_nutrisi, HIGH);  //saat level air berjarak lebih atau sama dengan 40 cm
else{
lcd.setCursor(0,1);                    //text dimulai dari baris 0 dan kolom 0
lcd.print("POMPA PH OFF        ");          //lcd menampilkan text POMPA ON
```

```
delay(1500);
digitalWrite(motorPompa_nutrisi, LOW);  //saat level air berjarak lebih atau sama dengan 40 cm
INSTRUKSI PADA SENSOR ULTRASONIK(PROGRAM LOGIKA YANG DIMINTA)
if (distance >= 40)
lcd.setCursor(0,0);                    //text dimulai dari baris 0 dan kolom 0
lcd.print("POMPA ON         ");         //lcd menampilkan text POMPA ON
delay(500);
digitalWrite(motorPompa_isiUlang, HIGH);  //saat level air berjarak lebih atau sama dengan 40 cm
if (distance <= 5)
lcd.setCursor(0,0);                    //text dimulai dari baris 0 dan kolom 0
lcd.print("POMPA OFF         ");        //lcd menampilkan text POMPA OFF
delay(500);
digitalWrite(motorPompa_isiUlang, LOW);   //saat level air berjarak kurang atau sama dengan 5 cm
//waktu tunda 50mS
delay(500);}.
```

2.2. Overall Testing

The following is a picture of the hydroponic installation and control system used.

Figure 2. Control system hydroponic instalation.

After all the equipment is installed it will be tested in its entirety for 3 days to see if all controls run as desired. As seen in Table 1.

Table 1. Overall testing.

1. Time	Temperature	Ultrasonik	PH	DHT 11
06.00-12.00	32^0	15 cm	6	65% RH
12.00-18.00	$34,3^0$	16cm	6	65% RH
06.00-12.00	33^0	17,5	6.3	65% RH
12.00-18.00	35^0	17.9	6.3	66%RH
06.00-12.00	33^0	18,2	6,4	67%RH
12.00-18.00	34^0	18.3	6	67%RH

System starts from filling the hydroponic installation by using a filling pump that will fill the installation within minutes. The flow of nutrient water will circulate back into the water reservoir. The

ultrasonic sensor will read the water level in the circulation bath, and will turn on the relay to start the motor if the water volume decreases. The PH sensor will work if there is a change in the PH of the water and will turn on the relay to turn on the nutrient pump motor so that the nutrient ph in the tub will return to its normal PH. A decrease in pH can be caused by plants and the environment. And the process of watering plants will occur if the humidity is reduced by 65%.

3. Methodology

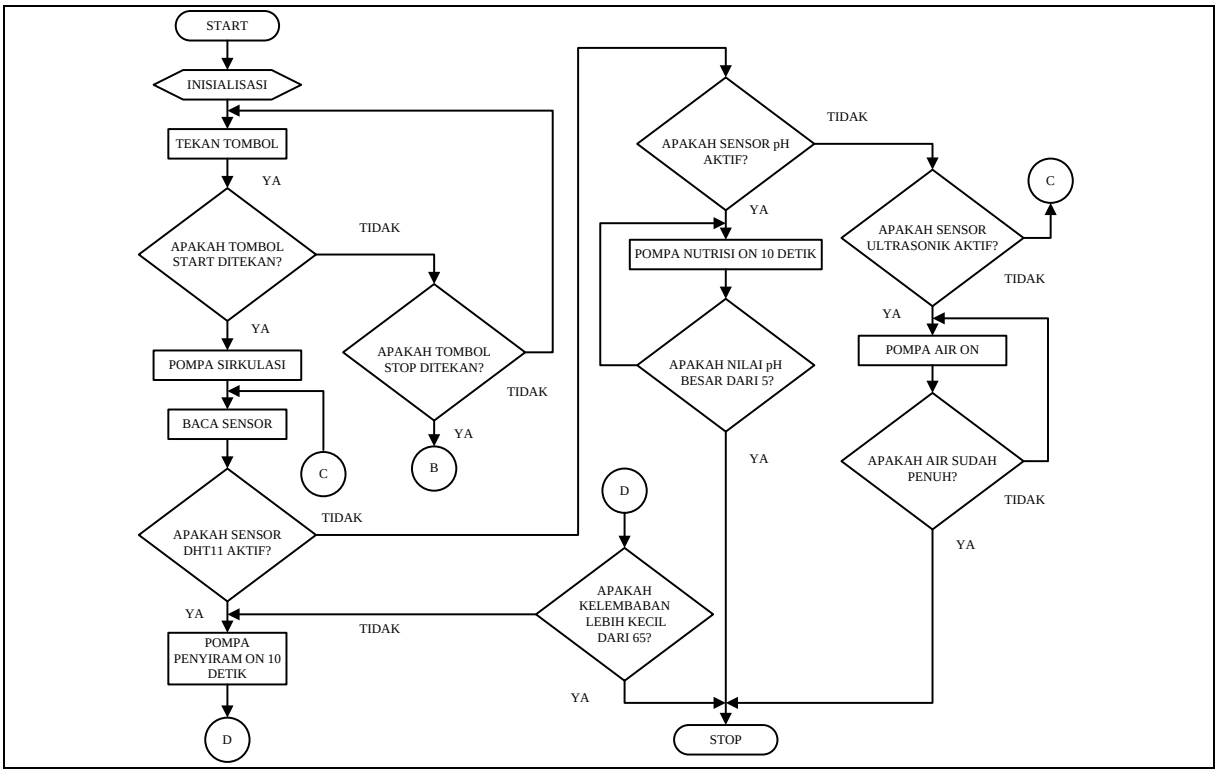

Figure 3. Working system of the hydroponic device.

The working system of the hydroponic device is described as starting from Start, indicating that the program is started. The initialization is the introduction of input and output components on the microcontroller. Press the button to connect or disconnect the flow of electric current with the work system press lock (lock). Is the start button pressed? is asking for a condition, whether the start button pressed is legible or not. If read, the circulation pump and all connected devices are active. Is the stop button pressed? is asking for a condition, whether the stop button being pressed is read or not. If it is read, the circulation pump and all connected devices will be deactivated. Is the DHT11 sensor active? is asking whether the sensor is working or not. If it works, the sprinkler pump will run for 10 seconds. Is the humidity smaller than 65? is asking about the humidity conditions after the watering process. If the humidity is still below 65, then the sprinkler pump will reactivate for 10 seconds and so on until the humidity value is greater than or equal to 65, the sprinkler pump will stop working. Is the pH sensor active? is asking whether the sensor is working or not. If it works, the nutrient pump will run for 10 seconds. Is the pH value smaller than 6? is asking the condition of the acidity of the solution in the tub after the nutrient pump has been running for 10 seconds. If the pH is still below the value of 6, then the nutrient pump will reactivate for 10 seconds a few moments later and so on until the pH value is greater than or equal to 6 then the nutrient pump will stop working. Is the ultrasonic sensor active? is asking whether the sensor is working or not. If it works, the nutrient pump will turn on until the hydroponic solution bath is full with the distance of the water surface to the sensor 5 cm and so on if

the water level in the tub is at a height of 40 cm then the water pump will turn on again and fill the water into the tub until the solution bath is full. Stop indicates that the program has stopped.

4. Research contributions

By regulating the hydroponic system automation can provide convenience in treatment, among others, through the plant irrigation circulation system the impact is the availability of water is maintained, control of plant nutrients, plant watering systems and refilling water tubs.

5. Conclusions

The energy system used is a solar cell with a capacity of 50 WP for one hydroponic installation measuring 94 cm x 13 cm and measuring 105 cm x 13 cm. The hydroponic control system works by processing sensor output data and providing an output response by activating the motor according to the determination that has been made on the program. The HC-SR04 Ultrasonic Sensor works with an accuracy rate of 99.41% in the process of filling water into a hydroponic installation.The DHT 11 sensor works at a sensitivity of 65% and an accuracy rate of 72.35% which instructs the watering pump.The pH sensor works with an accuracy rate of 92.74% for the pH solution testing solution and works with 100% accuracy during testing with a nutrition pump motor with a benchmark reading from the sensor. The entire device works accurately according to the input instructions on the Arduino uno program by reading the values referring to the readings displayed by the sensor.

6. References

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