Water Quality Monitoring System for Vannamae Shrimp Cultivation Based on Wireless Sensor Network In Taipa, Mappakasunggu District, Takalar

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***Abstract*—Water quality is one of the factors that influence the cultivation of vannamei shrimp. Therefore it is necessary to periodically monitor water quality. In this study it was designed to monitor pond water quality parameters based on Wireless Sensor Network. This system is designed to monitor the parameters of temperature, pH and turbidity in the water of vannamei shrimp aquaculture ponds. This design consists of several transmitter units consisting of 3 sensor parameters namely ph sensor, temperature sensor and turbidity sensor which works to take a value data on shrimp pond water and then the value obtained is processed by Arduino devices. After that it is processed by the Xbee device to be sent to the receiver device. While the receiver unit consists of Xbee devices that work as recipients of data processed by Arduino then displayed on the LCD. The ESP8266 device functions as an internet link. From this device the data that has been obtained will be sent to the database using the internet. Then it can be seen in the web application that has been made. The results of the design show that the system can be used to monitor the quality of shrimp pond water by providing relevant information. After testing the sensor and calibration of the sensor, it was found that the average accuracy of the temperature sensor reached 97.75%, the pH sensor reached 98.84% and the turbidity sensor reached 99.73%.**

Keywords*—*Vannamei shrimp, water quality, sensors, Wireless Sensor Network

I. INTRODUCTION

Shrimp is one of the mainstay commodities from the fisheries sector. One type of shrimp that is easily cultivated in Indonesia is because of the many advantages possessed by the type of vaname shrimp (Litopenaeus vannamei). According to Amri & Iskandar (2008), vaname shrimp was officially introduced as a superior variety to the cultivating community on July 12, 2001 through the Decree of the Indonesian Minister of Marine and Fisheries No. 41/2001 after the decline in the production of tiger shrimp (Penaeus monodon) due to various problems encountered in the production process, both technical and non-technical problems. The advantages of vannamei shrimp are more resistant to disease and the entire life cycle is more controlled and has a large market, especially in America. Compared to tiger shrimp, this shrimp grows faster and is more tolerant of environmental changes. These characteristics which cause white shrimp to become a promising alternative to be cultivated in Indonesian ponds. Because of this, many Indonesian farmers cultivate it in Indonesia [1]-[5].

Water quality is one of the factors that influence the cultivation of vannamei shrimp. Healthy shrimp growth is largely determined by pond water quality. Therefore it is necessary to periodically monitor water quality. The parameters that become indicators to see water quality such as temperature, degree of acidity (pH), turbidity (turbidity) [5]-[7].

One of the intensive vanname shrimp ponds that became the object of research was in Soreang Village, Mappakasunggu District, Takalar District. Monitoring of water quality in intensive ponds is currently only done manually, namely the measurement of water quality is carried out periodically every morning and evening using a measuring instrument manually. Such monitoring processes tend to be impractical, requiring high worker wages and high levels of human error. With advances in Information Technology, data can now be collected at locations and transmitted across a wide area using Wireless Sensor Networks (WSN) and the Internet of Things (IoT) [8].

Based on the above problems, in this study a water quality monitoring system was designed for vannamei shrimp ponds. In this study it was designed to monitor pond water quality parameters which were the implementation of the WSN. This system consists of sensors to monitor temperature, pH and turbidity of water in vannamei shrimp ponds. This design consists of 3 main parts, namely the input part is a sensor node consisting of three sensor parameters namely temperature, pH and turbidity, part of the process consisting of atmega 2560 microcontroller and atmega 328 microcontroller as water quality monitoring processors where in making programs using arduino software IDEA. In addition there are also communication devices, namely sensor nodes and output parts consisting of LCD and Web. With this system, the water quality of Vannamei shrimp aquaculture ponds can be monitored and provided data online [9]-[11].

II. WIRELESS SENSOR NETWORK

Wireless Sensor Network (WSN) is an integrated system consisting of a group of distributed sensor modules and wirelessly connected to a network topology and serves to extract various information to be processed according to the application field. This system is included in Lowrate Wireless Personal Area Networks because the bit rate is low and does not require remote communication distance. Sensor nodes as network builders consist of 4 main parts, namely sensors for detecting and measuring applicative parameters, data processing processes into information, transceivers as data transmission media, and power management to ensure the entire system can run optimally [12].

In WSN, sensor nodes are spread with the aim of capturing the symptoms or phenomena to be investigated. The number of nodes distributed can be determined as needed and depends on several factors such as area, sensing node capability, and so on. Each node has the ability to collect data and route it back to the Base Station. Sensor nodes can collect large amounts of data from symptoms arising from the surrounding environment [13]-[14].

Small sensor nodes are spread out in a sensor area. The sensor node has the ability to route data collected to other adjacent nodes. Data sent via radio transmission will be forwarded to the BS (Base Station) which is the link between the sensor node and the user. This information can be accessed through various platforms such as internet or satellite connections, allowing users to be able to access realtime through a remote server [15]-[16].

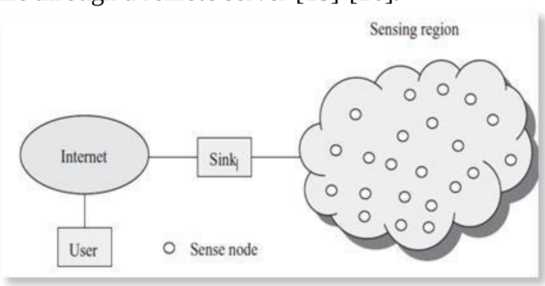

Figure 1. WSN Arschitecture

III. RESEARCH METHOD

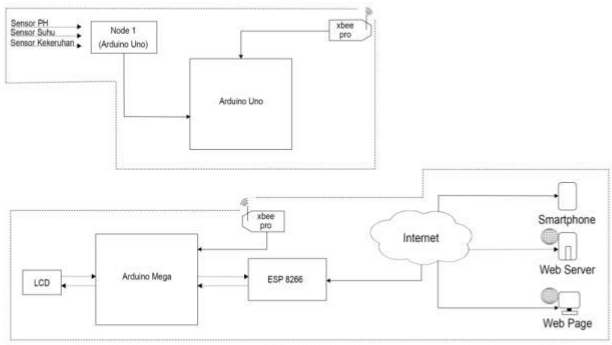

Figure 2. Research Design

The design of the research monitoring the water quality of shrimp-based wireless network sensors as shown in figure 1 where using Atmega 2560 and ATmega 328 microcontrollers and wireless communication is composed of two main parts, namely the sending unit (Tx) and the receiving unit (Rx). In the sending unit consists of Atmega 2560 Microcontroller, sensor node, DS18B20 temperature sensor PH sensor, Turbidity Sensor. While the receiver consists of Atmega 328 Microcontroller, ESP8266 sensor node, LCD to display data, DS1307 RTC Module.

The microcontroller used in this tool is the Atmega 2560 Microcontroller and the Atmega 328 Microcontroller. Where two microcontrollers are used, the Arduino one is used for the sending unit and the other for the receiving unit. Data transmission system between Atmega 2560 uses sensor nodes with maximum capability of distance in sending data around 200 m. Like the Arduino, two sensor nodes are used, where one sensor node is in the sending unit and the other is in the receiving unit. This sensor node is used for data transfer between Arduino.

For monitoring systems, LCD Character 16 * 2 is used. This LCD is placed on the receiver. This tool is used to display the value data that is read by a temperature sensor and Ph turbidity sensor that has been sent by the sending unit. The receiving unit is equipped with RTC1307. This RTC1307 provides time and can then be displayed on the LCD.

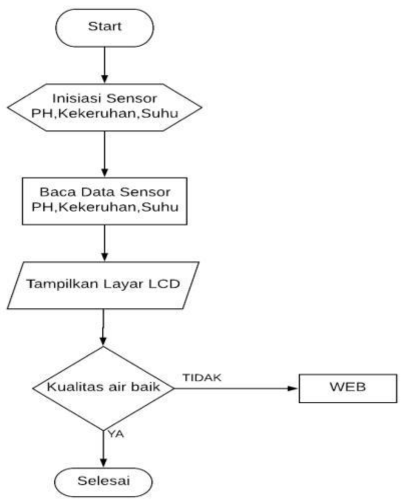

Figure 3. Flow chart of the monitoring system

IV. RESULTS

A. *Hardware Results*

Based on the research conducted, a wireless sensor network based shrimp water quality monitoring system was produced. This section consists of several transmitter units consisting of 3 sensor parameters namely ph sensor, temperature sensor and turbidity sensor which works to take a value data on shrimp pond water and then the value obtained is processed by a microcontroller device. After that it is processed by the Xbee device to be sent to the receiver device. While the receiver unit consists of Xbee devices that work as recipients of data processed by Arduino then displayed on the LCD. The ESP8266 device functions as an internet link. From this device the data that has been obtained will be sent to the database using the internet. Then it can be seen in the web application that was created.

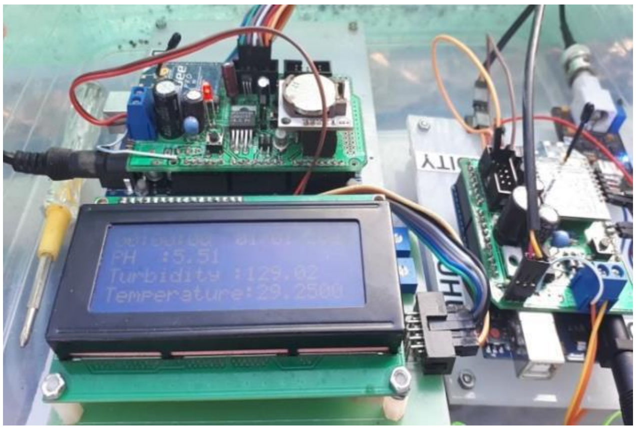

Figure 4. Display of Water Quality Monitoring Hardware Results

B. *Software Results*

In the software section displays the results of research on web-based software that displays water quality monitoring sensor output.

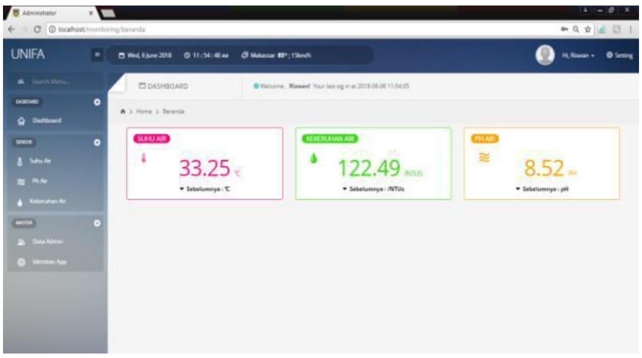

Figure 5. Display of monitoring on web pages

In monitoring pond water quality online using the ESP8266 device as an internet link. Through this device, the data that has been obtained will be sent to the database using the internet. Based on the results of testing carried out in monitoring water quality online, it was found that the monitoring system was very dependent on the available internet network conditions. From several times online testing found failure in monitoring and the delay in the time when it will be displayed on the web application. This is because the quality of the internet is less supportive in the process of sending databases to web applications.

C. *Sensor Parameter Test Results*

Testing of Water Temperature Sensors

This section is the result of the DS18B20 type temperature sensor calibration with BBQ thermometer TP500.

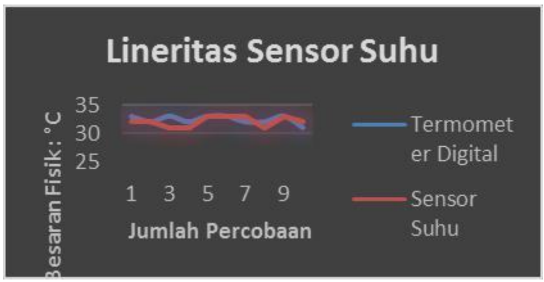

Figure 5. Graph of Temperature Sensor Calibration Testing Test

Based on the table above after testing 10 times on four farm corners where the water temperature using a digital thermometer and the temperature of the water are obtained the difference in values is not so far as fragile and some have the same value and the accuracy of the system reaches 97.76%.

Testing of pH Sensors

This section is the result of the calibration of the pH type SS15 sensor with a pH meter.

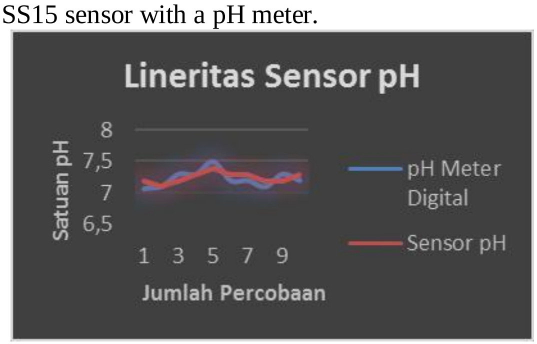

Figure 7. Graph of Testing the Calibration Process of the pH Sensor

Based on the table above it can be concluded that the accuracy of the pH sensor calibration with a digital pH Meter, with testing as many as 10 times in four pond corners so that it has an accuracy rate of 98.85%. As for Figure 4.9 graph on testing the pH sensor calibration process with a digital pH Meter.

Turbidity Sensor Testing

This section is the result of turbidity sensor calibration with digital turbidity.

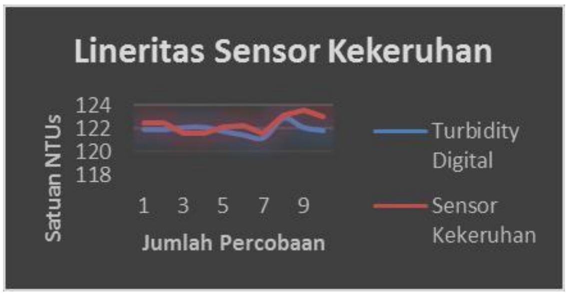

Figure 8. Graph of Turbidity Sensor Calibration Testing Test

Based on the table above after testing 10 times in four farm corners, the results of the water temperature using turbidty digital and water turbidity corsets, the difference in values is not so fragile and even the value is equal and the accuracy of the system reaches 99.73%.

V. CONCLUSIONS

The conclusions that can be drawn are as follows:

1. The design of WSN-based water quality monitoring tools in vannamei shrimp ponds can run well, using temperature sensor devices, pH sensors, turbidity sensors.
2. Based on the measurement and calibration results obtained the accuracy of the temperature sensor reached 97.76%, the accuracy of the pH sensor reached 98.85%, and the accuracy of the turbidity sensor reached 99.73%
3. With the design of a pond water quality monitoring system, it can make it easier for farm owners to monitor water quality anywhere on internet-connected devices, thereby saving costs, time and effort.

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