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IOT POWER SYSTEM MQTT POTOCOL AT MICRO-SCALE SHRIMP FARMING IN URBAN AREAS

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Abstract

In the post-pandemic era, Food security is activity that recommended by the government to save food crisis especially to increase food activity in urban areas. Like a shrimps, is the most favorite fish for food at urban area where in general this fish cultivation is carried out in the pond area. With the IOT MqTT protocol we propose the model of prototype system of shrimp cultivation at urban area where the place had topography characteristic like 5-9meter ground level, 31 °C temperature and 71%humidity. with the MQTT mobile telemetry we get the information about the changes condition like a temperature, PH, turbidity at the pond based android. Temperature for the heat level, PH for acidity and turbidity for clarity. Using wifi microcontroller AVR based to connect firebase cloud for storing data sensor that input data MUX microcontroller get from analog sensor. The power plant using solar power that implemented for power system at the peripheral. The result is the information condition of pond and alert if the value is out of set point value in the shrimp pond also the model of solar power system that implemented of shrimp farming.

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I. INTRODUCTION

Vaname Shrimp is one of the sea food commodities that has a fairly good business opportunity for local consumers and also a mainstay export sector. The variety of shrimp like vannamae shrimp (Litopenaeus vannamei) is the most shrimp that cultivated on the north coast of java [1]. Power system microprocessor also need to be considered in distributing the power flow [2]. Shrimp cultivation activities are carried out in various locations in Indonesia, but at the stage of cultivation development, farmers still encounter many obstacles, among these obstacles, one of which is that many shrimp seeds die at an early age. One of the factors is a change in water temperature, water pH, turbidity factor, and others.

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Generally, farmers at this time are only testing the water condition of a pond manually without any equipment that can provide a very precise value, so that maximum and precise measurement results are not obtained. So they went through a critical period that is period before pond changes impact the fish then the pond change color, smell bad and growing mushroom. Before the pond change condition the system gives early warning of changes in normal condition so failure during shrimp enlargement can be anticipated. With this measurement tool, it can be easier for farmers to know the state of the water in the pond so as to minimize the impact that occurs on shrimp seeds.

Temperature is one of the factors in the life of shrimp vanamme farming. The temperature of the water is closely related to the concentration of oxygen in the water and the progress of the oxygen consumption of aquatic animals. The temperature in water has an inverse ratio to the concentration of oxygen in the water and has a direct ratio to the rate of oxygen consumption in aquatic animals. A good and optimal temperature for shrimp culture ranges from 24-35°C. That the temperature in the water has an influence on the biochemical reactions and chemical reactions of the waters in the shrimp's body. With temperatures below 24ºC and above 35ºC, shrimp growth will decrease [3]**.**

The degree of acidity and pH is used to express the level of base or acid possessed by a substance, object, or solution. The normal pH has a value of 7 and then if the value of the pH is more than 7 indicates the substance has an alkaline nature and then if the pH value is more than 7 indicates it is acidic. Each type of aquatic animal has a different tolerance for changes in pH. pH is said to be good for shrimp growth between 6.5 to 9 [4] and optimally between 6.5 to 8.5 [5] [6]**.**

Clarity or Turbidity is a measurement using the effect of light as the basis for measuring the state of water. Nephelometrix Turbidity Unit or commonly abbreviated as NTU is a unit of the turbidity of water seen in the concentration of insoluble, the weight of the particles in a liquid which if the water is not transparent then it has a high level of turbidity, then if the water is seen transparent then it has a high level of turbidity. low water turbidity. High turbidity values can be caused by the presence of dissolved particles in the water such as clay, mud, organic material, and microorganisms. The optimal value for turbidity for shrimp culture ranges from 25-400 NTU. [3]

Temperature sensor. The DS18B20 digital temperature sensor is useful for converting the amount of heat into the amount of voltage. The DS18B20 sensor has 3 legs as VCC, GND and Vout. The DS18B20 sensor works by changing the temperature scale into an electrical quantity. The ideal voltage out of the DS18B20 has a ratio of 100 which is equivalent to 1 volt. This sensor has a self heating of less than 0.1, which can be operated using a single power supply (Arduino, 2010).

Figure 1. Sensor DS18B20

The turbidity sensor is useful for detecting the level of turbidity in water through optical water technology caused by light as well as being a comparison of light to reflect the incoming light. Turbidity is a condition where the water is not clear or cloudy and is caused by the presence of particles that usually cannot be seen with the human eye, such as smoke. the more particles the turbidity level of the water is also not low. In this method, it is stated that the higher the level of water turbidity will be followed by a change in the voltage from the sensor output [7]**.**

Figure 2. Turbidity Sensor

Sensor module pH meter SEN0161-V1 is a module that is useful in detecting the pH level of water where the output is an analog voltage. This sensor module is used for environmental water testing, aquaponics, hydroponics, and so on.

Table 1. Spesifikasi Modul SEN0161-V1

Tegangan	5V
Range pH	0-14
Temperatur	0-60
Akurasi	(±0.1 pH)
Respon Time	1 Menit
pH Sensor	With BNC Connector

NodeMCU ESP8266 NodeMCU is an electronic board based on the ESP8266 chip with the ability to run microcontroller functions and also an internet connection (WiFi). There are several I/O pins so that they can be developed into a monitoring and controlling application for IOT projects [8].

MIT App Inventor An open source website-based software provided by Google, and currently managed by the Massachusetts Institute of Technology (MIT) [9] App Inventor is an application system for creating software application mobile on Android devices. This application is also made not like the existing development system in applications in general, where a programmer is required to write various lines of program code. But also with visual interaction with a graphical basis.

Google Firebase Firebase is a service from Google to provide convenience and make it easier for application developers to develop their applications. The Firebase Realtime Database (RTDB) is a database hosted in the cloud. Data is stored as JSON and synchronized in realtime on every connected client. When users create cross-platform applications such as in Android SDK, and Java Script, all clients share 1 Realtime Database instance and automatically receive updates containing the latest data.

Thingspeak Thingspeak is an open source Internet of Things (IOT) API platform and application for retrieving and storing data via the HTTP protocol.Thingspeak is possible in terms of building related software on location tracking, sensor logging, social networking. ThingSpeak can visualize and analyze uploaded data using Matlab.

MQTT protocol One protocol that is considered suitable for the IoT communication model is the Message Queueing Telemetry Transport (MQTT) protocol. The MQTT protocol uses the Hypertext Transfer Protocol (HTTP) in IoT communication because it has a lower protocol overhead and is more efficient in terms of using bandwidth and network resources in communicating [10]. This is because the MQTT protocol is a protocol specifically designed for devices that have limited resources with high-latency and low bandwidth [11]**.** In the MQTT protocol communication model, brokers play an important role in the success of the communication process that occurs. This is because communication between publishers and subscribers occurs asynchronously, which means that communication must go through an intermediary broker. However, the broker that is the communication bridge may not be available. This can

be caused because the broker has problems with the network or hardware used. Publishers and subscribers will lose service when a broker is not available which causes publishers to be unable to publish information and subscribers to not be able to subscribe to a topic.

II. METHODS

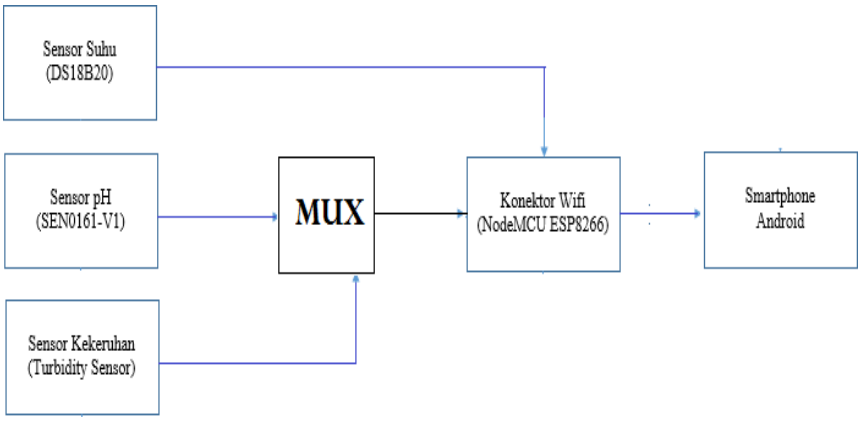

Figure 3. Block diagram of a mobile-based control system

Figure 1 is a block diagram where the control center is controlled using an android mobile device with reference to the status and control control where the ArduinoNodeMCU is the control action plant system while the communication uses wireless. The microcontroller that has built in ESP looks for IP addresses with the AP or access point and Android also connects with the access point to forward its communication via wifi waves so that commands or commands sent via Android are based on the port 80 communication protocol with the destination address using the IP of the Arduino MCU. through peer to peer communication [7] esp8266mp which is connected to the sensor while for the cloud using firebase as a public IOT control service provider.

Android Application Implementation To create an android application, the MIT App Inventor software is used to design the display in the application that can be used to enter the application to monitor and monitor the condition of the shrimp farming pond water.

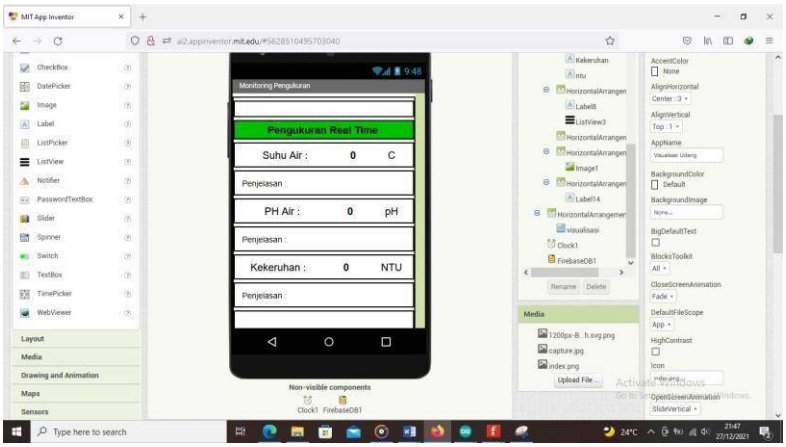

Figure 4. MIT App Inventor main view

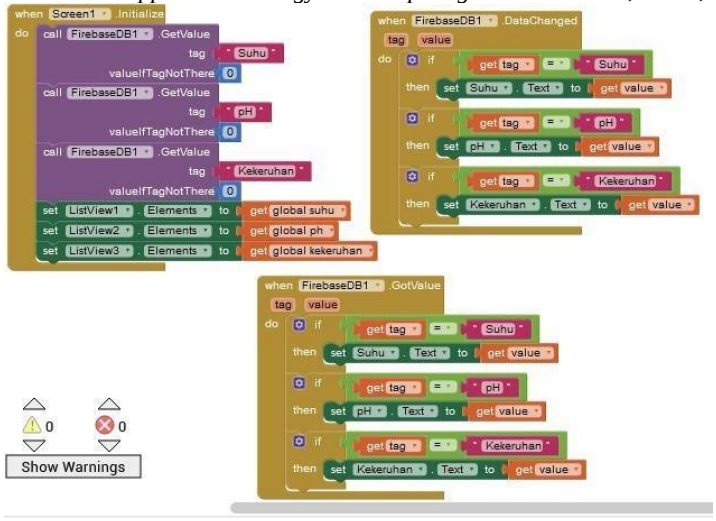

Figure 5. Displays the value of each sensor

Testing experimental stage of measurement visualization tool using arduino microcontroller is carried out to determine the performance of the system, whether the circuits and programs that have been made are running according to the design. The following are the stages of testing carried out to ensure that the system created has worked well.

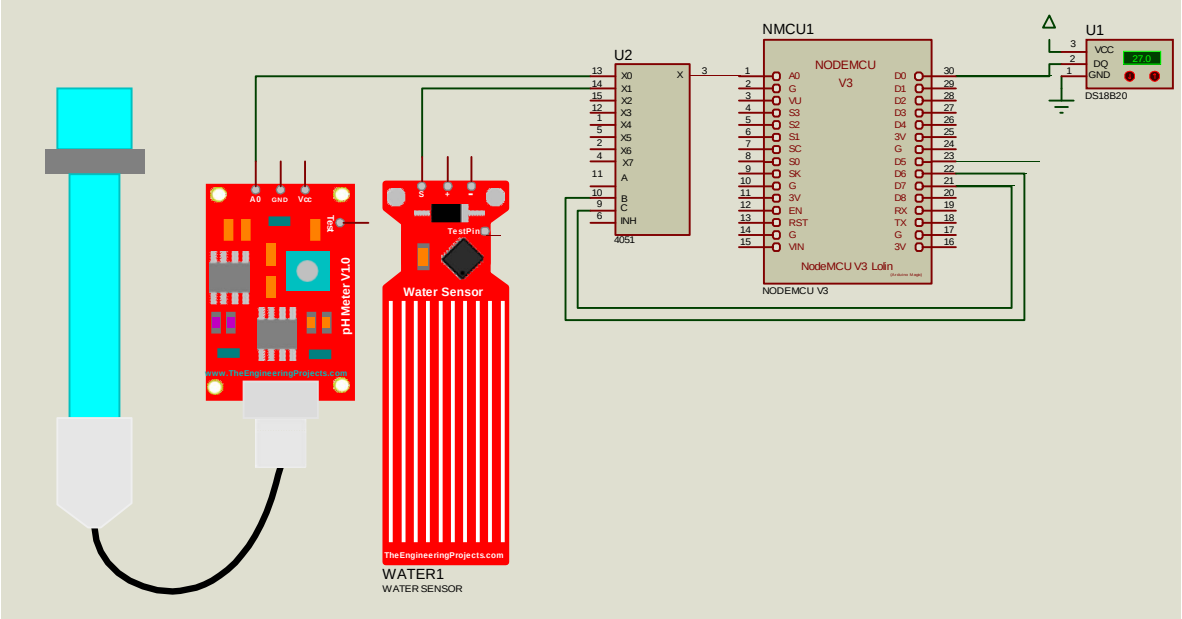

Figure 6. Schematic diagram proteus Simulation

The design on the software was made using a computer simulator proteus and then implemented into nodeMCU using the arduino IDE while for making android applications using MIT App Inventor.

In the sensor simulator, a library is added to Proteus so that the sensor and microcontroller can be used to get the pH value, turbidity, temperature and the ArduinoJson.h library to send the value from the Arduino Mega sketch program to the NodeMCU sketch program so that the value is read.

The program for the NodeMCU ESP8266 board requires the ESP8266WiFi.h library to be able to connect to the internet wifi and the FirebaseESP8266.h library to send values to the database on google, namely firebase.

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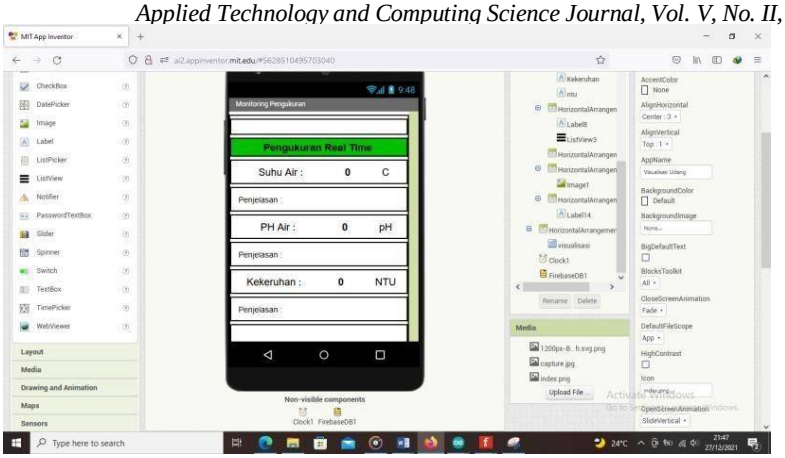

Figure 7. Android application

III. RESULTS AND DISCUSSIONS

Result

This is the results of designing a Visualization Tool on Micro-Scale Shrimp Cultivation Based on a Microcontroller.

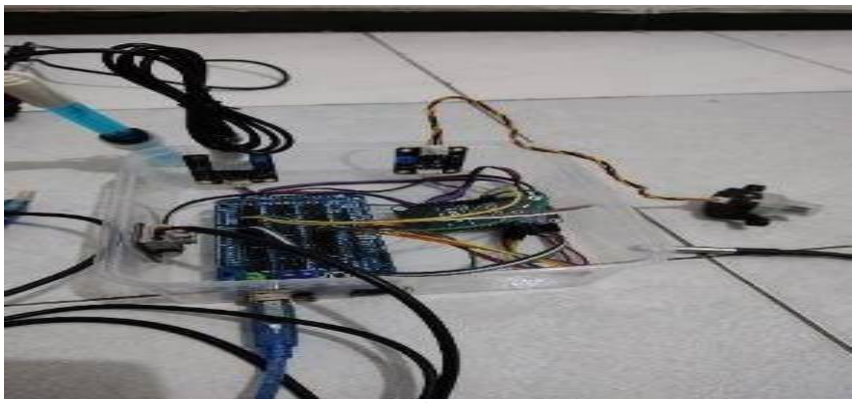

Figure 8. The result is the design test of the Measurement Visualization Tool

This tool is made for micro-scale shrimp farming in urban areas which will regulate and monitor pond conditions so that urban shrimp farmers can adjust the differences between northern coastal shrimp farming conditions and urban areas through the use of sensor readings and graphs on temperature, pH, turbidity. In the control system there is the main board of each sensor as a data retrieval medium. The NodeMCU ESP8266 board functions to receive data from the multiplexer and then sends it to the firebase and thingspeak databases using the internet wifi connector.

In the acquisition of control data for motor security with Arduino wireless communication, in carrying out the control it is implemented on the motor and the system work test process. Testing for smoothness includes software applications both on the microcontroller and the Android mobile program and the mobile program builder as well as constraints on serial and wireless communication between the microcontroller and the Android mobile.

The fish pond model for shrimp farming on an urban scale is carried out in pond conditions with a pool height of 1.5m and 9m above sea level.

Table 2. Measurement Visualization Tool Test Results

Number of test	DS18B20 Sensor	Sensor pH meter	Turbidity Sensor
	Temperature	Acid base level	clarity
1	26,07	6,03	26,68

2	26,2	6,22	25,8
3	26,53	6,13	27,47
4	26,12	6,23	27,1
5	26,42	6,62	25,08
6	26,5	6,84	25,27
7	26,01	6,25	25,32
8	26,05	6,86	26,21
9	26,13	6,22	26,26
10	26,13	6,3	26,3

The test was carried out for 10 trials. Table 1 shows the results of testing the DS18B20 temperature sensor, pH meter sensor, and Turbidity. The temperature sensor obtained an average of 26.21 C that is an ideal condition range for shrimp, the pH sensor obtained an average pH of 6.3 and the turbidity sensor obtained an average of 26.03 NTU. This means that each sensor work properly.

Table 3. Sending data sent range by nodeMCU

range (m)	Sensor	status
1	Sensor DS18B20	Sent
	Sensor pH Meter	Sent
	Turbidity Sensor	Sent
5	Sensor DS18B20	Sent
	Sensor pH Meter	Sent
	Turbidity Sensor	Sent
10	Sensor DS18B20	Sent
	Sensor pH Meter	Sent
	Turbidity Sensor	Sent
15	Sensor DS18B20	Not sent
	Sensor pH Meter	Not sent
	Turbidity Sensor	Not sent

From this test, the distance from the NodeMCU ESP8266 wifi gets results for a distance of 1-10 meters and data can be sent. Meanwhile, for distances of more than 10 meters, data cannot be sent and the range from the device to the Android is cut off and lost.

Sensor test and result

Testing the DS18B20, PH and clarity sensor aims to measure the ability of the sensor to receive stimulus changes in parameters on the measuring device being measured, namely the temperature of the water. In this test, a comparison was made between the temperature measured using a simple temperature and humidity meter with the temperature data displayed on the android application and the Arduino serial monitor. The value on the temperature sensor is generated by immersing the DS18B20 sensor in the pool.

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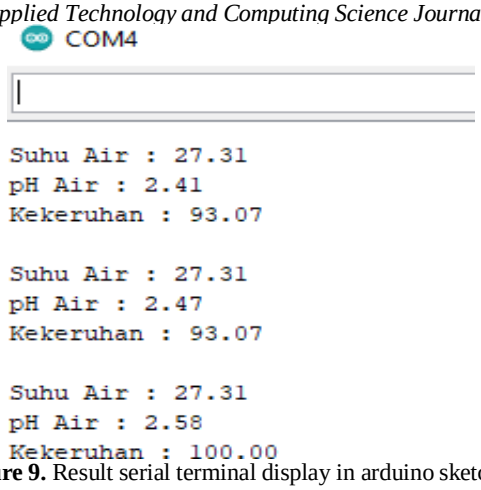

Figure 9. Result serial terminal display in arduino sketch

```
StaticJsonDocument<1000> doc;
doc["A"] = Suhu;
doc["B"] = pH;
doc["C"] = Kekeruhan;
//data.printTo(serial);
serializeJson(doc, serial);
delay(5000);
```

```
String incomingString = serial.readString();
Serial.println(incomingString);
StaticJsonDocument<1000> doc;
DeserializationError err = deserializeJson(doc, incomingString );
 if (err == DeserializationError::Ok)
 {
    Suhu = doc["A"];
    pH = doc["B"];
    Kekeruhan = doc["C"];
 }
```

Figure 10. Sent and receive data

Testing Sending Sensor Values to Google Firebase

A database is a collection of data or information that is stored on a computer, so it is easier to be accessed by programs on a computer to obtain data information. In Figure 9 describes database design on Google Firebase in real time communication. This database contains values from each sensor sent via the NodeMCU ESP8266. This value consists of temperature, pH, and turbidity. After the value of each sensor appears in Firebase, the value will be sent to the Android application and display it.

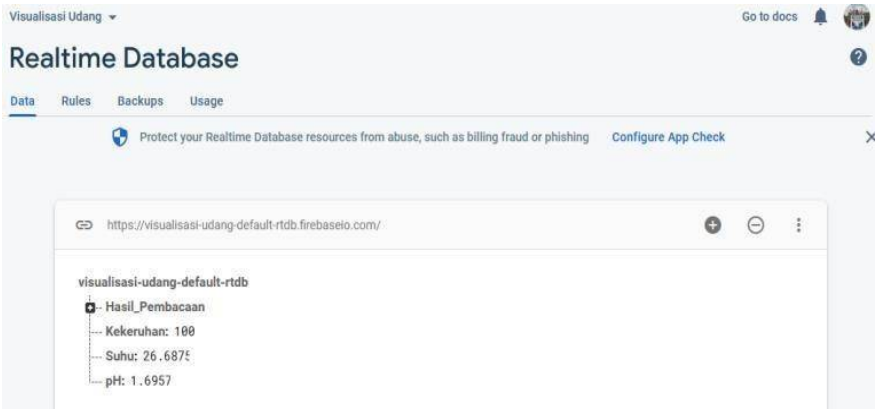

Figure 11. Real time database

This test is carried out to ensure the value of each sensor can be sent to the database via the wifi module. Testing can be done if the wifi module is connected to the internet and adds Firebase Authentication and Firebase Host to the Arduino IDE program.

```
COM5

ßß.Koneksi Tersambung
connected: 192.168.2.198
PASSED
PATH: /Hasil_Pembacaan/Suhu
TYPE: int
ETag: 7ysMph9WPitGP7poMnMHMVPtUlI=
------------------------------------

PASSED
PATH: /Hasil_Pembacaan/pH
TYPE: int
ETag: 7ysMph9WPitGP7poMnMHMVPtUlI=
------------------------------------

PASSED
PATH: /Hasil_Pembacaan/Kekeruhan
TYPE: int
ETag: 7ysMph9WPitGP7poMnMHMVPtUlI=
------------------------------------
```

Figure 12. Serial View

Table 4. result clarity,PH and temperature measurement

Ujicoba	Data Terkirim dari NodeMCU	Data di terima Firebase	Data Terkirim dari NodeMCU	Data di terima Firebase	Data Terkirim dari NodeMCU	Data di terima Firebase
1	26,07	26,07	6,03	6,03	26,68	26,68
2	26,2	26,2	6,22	6,22	25,8	25,8
3	26,53	26,53	6,13	6,13	27,47	27,47
4	26,12	26,12	6,23	6,23	27,1	27,1
5	26,42	26,42	6,62	6,62	25,08	25,08
6	26,5	26,5	6,84	6,84	25,27	25,27
7	26,01	26,01	6,25	6,25	25,32	25,32
8	26,05	26,05	6,86	6,86	26,21	26,21
9	26,13	26,13	6,22	6,22	26,26	26,26
10	26,13	26,13	6,3	6,3	26,3	26,3

Testing Sending Sensor Values to Thingspeak

Thingspeak is an open source for displaying data in graphical form. Apart from being sent to Firebase to store and display values in the Android application, the values for each sensor are also sent to the Thingspeak web to store data and form a graph and display it in the Android application created by the author.

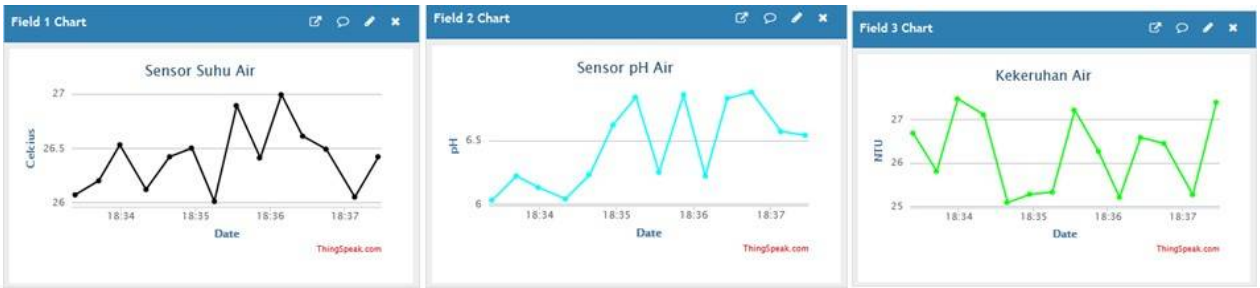

Figure 13. Temperature, PH and clarity chart on Thingspeak

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Results in shrimp farming

From the results above it can be concluded that the measurement tool works very well and is appropriate. This tool can measure temperature, pH, and turbidity conditions in shrimp farming ponds. If the temperature is < 24 C, the shrimp growth will decrease, whereas if the temperature is > 35 C, then the shrimp will be stressed. If the pH is below 6.5, then the growth of shrimp will be hampered, while the pH > 9, it can cause death in shrimp. If the turbidity exceeds 400, then the pond water is more concentrated and there is less visibility in shrimp farming pond water. For android applications work and run accordingly. Displays values and graphs for each sensor. Below is a test of an android application.

IV. CONCLUSION

This tool is more useful in conditions of monitoring PH levels where urban fish farms have salt levels which affect the condition of the water as a cultivation medium. Cloud visualization with graphics makes it easier to study environmental changes with predictable handling and remote monitoring. notification response and ideal environmental condition thresholds are needed in a monitoring system like this because when there is a sudden increase it will make conditions outside the ideal limit. for the system itself this system has the advantage of being economical because the operating power of the Arduino microprocessor and can be backed up using solar energy.

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