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Betta Fish Monitoring System: Development of Water Quality Control and Video Monitoring System

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Abstract: Betta fish monitoring system with water quality control and a video monitoring system is developed to assist the breeder in cleaning the fish tank and controlling the water quality to ensure the water is clean. It is because breeding and monitoring this betta fish involves a lot of labour and a considerable amount of time to maintain the quality of pure water so that the fish grown are healthy and beautiful. When the betta fish's water condition is dirty, this has spurred the notion of developing a more productive method of betta fish breeding with an automatic water exchange system. In addition, a camera-based surveillance system that enables breeders to monitor the state of their betta fish via internet video can assist breeders in ensuring that their betta fish are in good condition. This system states water cleanliness by adjusting the pH, turbidity, and temperature appropriately for this betta fish. Based on this project, have two types of water replacement: automatic water replacement and manual control water replacement. For automatic water replacement, sensor pH and turbidity will detect water quality. When the quality of water decreases, which is the value of turbidity more than 25 and value pH less than 6.5 and more than 8.5, water will change automatically. For manual water replacement, the user will control the water pump via smartphone using the Blynk application to change the water. At the same time, the breeder can monitor their fish from a video live at Blynk application. As a result, this product gives betta fish breeders advantages through the use of less labour and the acceleration of the water change procedure for betta fish in a single instance.

Keywords: Water Quality Control, Video Monitoring System

1. Introduction

The efforts to keep an ornamental fish can provide more profits for ornamental fish breeders. The marketing of Betta fish is increasing because many people are starting to make the business of keeping

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ornamental fish in aquariums to decorate their rooms or in ponds - small ponds in the garden or backyard. In addition to people with a hobby with ornamental fish, they will take advantage of breeding and marketing ornamental fish of various types [1].

Furthermore, some breeders venture into this field diligently and have reared this ornamental fish with several types of ornamental fish in high demand, such as Betta fish, guppy fish, limbate fish, and others. All this is done because the business opportunities and potential of ornamental fish farming have high profits compared to fresh fish [2]. Therefore, starting to keep ornamental fish as a hobby has become a livelihood source for their living economy. The existence of ornamental fish is no longer solely for entertainment or hobby. Still, it has evolved into an object that benefits education, research, medicine, and nature conservation [3].

Therefore, due to the scenario, this project is designed to ensure that the water quality of these Betta fish can be regulated and that breeders can save time and effort while monitoring their Betta fish's health. The system work in manual control and automatic control. For automatic control, water will change automatically when the value pH is more than 8.5, less than 6.5 [4], and the value turbidity is more than 25. For manual control, the user will control the water pump using the Blynk application, switch on/off the pump [5], and the user can see the water level from live video and indicator water level from the smartphone.

2. Methods

2.1 System overview

The project's workflow, as in Figure 1, aims to help a breeder monitor water quality in the water tank and speed up the water exchange process in and out of the tank. The sensors that will be used aim to maintain the fish water quality and check the condition of the fish using images live by the camera.

Figure 1 shows the system project, which is divided into two parts. The first part involves controlling the sensors, and the second requires image monitoring. The system aims to ensure the fish water quality is clean for the sensor part. The image monitoring system aims to inform the breeder about the current situation of the fish.

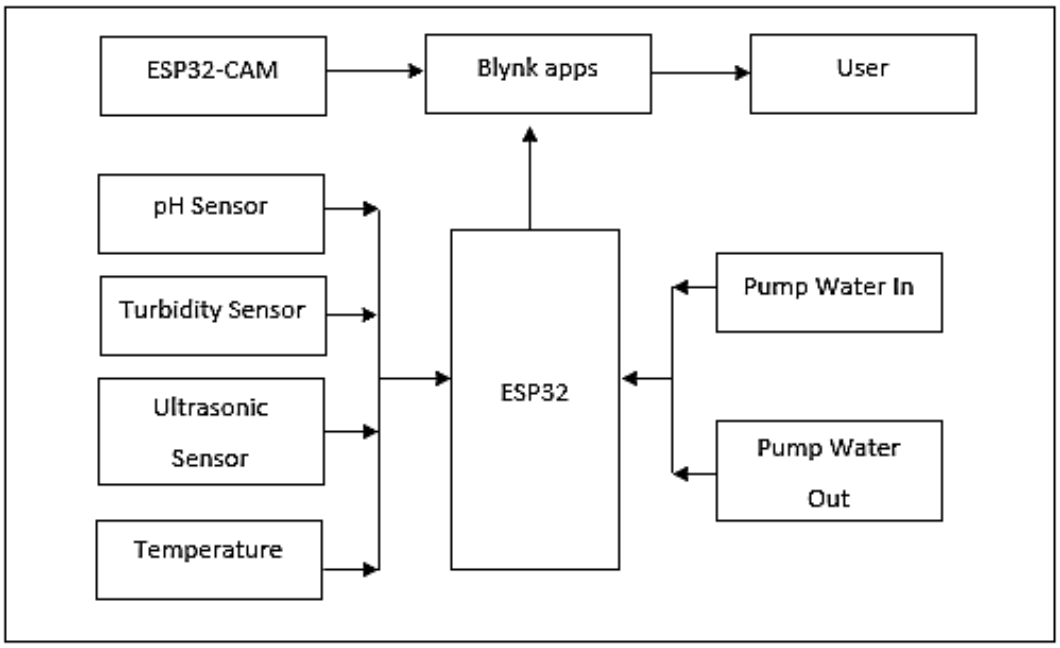

Figure 1: Steps of development of sensor system

2.2 Sensor System Implementation

The pH, turbidity, ultrasonic, and temperature sensors are the five types of sensors used to control water quality in this sensor system. Each of these sensors, as shown in Table 1, has a unique reading to maintain appropriate water quality, and the following are ideal readings for governing the quality of fish water. This project system, is shown in Figure 2.

Table 1: Ideal readings for controlling the quality of fish water

Parameter	value
Temperature	25˚C-32˚C
pH	6.5-8.5
Turbidity	Less than 25 NTU
Ultrasonic	5cm >distance> 15cm

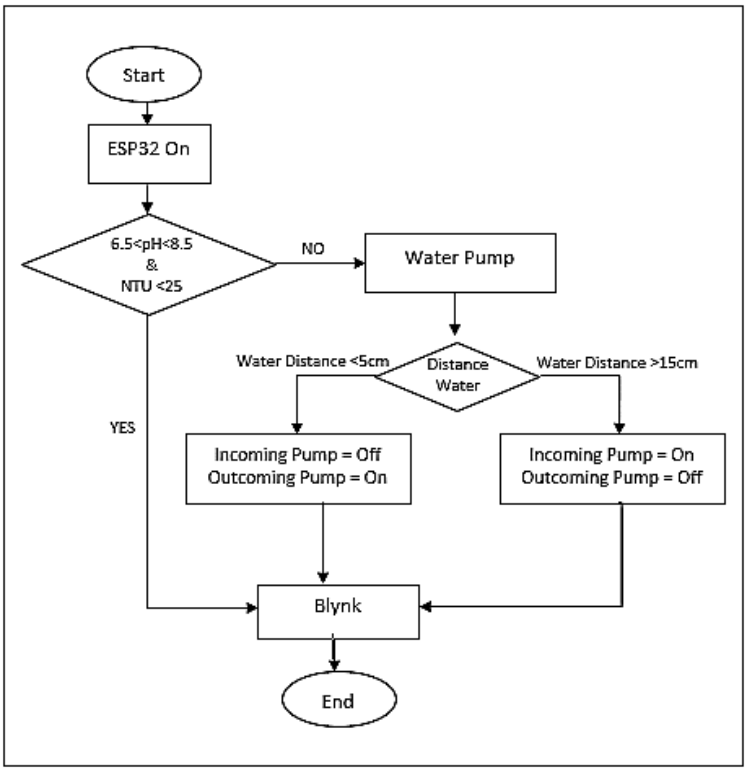

Figure 2: Sensor System Flowchart

Figure 2 shows the system of this project. Its starts when ESP32 is turned on and the system connects to the supply. Data on the water condition will be read using the sensor to check the situation, and when the quality of the water is in good condition, the system will maintain the water. Still, when the water quality is low, the sensor will give instructions to change the water, and the user can monitor the situation via mobile phone.

2.3 Video Monitoring System Implementation

Previously, by using the manual technique, the breeders always spent a lot of time monitoring the condition of their Betta fish. Referring to Figure 3, the solution to the problem is live monitoring video through the smartphone Blynk application. This visual system can assist breeders in virtually

monitoring their fish in real time. ESP32-Cam is the ESP32 camera module that implements in this system. For video monitoring, as shown in Figure 3, the user can monitor the Betta fish using a mobile. This system will inform the user with an image/video on a mobile smartphone. It will help a user see the Betta fish condition and get information about water quality.

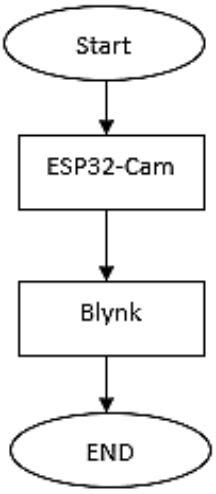

Figure 3: Video monitoring System flowchart

2.4 Measurement sensors

2.4.1 pH Sensor Measurement

To ensure that the water is in good condition, the pH of the water plays an essential function in ensuring the health of betta fish. Therefore, the pH module should be tested to ensure accurate readings. To conduct this test, a comparison was made between the pH module and a digital pH device in Figure 4. Based on Figure 4, there are 2 tests made based on different pH solution values: pH 4.01 and pH 6.86. the results of the tests show that there is no significant amount based on the readings on the pH module and the digital pH device on both solutions. Therefore, it shows that the reading from the pH module can be used in this system.

Figure 4: pH value reading testing

2.4.2 Turbidity Sensor Measurement

Fish thrive in pristine and lovely water. Consequently, the turbidity level of the water must be considered to guarantee that it is in good condition. Figure 5 depicts the evaluation of water turbidity based on two distinct water circumstances, namely low-turbidity water and high-turbidity water. The

reading from the turbidity sensor increases as the turbidity of the water solution increases. The results of this test indicate that the turbidity sensor accurately measures the turbidity of the water solution.

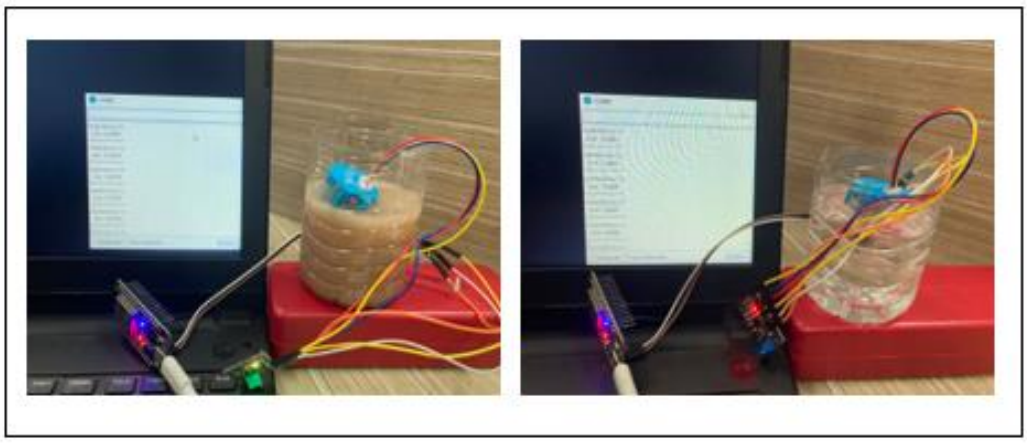

Figure 5: Turbidity value reading testing

2.4.3 DS18B20 Temperature Sensor Measurement

The temperature of the fish's water is crucial to maintaining its health. Although bettas appear more adapted to cooler temperatures, they will become less active and more disease-prone. Thus, their health must maintain a temperature between 24 and 29 degrees Celsius. Suppose the aquarium is kept in a room below 24 degrees. Figure 6 depicts the ds18b20 sensor's testing. Figure 6 depicts the testing of the ds18b20 temperature sensor. According to the tests conducted, there is a disparity between the values at ambient temperature and when the sensor is heated. When the sensor is heated, the sensor reading climbs above the ambient temperature. This demonstrates that the sensor may be utilized because it provides accurate readings of its surroundings.

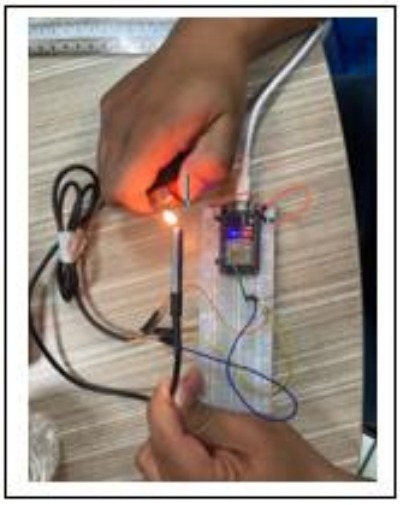

Figure 6: Temperature value reading testing

2.4.4 Ultrasonic Sensor Measurement

The ultrasonic sensor obtains a reading based on the object's distance from the sensor. To measure the height of the water, this sensor is responsible for acquiring a readout of the aquarium's water level. Figure 7 depicts ultrasonic sensor testing utilizing an object to measure the sensor's reading level. According to the experiments, the ultrasonic distance is identical to the distance measured with a ruler. Consequently, the results of this test indicate that this ultrasonic sensor functions well.

Figure 7: Ultrasonic value reading testing

3. Results and Discussion

This section discussed on the project results and hardware interface data results, programming with Arduino software, and the overall development of a Betta fish monitoring system which is the development of a water quality control and video monitoring system. This section will also explain how product accuracy can guide users to monitor the aquarium using the Blynk application on mobile phones.

3.1 Hardware Design

The final prototype is depicted in Figures 8 and 9. Figure 8 depicts the location of the aquarium-adjacent system control component. Figure 9 depicts the aquarium's water irrigation system, while Figure 10 depicts the camera system used to monitor the aquarium's fish. Figure 8 shows the system controller of this project. For the control of this system, there are two parts: the location of the control system, which controls the sensor system and irrigation system, and the voltage input for this system. The second section is a location for the sensor to collect data. Four sensors are utilized, including a pH sensor, turbidity sensor, ultrasonic sensor, and temperature sensor.

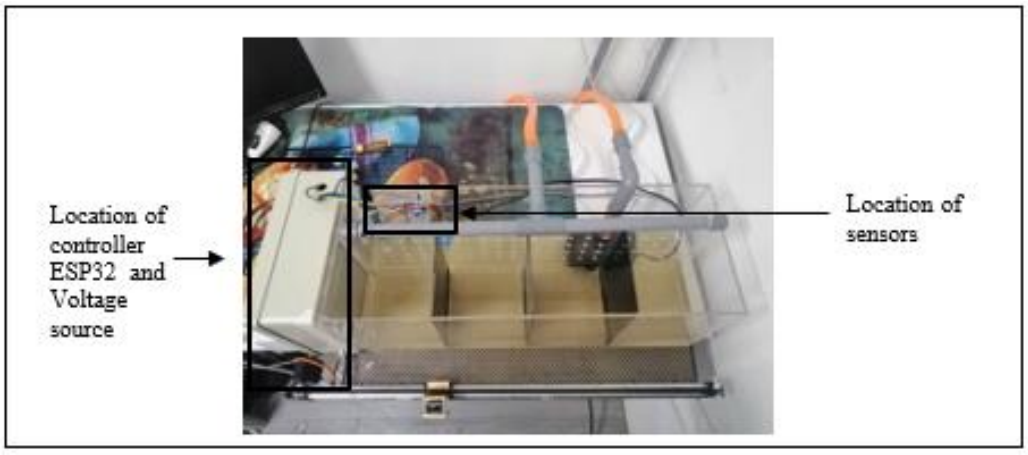

Figure 8: System controller of this project

Figure 9 depicts the aquarium system's irrigation system. There are two major components: the part that receives and discharges water. This system removes water from the aquarium and stores it in the impure water storage tank when the pH is less than 6.5 and more than 8.5 than value turbidity sensors indicate poor water quality, which is more than 25. When as much as a quarter of the aquarium's water has been withdrawn, the ultrasonic sensor plays a part in establishing the set distance to guarantee that

the water is not entirely taken and to retain a quarter of the aquarium's water. When three-quarters of the water in the aquarium is withdrawn, the aquarium's water pump will automatically shut off, and the water pump for adding new water will activate. Clean and fresh water will be added to the aquarium until the ultrasonic sensor receives a reading at the predetermined distance to close the inlet water drain from the inlet water pump.

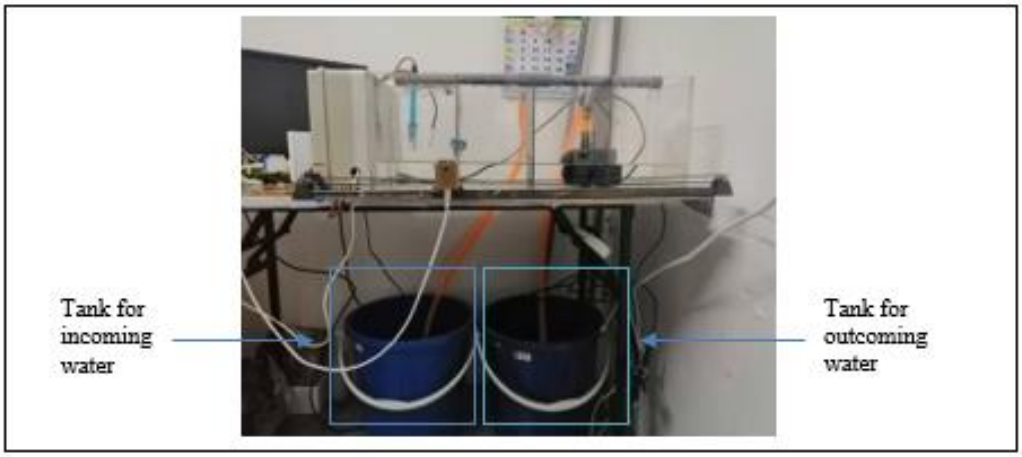

Figure 9: Water irrigation system

Figure 10 depicts the camera system that allows viewers to view live video of the fish's condition. For this camera system, the servo motor is crucial for controlling the left and right movement of the camera. Consequently, when the user watches the video, the user will move the camera through the servo motor to observe the aquarium's fish.

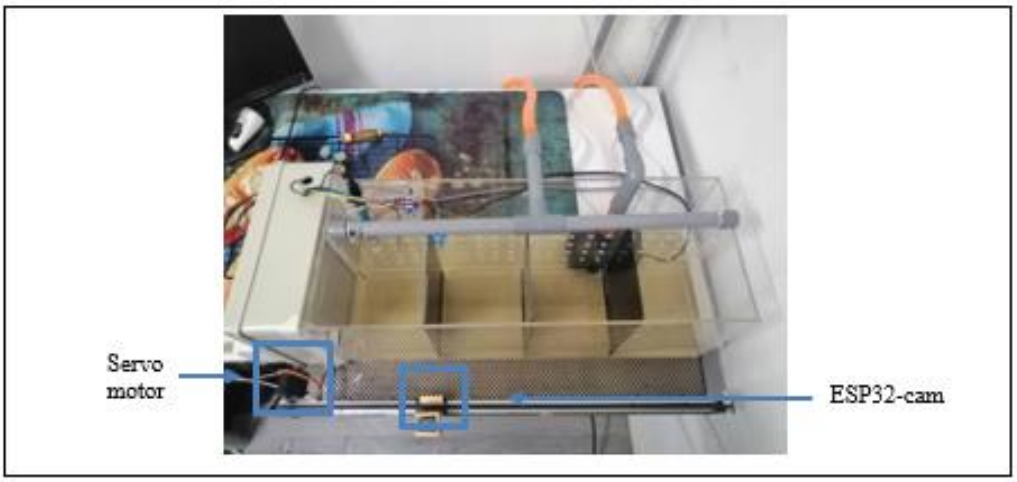

Figure 10: Camera system

Figure 11 depicts the interface of the Blynk application, which allows the user to view live videos of the aquarium's fish and the water's state. In addition, it features left, and right camera movement controls to make it easier for the user to observe the aquarium's fish.

Figure 11: Blynk display

3.2 Project functioning

This project has two system water replacements: automatic water replacement and manual water replacement.

3.2.1 Automatic water replacement

For automatic water replacement, water quality is based on pH and turbidity. The water pump will activate when the pH value is less than 6.5 and more than 8.5. For the value of turbidity, if the value is more than 25, it means the water's turbidity is higher. Figure 12 and Figure 13 show the level of water decrease when the quality of the water is dirty. The water pumps outcoming water will be on until the water level is over 15 cm from the ultrasonic sensor. Then the pump for incoming water will turn on until the water level is less than 5 cm.

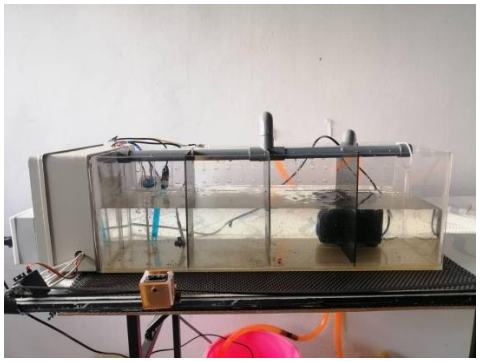

Figure 12: Level of water high

Figure 13: Level of water low

3.2.2 Automatic water replacement

For the automatic water replacement, this system control by user at Blynk application at smartphone. Figure 14 shows the dashboard of the Blynk application. Figure 14 have two value display for the distance of water and temperature. This display lets users get info on the water tank level and the water temperature. After that, have a live video to see the real situation of the aquarium. Button right, stop and left is the function to control of movement camera. So, a breeder can control the camera

to monitor their fish. Lastly, have a button for water in and water out. This button function to control on/off water pump. For this system, breeder can change water manually and check the level of water based on the value display.

Figure 14: Dashboard Blynk application

4. Conclusion

In conclusion, the Betta fish monitoring system, development of water quality control and video monitoring system can help breeder Betta fish to monitor their Betta fish from afar. The monitoring system uses a pH sensor, turbidity sensor and temperature sensor to check the quality of the water tank. Ultrasonic sensor function to check water level for process changing water tank to ensure water flow in good condition and reasonable level. The pH sensor and turbidity sensor have problems that need to be troubleshot because the reading of this sensor has some errors. After changing the circuit and programmer coding, the sensor can read the value of pH and turbidity accurately. Another hardware implemented in this project is ESP32- cam, the module camera that checks fish condition in real-time/live from the Blynk application. User will see their fish and can analyze the condition of Betta fish. With the implementation of the Internet of Things (IoT), the system provides easy access for breeders during monitoring. The breeder can use the mobile application to monitor the measured parameters and video lives far away. As the data result is obtained, the system can help the breeder to monitor their Betta fish. After that, this project also makes the water system change automatically when the water quality is dirty.

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