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Design of a Catfish Feeding Control System and Water Temperature Monitoring Based Internet of Things (IoT)

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ABSTRACT

Catfish (Clarias gariepinus) is the main commodity and prima donna in the freshwater fish market which also generates significant sales in the market. Data from the Directorate General of Aquaculture from 2009 to 2013 shows an increase in consumption of catfish in Indonesia. From these data it can be seen that there is an economic potential from the needs of catfish in the market. To support meeting the needs of catfish, it is necessary to make efforts to increase catfish production, one of which is by increasing the work efficiency of catfish farming and monitoring water quality. Feeding automatically using a microcontroller is one way to increase work efficiency. This effort is realized in a design of an automatic catfish feeding device whose operating method uses the Internet of Things (IoT) concept to adjust the opening and closing of the feed door. The feeding algorithm or program is stored in the microcontroller (NodeMCU esp8266) as the control unit. The results of the application of the tool show that in terms of quality, automatic fish feeders can improve efficiency in feeding fish. In this case, the farmer's workload can be reduced for feeding activities. It is hoped that reducing the burden and working hours of farmers will provide opportunities for other productive activities for farmers.

Keywords: Catfish, Microcontroller, Internet of Things

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INTRODUCTION

The development of increasingly advanced technology, people expect convenience in different aspects of life. One of the developments in today's technology is the application of automation systems that have been widely used to facilitate human work. For example, it is used to implement automation systems for electronic devices at home. Besides making household chores easier, an automated system can save time and costs (Saputra & Prasetio, 2018). Another application offered by the automation system is to support entrepreneurial activities so that businesses can run efficiently, practically and effectively (Laksono, 2017). The development of this technology is also used by the community to facilitate the maintenance of agriculture and fisheries.

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Catfish (Clarias gariepinus) is the main commodity and prima donna in the freshwater fish market which also generates significant sales in the market. (Islam, 2021). Fish farming is currently a very promising results. Data published by the Directorate General of Aquaculture in 2009 to 2013 shows an increase in the amount of consumption of catfish in Indonesia from 144,755 tons in 2009 which increased to 758,455 tons in 2013 (Cristiand et al., 2022). This excellent economic potential is welcomed by catfish farmers, one of them in the Puger area, Jember Regency. Many breeders also choose to cultivate catfish because it is easy to care for and grows fast.

Feeding in catfish farming is one of the most important things in the cultivation process. Feeding can be easily done by simply sprinkling fish feed directly into the pond which is done regularly every day and generally feeding is still manual based (Supriadi & Putra, 2019). For fish farmers who have many ponds, manual feeding is difficult and causes delays in feeding. In general, the catfish farming system in the late feeding of fish can result in cannibalism in the pond, thereby reducing the fish population (Feranita et al., 2019). Several variants of the development of automatic feeders have also been developed by several institutions. Even so, an automatic feeder is still needed that suits the characteristics of catfish. In this case the feeding must be adjusted to the nursery strategy of each cultivator, especially regarding the time of feeding the catfish.

In aquaculture, water quality is also a parameter that must be considered. Temperature tolerance for good stewardship ranges from 24°C to 29°C. At the same time, temperatures that are too low can interfere with the organism's ability to bind oxygen, thereby inhibiting growth (Suwito & Rivai, 2018).

Most of the catfish farmers in Kasiyan Timur Village, Puger District, Jember Regency make catfish farming activities as a side job which is expected to increase their income. Catfish breeders are required to be more observant in terms of their cultivation process to maintain their existence. Departing from this background, community service activities were carried out to design automatic scheduled fish feeding automation and IoT-based water quality monitoring to facilitate the work of catfish farmers and reduce the level of cannibalism in catfish ponds.

METHODS

The activity begins with determining the main topic of the community service program objectives. After discussing with the intended partners, namely catfish farmers in the East Kasiyan Village area, Puger District, Jember Regency, it was agreed that the theme of the activities to be carried out was designing an automatic feeding system and monitoring water temperature. The reason for choosing this topic is the lack of operational efficiency of feeding in catfish farming, because the feeding of catfish farming is still done manually. This causes a lack of time efficiency in catfish farming and adds to the burden on breeders and extends production time.

The implementation method in outline at the design stage of this feeding device can be described systematically (Saputra & Rahmadani, 2022). The activity method is shown in Figure 1.

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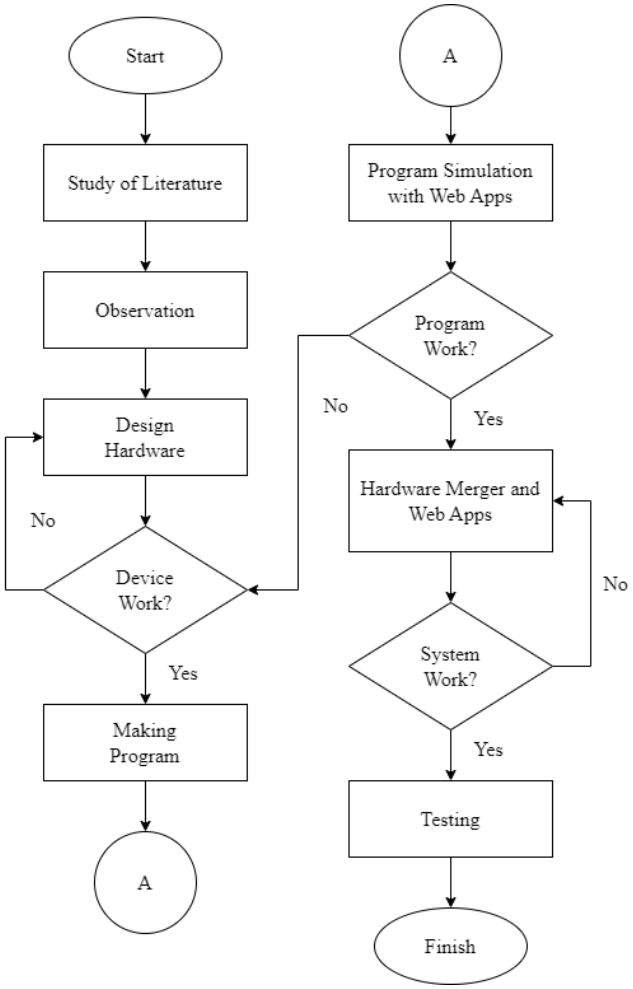

Figure 1. Tool Making Design Stages
Source: Observation results, 2022

1. Study of Literature
   A literature study was carried out regarding catfish farming and tools that can be used in the IoT design process of feeding and monitoring water temperature (Pangestu et al., 2018).
2. Observation
   Observations were made to observe the mechanism of manual feeding by catfish farmers which can later be applied in an IoT-based system (Afif Dewantoro, 2022).
3. Hardware Design
   The design consists of mechanical and electronic design of the components of the tools and sensors used (Gunarjati, 2019). The tools used in designing IoT system hardware are as follows:
   a. *Node MCU ESP8266*
      Node MCU ESP8266 is an electronic board based on the ESP8266 chip with the ability to perform microcontroller functions and also an internet connection (WiFi). There are several I/O pins so that it can be developed into a monitoring and controlling application for IoT projects. The ESP8266 MCU node can be programmed with the Arduino compiler, using the Arduino IDE. The physical form of the ESP8266 NodeMCU has a USB port (mini USB) so that it will make programming easier (Dewi et al., 2022).
   b. *Motor Servo Tower sg90*
      Motor Servo Tower sg90 is a motor with a closed feedback system where the position of the motor will be informed back to the control circuit inside the servo motor. With input to the control which can be either an analog signal or a digital signal, basically a

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servo motor is widely used as an actuator that requires a precise motor rotation position. Meanwhile, the angle of the servo motor axis is set based on the width of the pulse sent through the signal leg of the motor cable. Servo motors usually only move up to a certain angle and not continuously, but for some purposes the servo motor can be modified to move continuously. The potentiometer component on the sg90 servo motor functions to determine the maximum limit for the axis of the moto servo (Salim et al., 2020).

c. Temperature Sensors ds18b20
The ds18b20 temperature sensor is a temperature sensor that uses a one-wire interface, so it only uses a few cables in its installation. Uniquely, this sensor can be used in parallel with one input. This means that we can use more than one ds18b20 sensor, but the sensor output is only connected to one Arduino pin. This reason makes this sensor widely used, especially since this sensor has a waterproof type, so we can make this sensor as a measuring and control tool for water heaters (Imam et al., 2019).

d. Time Sensors *RTC ds1302*
RTC (Real Time Clock) is an IC chip that has the function of accurately calculating time starting from seconds, minutes, hours, day, date, month, to year. To maintain or store the time data that has been turned ON, the module has its own power supply, namely a button clock battery, and the accuracy of the time data displayed uses an external crystal oscillator. An example that can be found in everyday life is on a PC motherboard which is usually located close to the BIOS chip. Enabled to store the latest time information sources so that the clock will remain up to date even if the computer is turned off (Suryanto, 2019).

e. *Hole Breadboard mb-102 400*
Breadboard is a board or board that functions to design a simple electronic circuit. The breadboard will later be prototyped or tested without having to solder.

f. Jumper Cable
Jumper wires are electrical wires that have connector pins at each end and allow you to connect two components involving an Arduino without the need for solder.

4. Programming
Program created to connect between electronic components and sensors used using the Arduino IDE application. Arduino IDE is software that is used to make programming sketches or in other words Arduino IDE as a medium for programming on the board you want to program..
5. Web Apps Program Simulation
The program is made to be controlled using an Android mobile or laptop using the PHP programming language.
6. Merging Hardware and Web Apps
The merger is intended to test the system electronically and the software system can run as expected. The combination of hardware and Web Apps is shown in Figure 2.

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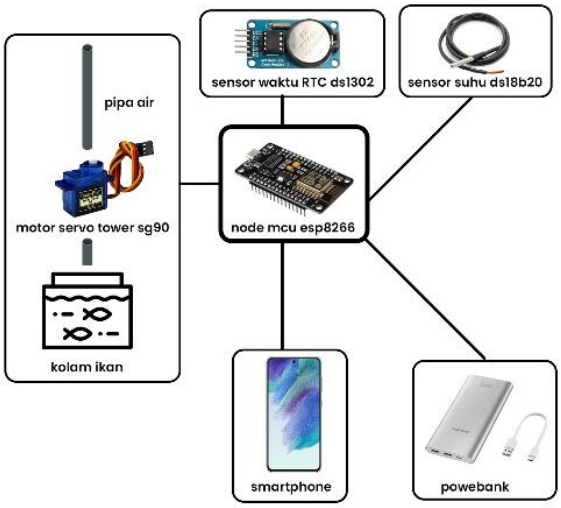

Figure 2. Hardware Suite and Web Apps
Source: Observation results, 2022

In general, the merger consists of three main components, namely::

a. The IoT device consists of sensors (water temperature sensor, real time clock sensor, and servo motor) combined with the ESP8266 NodeMCU device as the main brain of the system..
b. Smartphones consist of Web Apps software as a link and remote device controller. The smartphone used can be Android OS or iOS because the nature of the software can be opened as long as you have a web browser.
c. *Powerbank as the main power to run the hardware*.

7. Testing
   The test is carried out by simulating the tools that have been developed with the volume of feed and the conditions of the catfish pond.

RESULTS AND DISCUSSION

The target of this community service activity is catfish breeders in the East Kasiyan Village area, Puger District, Jember Regency. The output of this activity is the creation of an automatic feeding device that can increase the work efficiency of the catfish farming process.

This IoT-based catfish feeding tool with a remote control system is designed and built to be easy to access. The tool design is shown in Figure 3.

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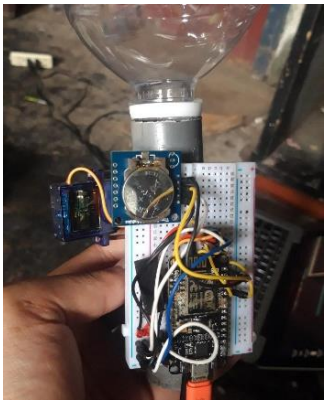

Figure 3. Design of Feeding Equipment and Temperature Monitoring
Sumber: Observation results, 2022

In its implementation, programming is carried out on the ESP8266 MCU Node so that it can carry out serial communication which functions so that the MCU Node and the sensors used can send or receive data to each other. After being able to communicate, the MCU node will be programmed so that it can read data on each sensor and send it to the database. After that the data will be displayed via Web Apps so that catfish breeders or cultivators can feed the catfish and monitor the condition of the water temperature in the pond. (Kurniawan et al., 2020). The flowchart of how the tool works is shown in Figure 4.

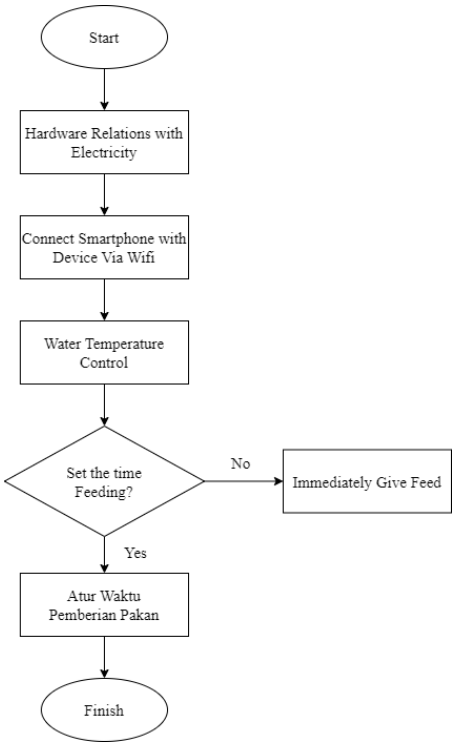

Figure 4. How the Tool Works
Source: Observation results, 2022

The first process, the hardware must first be connected to the mains voltage, which can be a power bank. Furthermore, the process of setting up the remote control system can be accessed using the

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Web Apps application which can be accessed using a Smartphone. Web Apps used in the IoT system are shown in Figure 5.

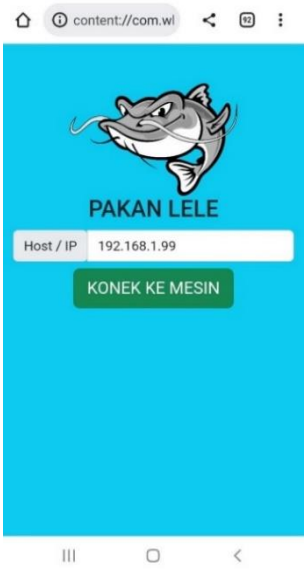

Figure 5. IoT Device Web Apps Front Page
Source: Observation results, 2022

On the front page of the Web Apps, the user must first connect to the hardware device. The connection process can be done by pressing the "Connect to Machine" button which will later be searched for the IP address inside the IoT machine. After the connection process is complete and can be connected, a menu page will appear. The menu page is shown in Figure 6.

Figure 6. Feeding Apps Web Menu Page
Source: Observation results, 2022

On the Web Apps menu page for automatic feeding and temperature monitoring, there are several displays that adapt to the needs of catfish farmers. The Node Time section provides real time information accessed by the device and adjusts to the real time on the Smartphone. The temperature

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menu provides access to temperature information in the pool and will be updated by the machine every one second. The feed period menu gives options to catfish breeders for how many times to give feed within 1 day. The automation tool is given six choices of periods that can be used, including: once an hour, once in 2 hours, once in 3 hours, once in 4 hours, once in 5 hours, and once in 6 hours. An open feed menu is given if the catfish farmer does not use a certain period of time, so the catfish farmer can immediately open the feed door according to his wishes. The process of opening the feed door occurs for 1 second.

Application of the tool is the last part after the tool has been successfully piloted on site and the program has been rearranged to suit partners' needs. After implementing the tool, partners are asked to carry out the process of evaluating the tool. The application of the tool is shown in Figure 7.

Figure 7. Application of Tools to Catfish Ponds
Source: Observation results, 2022

In addition, breeders only need to fill it once per day in the morning so that the tool will work automatically according to the predetermined feeding time. Breeders can also change the size of the feed storage tube according to their needs.

CONCLUSION

From community service activities related to the design of an automatic feeding device for catfish farming, several conclusions can be drawn as follows:

1. In terms of quality, automatic fish feeders can improve efficiency in feeding fish. In this case, the farmer's workload can be reduced for feeding activities.
2. Automatic fish feeder based on RTC (Real Time Clock) provides flexibility. Feeding without requiring direct intervention from breeders. It is hoped that reducing the burden and working hours of farmers will provide opportunities for other productive activities for farmers.
3. IoT system technology makes it easy to monitor catfish pond water temperature conditions anytime and anywhere as long as you still reach the wifi signal from the system.

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