Water Quality Monitoring in Carp (*Cyprinus carpio*) Culture using IoT Technology (Internet of Things): A Review

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ABSTRACT

Carp are classified as economically important fish because these fish are favored by the community. Carp is one of the important freshwater fish species which is quite developed and can be cultivated in Indonesia. There are several things that are the cause of not achieving the target in carp cultivation. Among them the emergence of disease and death of fish. A live fish transport technique is needed that can ensure the fish reaches the consumer alive. Temperature is also one of the physical factors that affect the physiological processes of fish and is a source of stress that can affect physiological changes in the fish's body. Incompatibility of temperature, pH, DO and ammonia levels where carp live (environment) will result in slow fish growth and can result in fish death. IoT (Internet of Things) is a concept that aims to expand the benefits of continuously connected internet connectivity. As for its uses such as data sharing and sensor reception, as well as applications that can identify, locate, track, monitor objects and trigger related events automatically and in real time. community economic management, production operations, social management and even personal life. The purpose of this paper is to find out how far the use of IOT (Internet of Thigs) technology as an automatic water quality monitoring system in carp aquaculture. The method used in this paper is a systematic literature review.

Keyword : *Water quality, Wireless Sensor Network (WSN), Internet of Things (IoT), Carp Culture*

1. Intoduction

Carp are classified as economically important fish because these fish are favored by the community. Carp is one of the important freshwater fish species which is quite developed and can be cultivated in Indonesia [1]. In addition, Carp has many advantages compared to other freshwater fish, such as high selling prices, distinctive meat taste and high feed efficiency.

Carp are freshwater fish that are usually sold alive. Carp production which was produced 127.772 tons in 2020 as well as the production value which only reached 90.89% of the target [2]. There are several things that are the cause of not achieving the target, including the emergence of disease and fish mortality. Live fish transportation techniques that can ensure that fish reach consumers alive are needed. These efforts have not been followed by efforts to increase fish survival and fish physiological studies so that there are still many problems faced. Temperature is one of the physical factors that affect the physiological processes of fish and is a source of stress that can affect the physiological changes of the fish's body [3].

Another factor is the degree of acidity or pH, dissolved oxygen, and ammonia levels are one of the chemical parameters of waters that have a major influence on the organisms that live in them [4]. Incompatibility of temperature, pH, DO and ammonia levels where carp live (environment) will result in slow fish growth and can result in fish death.

IoT (*Internet of Things*) is a concept that aims to expand the benefits of continuously connected internet connectivity. As for its uses such as data sharing and sensor reception, as well as applications that can identify, locate, track, monitor objects and trigger related events automatically and in real time. community economic management, production operations, social management and even personal life.

On this basis, the authors discusses the use of an IoT-based system that can facilitate monitoring of water quality indicators in Carp culture. Dissolved Oxygen, pH, temperature and Ammonia data collected in the *Data Logger* which will be sent to the *Cloud server* then will be monitored using desktop and mobile applications via internet access anytime and anywhere.

1.1 Understanding the Internet of Things (IoT)

Internet of Things or often called IoT is an idea where all objects in the real world can communicate with each other as part of an integrated system using the internet network as a liaison. Internet of things (IoT) is a concept that aims to expand the benefits of continuously connected internet connectivity. [5].

In general, the concept of IoT is defined as an ability to connect intelligent objects and enable them to interact with other objects, the environment or with other intelligent computing equipment via the internet network. Several important technologies related to the Internet of Things include RFID, Wireless Sensor Network and cloud computing. The internet of things has several application areas including home automation, monitoring patient conditions, and others (Fig. 1) [6].

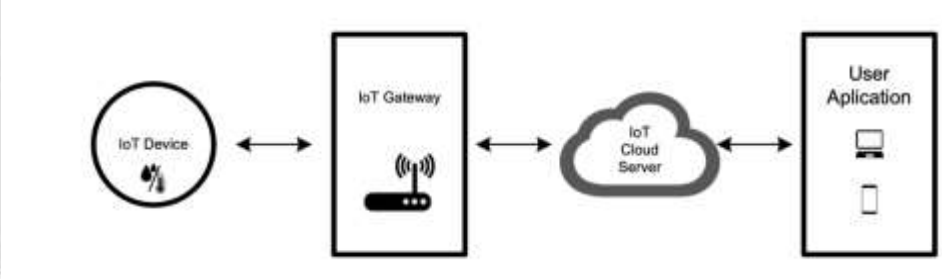

Fig. 1. A sample of Internet of Things (IoT) scheme [6]

In the application of the system to be designed, IoT devices consist of sensors whose task is to convert physical phenomena into signals that can be measured and analyzed by transmitting data to a gateway wirelessly called Wireless sensing. Sensing is a method used to collect information from an object or phenomenon. An object that is carried out for sensing is called a sensor node. The sensor node is a device. Sensor nodes can provide great benefits because they can be integrated into the device as well as directly into the environment. The benefits provided include being able to help avoid infrastructure failures, conserve natural resources, increase productivity, increase security and support new technologies such as smart city technology [7]. The most important thing about a sensor node is that it can be controlled centrally. In practice, hundreds to thousands of sensor nodes are needed for applications in remote and difficult to access areas. In this case, the wireless sensor node is used. A wireless sensor node not only functions as a sensing component but must have the ability to process data, communicate, and store data. In addition, the wireless sensor node is also responsible for collecting data, routing analysis, and forwarding data to and from other sensor nodes. Wireless sensor nodes not only communicate with each other but also communicate with the base station or commonly referred to as a sink node.

2. Automatic Water Quality Meter

Water quality monitoring is a method of taking water samples on a regular basis to analyze the condition of river water and its characteristics. This monitoring is usually the monitoring of fresh water sources such as water from rivers, lakes, streams, ponds, reservoirs, surface groundwater, wells, water in caves, and wetlands. Water quality monitoring systems have been implemented in recent years. The tool is based on Internet of Things (IoT) technology

with parameters for measuring pH, temperature, and turbidity levels displayed on website pages in real-time via the internet [8]. Another system is built by adding another parameter, namely dissolved oxygen [9], with a tool that can be placed in one location [10].

a) Disolved Oxygen Sensor
Dissolved oxygen (DO) sensors measure the amount of dissolved oxygen in a liquid medium, usually water [11]. This sensor provides an output voltage proportional to the concentration of dissolved oxygen in the solution. This value is amplified for better resolution and is measured with an analog-to-digital converter.

b) pH Sensor

c) This sensor is one of the components in this system because it is used to measure the pH value of water. This sensor is installed in each node to monitor the pH of the water and calculate the ammonia level. The output of this sensor is in millivolts (mV). The output of the sensor in millivolts will be automatically converted to a pH value after this formula is applied to programming [12].

d) Water Temperature Sensor
The temperature sensor measures the amount of hot/cold energy produced by an object so that it allows us to know or detect the symptoms of these temperature changes in the form of Analog or Digital output.

3. Hardware and Software

This carp aquaculture water quality monitoring system has components consisting of an Arduino Nano microcontroller, a pH electrode probe sensor for measuring pH levels, Dallas DS18B20 temperature measurement, GE turbidity for measuring water turbidity, voltage sensor for measuring battery capacity at the node, 16 x2 LCD. as a viewer on the node, the NRF24L01 module for sending data on the node to the base using WSN [13], star network topology [14], and ESP8266 for sending data collected at the base to the server via the internet network (IoT). So that the data can be stored in the database and displayed on the website page that has been designed.

Based on the working system of the tool, stages are made that can explain the design process into two parts including the process in the database section using the MySQL application and the interface process on the website page using Sublime Text as a Text Editor. Implementation is the last stage of a series of system tests that have been carried out. Implementation is the stage to directly observe water quality in carp aquaculture water to determine the state of the water and the performance of the system when monitoring.

4. CONCLUSION

WSN and IoT-based water quality monitoring systems have been successfully designed and implemented in aquaculture water flows. This system is designed to monitor pH, temperature and DO levels for a maximum period of 3 hours. Monitoring can be carried out as long as it is still within the radio frequency range. The data is displayed on the LCD at each node or can be viewed on the website page.

5. REFERENCES

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