Analysis Using Temperature Sensor DS18B20 Hydroponic Plants Smart In Vertical Agriculture

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1. Introduction

1.1 Background

The technology is now highly developed rapidly. One example of progress is the human automation system tools. A wide variety of tools have been created with the aim to facilitate human in doing his job, but with the automation system is then expected human tools that already exist can now work more efficiently and effectively lighten the burden of the work of man. Agriculture now also been highly developed. It can be seen from the limited agricultural land so that people start looking for more efficient ways of doing agricultural development with the limited land owned. This development can be seen with the new agricultural methods, one of which is known as hydroponic energy system.

The automation system can be applied in farming methods with the making automation tool that can control some aspects such as water temperature, acidity / alkalinity of the water (pH) and nutrients in plants using hydroponic plant maintenance. By incorporating technology into the right farming methods, then we will get results more effective and efficient and will directly alleviate the burden of the work of man. On the basis of this thought behind the making of the automation system for the control of this hydroponic plants. Hydroponics is growing plants and growing techniques that utilize water instead of soil by emphasizing the need nutrients, temperature and pH for plants. Needs of hydroponic water at less than the plant with soil media, so is suitable for areas that have water supply and limited land. (https://id.wikipedia.org/wiki/Hidroponik).

History Hydroponic growth in 1963 was born a term Hydroponics, a term given by someone agronomy from the University of California, United States. Beginning activity cultivating plants without soil media. Beginning of hydroponics experiment originated from research work in plant physiology laboratory testing using water fished. These systems use a lot of water as a growing medium that many people regard these media as aquaculture (Farming in the water). In the historical record how hydroponics has been around since thousands of years ago, for example, described in Babylon existing hydroponic hanging plants and floating plants in the region of china. In 1980, Indonesia began to develop hydroponics. In Indonesia, the hydroponic system first developed the system of hydroponic substrate, but as the development of a hydroponic system start developing the Nutrient Film Technique (NFT) are now widely used in by the people who want to grow crops using hydroponics. Nutrient Film Technique (NFT) is one method of cultivation with the roots of plants grown in hydroponic nutrient layer shallow and to circulate so that the plants can get enough water, nutrients and oxygen. Crops grown with polyethlene layer with plant roots submerged in water containing a nutrient solution is circulated continuously with a pump. (http://www.kebunhidro.com).

Technological development in the field of agriculture must be done with due regard to the agricultural system is used which also includes a wide variety of ways to develop crops other than on technology. The technology today is already highly developed rapidly. for example, today a lot of automation systems are designed to facilitate and ease the work of man in order to work automatically and efficiently and effectively within a short time. One area that is currently using the automation system is in agriculture began because many people who want to develop agriculture but limited problem less land, such as for example agricultural land in urban areas. Hydroponics can be made in large and small, so it allows developed in urban areas who have limited land. The automation system can be applied in various agricultural land with the automatic system made a tool to control some of the activities required by hydroponic crops such as pH sensor, temperature, and nutrition. so will get more effective results and facilitate human work in taking care of the plants.

Here are the things the background of scientific writing:
a. Knowing the water temperature of different plant species
b. Knowing how the hydroponic system
c. Knowing how the temperature sensor, Ph, and Nutrition
d. Knowing the volume of water contained in the hydroponic
e. Knowing how the Arduino and Raspberry
f. Knowing the light sensor is needed in hydroponic

2. Basis Theory

2.1 Literature

To support this Scientific Writing use some of the theoretical basis of relevant and related to the subject as follows:

1.) Journal Study Prepared by: Fanny Astria, Merry Subito, M.Si ., M. Eng.,

System pH and temperature measuring devices based SMS gateway is a measuring instrument that communicates with a provider, so it can be used to monitor the pH level and temperature of the water from a distance. It works by using a pH sensor and a temperature detector. PH and temperature measuring devices based SMS gateway can measure pH levels in the water with the scale between pH 0 to pH 14, while for the temperature measurement itself can be measured with a scale between -100 C and 1000 C. To make this system needs wavecom modem for communication with providers, pH and temperature sensor as a detector, and ATMega 128 as the controller. For programming the system uses Delphi 7 programming language and application micropascals. In this study designed a pH and temperature measuring devices based SMS gateway and SMS (Short Message Service) as an information medium to long distances. Measurement data can be viewed directly via the LCD on pH and temperature module. Moreover, it can also be viewed remotely via a PC that is already connected to the modem wavecom and on a cell phone. Keywords: pH Sensor, Temperature Sensor, SMS (Short Message Service) Gateway.

2.) Journal Study Prepared by: Mhd. Idris, Indra Jaya.

Water temperature data logger is a water temperature recording device from time to time automatically making it possible to get an overview of the condition of water temperature are monitored. This study aims to produce design and construction of water temperature data logger low cost. Designed casing uses aluminum cylinder with a diameter of 3.2 cm and 16.5 cm long. Electronic system consists of a central control ATmega328P microcontroller, DS18B20 as temperature sensors, miniature motors DC as an indicator shakes, DS3231 as a marker of time, and a micro SD card as the storage medium. Performance tests show the water temperature data logger watertight casing and sink when put into water so it does not need additional ballast. The battery can last for 10 days 8 hours at a sampling interval of 30 minutes. Sensor calibration error value between (-0.37) - 0:41 0:23 oC with RMSE values ° C. Lake water temperature measurement Bogor Agricultural University on 10th - October 20th, 2013 range between 27.69 - 31.63 ° C with the lowest daily temperature at 5:30 to 8:30 pm and the highest at 12.00 - 16.00. T-test comparison of temperature data between water temperature with a thermometer data logger for two days at the pool indicates that the data were not significantly different.

3.) Journal research compiled by Muhammad Rival, Rudy Dikairono and Adi Tomi.

Measurement of the acidity of the solution (pH) and temperature in the water is something very important in the cultivation of fish, like the seeding process freshwater fish, where the water in the pool should always be monitored acidity and levels of temperature in the water, it is very important to maintain a stable level acidity (pH) and the temperature of the pool water so that the fish do not die easily seed and have a good quality so as to increase the productivity of fish for fish breeding entrepreneurs. Optimal fish growth conditions in the range of -9.0 pH6.5. Water pH levels need to be controlled so that the conditions maintained in the range of -9.0 pH6.5, this can be done by adding acid or base solution in water. The basic solution used is NH3 plus water and acid solution used is CH3OOH plus water. The basic solution used is NH3 plus water and acid solution used is CH3OOH plus water. This study makes monitoring the pH levels and temperature using a pH electrode as a pH sensor and a temperature sensor LM35. For monitoring pH and temperature on wireless needed distant places as the sender of the data to be monitored without having to come to the nursery fish used is a wireless RF 802.15.4 Modules XBee Pro type that has a range of 1.6 Km of data transmission on the condition without hindrance and 300 m on the condition there is a barrier. To open the lid valve control valve used and PWM control window made in the program the microcontroller.

4.) Journal Study Composed by:Albert Gifson, Slamet

In this study will describe the design of a safety detection system use room with Passive Infrared sensor (PIR) -based microcontroller AT89S52 remotely. The output of the passive infrared sensor (PIR) on the tool, to logic low if you do not catch any heat waves in the detection of the human body. When the PIR sensor detects the presence of human beings, then the output of the sensor connected by 1.7 port on the microcontroller to logic high. The maximum distance that is capable of detection by the sensor is 5 meters. At the time of detecting sensor, the microcontroller is already in the program will process 8 detected data to give orders for the buzzer sounds and the motor Stapper to stop. The microcontroller will send data to-RS-232, then interface RS-232 aka signal the mobile phone mounted on the tool, then will send a message to a cell phone owner, while the message yag be sent in advance has been made with the programming language and then in save in AT89S52 microcontroller. Average - average delivery time beam for 8.8 seconds. Recipient of a message from a mobile phone, the owner can shut down and restart the alarm system by means miscall.

3. Analysis Of Results And Discussion

3.1 Workflow Hydroponics System

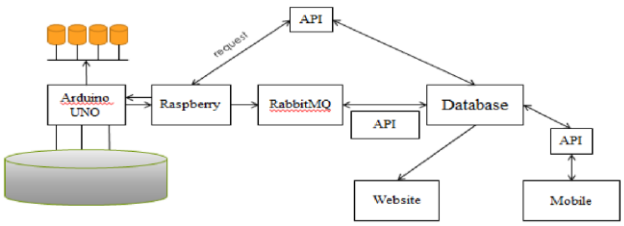

Figure 1 Workflow System

The system works as follows:

1. Data from Temperature sensors, temperature sensors send input of the water temperature. PH sensors, pH sensors send input of acidity air.sensor EC, EC sensors send input of nutrients in the water. and sent to arduino.
2. From arduino data is sent to raspberries, raspberry namely that process data from the arduino
3. From the raspberry and sent MQ RABBIT, RABBIT MQ queue namely that the data does not accumulate.
4. Then from RABBIT MQ send data to the database through an API, API is the application intermediary to link data from RABBIT MQ to the database, and the database for storing data.
5. Website and Mobile retrieving data from the database. And then sent to the Website or Mobile (Android) to display the results of data from temperature sensors, pH sensors, and sensors EC.
6. Raspberry perform data checks of plants from plant standard data tables in database, if it does not match then raspberries send commands to an Arduino.
7. Arduino sends the action to the bottle and valve nutrients.
8. valves secrete nutrients, temperature regulation and the acidity of the water.
9. The existing data again sent to the database.
10. The mobile Web and retrieve data from the database.
11. Users receive information via the Website and Mobile.

Testing 3.2 Temperature Sensor (DS18B20)

In a post last discussed LM35DZ a temperature sensor, a sensor is used for the measurement of body temperature in the thermometer. DS18B20 a temperature sensor in which the accuracy of temperature and velocity measurement value has a much better stability of the sensors LM35DZ. DS18B20 is a digital temperature sensor that is released by Dallas Semiconductor. For temperature readings, use sensor 1 wire communication protocol. DS18B20 have the 3 pin consisting of + 5V, Ground and Data Input / Output.

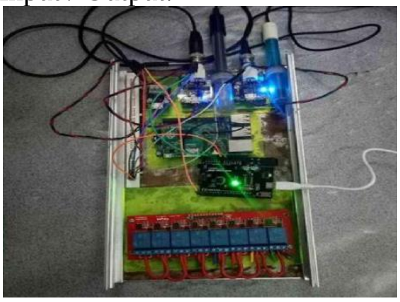

Figure 2 Test Tools Sensor

Figure 3 Sensor Temperature

Table 1. Result testing data to serial mmonitor

Percobaan	Serial Monitor		
	Temp	PH	EC
1	YA	YA	YA
2	YA	YA	YA
3	YA	YA	YA
4	YA	YA	YA
5	YA	YA	YA
6	YA	YA	YA

From the table above if the value of "YES" indicates the data has been sent and if the data has been sent in the show with the value "NO". In the table above it can be seen that all the data read by the sensor which successfully send to the *serial monitor* with no experience *an* error.

Table 2. Time delay between data

Percobaan	Data ke -	Waktu
1	1	10:30:05
2	2	10:35:10
3	3	10:40:15
4	4	10:45:20
5	5	10:50:25
6	6	10:55:30
7	7	11:00:35
8	8	11:05:40
9	9	11:10:45
10	10	11:15:50

From the test results obtained the results as shown in table form as shown in Table 1 and Table 2 where the data that has been read by the sensor successfully sent to *serial monitor* the average delivery time lag - average 5 minutes 5 seconds. Conclusions on this test in the read sensor data was successfully sent to *the serial monitor* with a stable time lag.

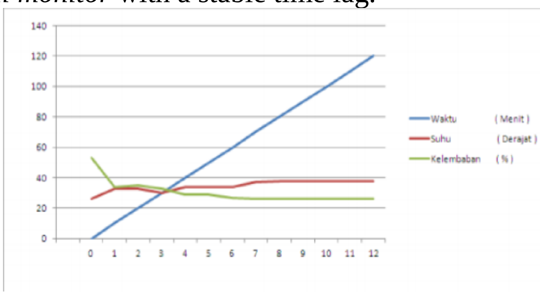

Figure 4 Graph Testing Temperature Sensor

From Figure 5.4 shows that the measurement of sensor voltage linear with respect to the levels of water temperature. Where to temperatures between 20 and 40 have a stable voltage, for temperature (neutral) output is approximately 5 volts and for Temperatures above 20 and 40 degrees has a negative output voltage.

3.3 Coding Temperature Sensor DS18B20

```
#include <OneWire.h>

#define StartConvert 0
#define ReadTemperature 1
//#define SensorPin A2          //pH meter Analog output to Arduino Analog Input 0
unsigned long int avgValue;     //Store the average value of the sensor feedback
float b;
int buf[10],temp;
char val;

const byte numReadings = 20;          //the number of sample times

byte ECsensorPin = A1;                //EC Meter analog output,pin on analog 1
byte DS18B20_Pin = 2;           //DS18B20 signal, pin on digital 2
byte in_serial,str;
unsigned int AnalogSampleInterval=25,printInterval=700,tempSampleInterval=850;
//analog sample interval;serial print interval;temperature sample interval
unsigned int readings[numReadings];     // the readings from the analog inputb
byte index = 0;                       // the index of the current reading
unsigned long AnalogValueTotal = 0;           // the running total
unsigned int AnalogAverage = 0,averageVoltage=0;           // the average
```

```
unsigned long AnalogSampleTime,printTime,tempSampleTime;
float temperature,ECcurrent,phVal;

//Temperature chip i/o
OneWire ds(DS18B20_Pin);  // on digital pin 2

void setup() {
 // initialize serial communication with computer:
 pinMode(3,OUTPUT);
 pinMode(4,OUTPUT);
 pinMode(5,OUTPUT);
 pinMode(6,OUTPUT);
 pinMode(7,OUTPUT);

  Serial.begin(9600);
  // initialize all the readings to 0:
  for (byte thisReading = 0; thisReading < numReadings; thisReading++)
    readings[thisReading] = 0;
  TempProcess(StartConvert);   //let the DS18B20 start the convert
  AnalogSampleTime=millis();
  printTime=millis();
  tempSampleTime=millis();
}
void loop() {
  for(int i=0;i<10;i++)       //Get 10 sample value from the sensor
                               for smooth the value
  {
    buf[i]=analogRead(0);
    delay(10);
  }
```

```
for(int i=0;i<9;i++)        //sort the analog from small to large
 {
  for(int j=i+1;j<10;j++)
  {
   if(buf[i]>buf[j])
   {
    temp=buf[i];
    buf[i]=buf[j];
    buf[j]=temp;
   }
  }
  //return buf[i];
 }

 avgValue=0;
 for(int i=2;i<8;i++)                   //take the average value of 6 center sample
   avgValue+=buf[i];
 float phValue=avgValue*(float)5.000/1024; //convert the analog into millivolt
 phValue=3.5*phValue;                   //convert the millivolt into pH value

 in_serial= Serial.read();
 str = char(in_serial);
 switch(str)
 {
  case '1': digitalWrite(3,1);//pompa
          break;
  case 'a': digitalWrite(3,0);
          break;
  case '2': digitalWrite(4,1);//Katup ph Basa
          break;
  case 'b': digitalWrite(4,0);
          break;
  case '3': digitalWrite(5,1);//katup ph Asam
          break;
  case 'c': digitalWrite(5,0);
          break;
  case '4': digitalWrite(6,1);//katup ec A
          break;

  case 'd': digitalWrite(6,0);
          break;
case '5': digitalWrite(7,1);//katup ec B
          break;
  case 'e': digitalWrite(7,0);
          break;
```

```
 if(millis()-AnalogSampleTime>=AnalogSampleInterval)
 {
  AnalogSampleTime=millis();
   // subtract the last reading:
  AnalogValueTotal = AnalogValueTotal - readings[index];
  // read from the sensor:
  readings[index] = analogRead(ECsensorPin);
  // add the reading to the total:
  AnalogValueTotal = AnalogValueTotal + readings[index];
  // advance to the next position in the array:
  index = index + 1;
  // if we're at the end of the array...
  if (index >= numReadings)
  // ...wrap around to the beginning:
  index = 0;
  // calculate the average:
  AnalogAverage = AnalogValueTotal / numReadings;

 }
 /*
  Every once in a while,MCU read the temperature from the DS18B20 and then let the
DS18B20 start the convert.
  Attention:The interval between start the convert and read the temperature should be
greater than 750 millisecond,or the temperature is not accurate!
 */
Koding Untuk Suhu

  if(millis()-tempSampleTime>=tempSampleInterval)
 {
  tempSampleTime=millis();   untuk suhu
  temperature = TempProcess(ReadTemperature());  // read the current temperature from
the  DS18B20
  TempProcess(StartConvert);              //after the reading,start the convert for next
reading

 }
  /*
  Every once in a while,print the information on the serial monitor.
 */
 if(millis()-printTime>=printInterval)
 {
  printTime=millis();
```

```
averageVoltage=AnalogAverage*(float)5000/1024;
   Serial.print(temperature);    //current temperature
   delay(5);
   //Serial.print(" 6.00");
   Serial.print(" ");
   Serial.print(phValue,2);
   delay(5);

   //Serial.print("^C     EC:");
```

Koding Untuk EC (Nutrisi Tanaman)

```
   float TempCoefficient=1.0+0.0185*(temperature-25.0);    //temperature      untuk
EC..compensation formula: fFinalResult(25^C) =
fFinalResult(current)/(1.0+0.0185*(fTP-25.0));
   float CoefficientVolatge=(float)averageVoltage/TempCoefficient;
   if(CoefficientVolatge<10)Serial.println(" 1.7");   //25^C 1413us/cm<-->about 216mv
if the voltage(compensate)<150,that is <1ms/cm,out of the range
   else if(CoefficientVolatge>3300)Serial.println("Out of the range!");  //>20ms/cm,out
of the range
   else
   {
    if(CoefficientVolatge<=448)ECcurrent=6.84*CoefficientVolatge-64.32;
//1ms/cm<EC<=3ms/cm
    else if(CoefficientVolatge<=1457)ECcurrent=6.98*CoefficientVolatge-127;
//3ms/cm<EC<=10ms/cm
    else ECcurrent=5.3*CoefficientVolatge+2278;
//10ms/cm<EC<20ms/cm
    ECcurrent/=1000;    //convert us/cm to ms/cm
    Serial.print(" ");
    Serial.println(ECcurrent);  //two decimal
    //Serial.println("ms/cm");

    delay(500);}
/*
ch=0,let the DS18B20 start the convert;ch=1,MCU read the current temperature from
the DS18B20.
*/
float TempProcess(bool ch)
{
 //returns the temperature from one DS18B20 in DEG Celsius
 static byte data[12];
static byte addr[8];
 static float TemperatureSum;
```

```
  if(!ch){
        if ( !ds.search(addr)) {
            Serial.println("no more sensors on chain, reset search!");
            ds.reset_search();
            return 0;
        }
        if ( OneWire::crc8( addr, 7) != addr[7]) {
            Serial.println("CRC is not valid!");
            return 0;
        }
        if ( addr[0] != 0x10 && addr[0] != 0x28) {
            Serial.print("Device is not recognized!");
            return 0;
        }
        ds.reset();
        ds.select(addr);
        ds.write(0x44,1); // start conversion, with parasite power on at the end
  }
  else{
        byte present = ds.reset();
        ds.select(addr);
        ds.write(0xBE); // Read Scratchpad
        for (int i = 0; i < 9; i++) { // we need 9 bytes
          data[i] = ds.read();
        }
        ds.reset_search();
        byte MSB = data[1];
        byte LSB = data[0];
        float tempRead = ((MSB << 8) | LSB); //using two's compliment
        TemperatureSum = tempRead / 16;
    }
        return TemperatureSum;
 }
```

Koding Untuk Ph (Zat Asam Basah Di Air

```
float ph(){
untuk ph
  for(int i=0;i<10;i++)       //Get 10 sample value from the sensor for smooth the value
  {
    buf[i]=analogRead(0);
delay(10);
  }
```

```
for(int i=0;i<9;i++)        //sort the analog from small to large
  {
   for(int j=i+1;j<10;j++)
   {
    if(buf[i]>buf[j])
    {
     temp=buf[i];
     buf[i]=buf[j];
     buf[j]=temp;
    }
   }
   return buf[i];
  }

 avgValue=0;
 for(int i=2;i<8;i++)                //take the average value of 6 center sample
  avgValue+=buf[i];
 float phValue=avgValue*(float)5.000/1024; //convert the analog into millivolt
 phValue=3.5*phValue;                //convert the millivolt into pH value
 Serial.print("    pH:");
 Serial.print(phValue,2);
 Serial.println(" ");
 }
```

3.4 Test Result Temperature Sensors, pH and EC

From the test results the sensor temperature, pH and EC, it can be concluded that a system in which the output of all the conditions of work in accordance with the actual conditions of obtaining the results of water temperature 28.33 with an acidic pH , the average pH of 6.5, as well as the EC 2.3no / cm.

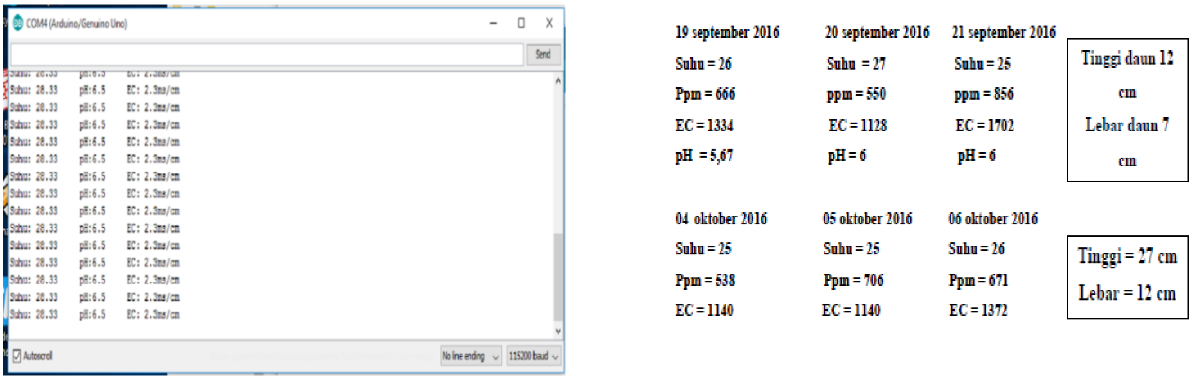

Figure 5 Results of Testing Sensor

4. Conclusions And Recommendations

4.1 Conclusion

Based on the analysis discussion with temperature sensors in the testing process, it can be concluded that:

a. The test results showed that the temperature of temperature sensor thatobtained is the number of data centigrade.

b. Hopefully, by the automation system that was built to alleviate human tasks in terms of cultivation using hydroponic growing media.

c. Development of analog temperature calibration system andusing methodfuzzy logic how to keep within 1 bath hydroponics can be planted a few plants of different species.

4.2 Recommendations

Based on the results of research and discussion in the previous chapter there are some suggestions that can be given to the author for subsequent research:

a. Hopefully with the analysis of this study can be utilized by the user associated with the well.

b. Analysis of the previous chapter, the author may be implemented for future research.

c. The author realizes that this paper is not perfect, there are still a lot of shortcomings. for it is expected for other users to be able to develop it.

References

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