Proceedings of the 3rd Faculty of Industrial Technology International Congress
Bandung, Indonesia, October 28-29, 2021
ISSN

Automatic Fish Feeder Design Based on IoT

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Abstract. The feeding of fish at irregular times and temperatures are the problems in the fish cultivation business. The research is to design automated fish feeder that can provide fish food at the right time and temperature. Automatic fish feeder is designed by using the Internet of Things method. Automatic fish feeder could feed through a scheduled times that are at 8 am, 1 pm, and 6 pm, and through the optimal growth temperature of tilapia fish which is at 25-30°C. The user will also get the information about the feeding that has been done through email and smartphone. The test result shows that the prototype works well on a big stream pond and has an opposite entry lane. Maximum wifi reach for this tool is 19 meters if there's a wall between and 20 meters if there are no walls in range. The limitation of this tool is it has to be placed near the big stream water source and the feeding spreads about 80% of the whole pond.

INTRODUCTION

In line with the increasing intensity of development of Sukabumi City, the population growth increases, therefore food needs also increase. Tilapia became one of the needs in demand according to data from the central statistics agency of Sukabumi City tilapia production in 2018 was 510.05 tons and in 2019 increased to 652.62 tons. The increasing demand for tilapia is widely used by businesspeople to breed tilapia. One of them is a tourist spot located in Sukabumi City, applying tilapia cultivation in each pond, fish cultivation in this tourist spot is added to increase the income obtained from fish cultivation. The high demand for fish encourages many businesses including tourist attractions to produce many fish that certainly have good quality. Feeding in tourist attractions is usually done at uncertain times that cause 15% of the seedlings of fish cultivated to die, the death of this fish is caused by irregular feeding and the time of the feed given does not consider the temperature of the water. Feeding fish is not in accordance with the time or not fed is a case that often occurs when cultivating fish, and for the tourist attractions themselves, employees sometimes forget about fish feeding because they are busy by work that is far from the pond plus the owner of the tourist attractions who often go out of town so that monitoring of fishponds is rarely noticed. Automatic fish feeder allotment ponds on the market have the disadvantage of not applying temperature settings in feeding and using electricity above 15 watts with a voltage of 220 volts and for the price offered is quite expensive around Rp.400,000 - Rp.1,000,000 while for the needs needed in tourist attractions located in Sukabumi City does not need tools with expensive prices due to the scale of the fishpond itself. 12are or equivalent to 1200m_2 sees the temperature around Sukabumi City that tends to be cold automatic fish feeder which is expected to reduce feeding if the temperature decreases to keep the condition of the fish healthy. The necessary fish feed shelter is also expected to come from plastic waste because utilizing plastic waste is expected to reduce existing plastic waste, selected plastic waste that can accommodate ±15 kg of fish feed so that refilling fish feed only every once a week, therefore the use of used gallons becomes an option besides being able to accommodate ±15 kg of fish feed form from sunken gallons at the end can help stored feed to get out easily.

Feed that is not given can cause a decrease in the quality of fish can even cause death in fish if feeding is not done for a long time. Feeding with attention to time and temperature is very necessary so that the results of fish cultivation can be maximized. The quality of fish is influenced by the timeliness of feeding fish because fish will only eat when the stomach is almost empty or when the fish is very hungry [1]. Feeding is also good to adjust to the temperature of the water when feeding is done. The optimal temperature for fish growth is between 25-30°C [2]. The effect of rising water temperature at 34°C for 2 hours can cause stress in fish [3]. Feeding time must be on time so that the growth of optimal fish so that when harvesting is done will be obtained fish with good quality fish feeding time should be done three times in a day at 8:00, 13:00, and 18:00 [4]. Feeding should also pay attention to the temperature because the decrease or increase in water temperature can cause stress in the fish therefore fish tend to eat less if they are not. The temperature of water in the pool decreases or increases below the optimal value it is better to reduce the quantity of feed in accordance with [5]. Temperatures

below 25°C to 18°C are conditions where fish decrease their appetite and if below 18°C will be a dangerous condition to fish [2].

Research focuses on making automatic fish feeder based on IoT at a low price and can feed based on optimal temperature for tilapia growth. Automatic fish feeder is expected to be able to conduct scheduled feeding with a good feeding time and considering the optimal water temperature of the tilapia growth itself. Automatic fish feeder made is also used as a tool to monitor feed that has been or has not been done so that owners of tourist attractions will get notifications either via smartphone or via email so that the owner can feel calm about the feeding has been done or has not been added every day will get a report in the form of excel files containing about water temperature, time, and feed reports that have been done.

RESEARCH METHODOLOGY

The design method used in this study is a method developed by Desai (2015) that starts from determining the purpose of making the tool to the testing of the tool that was made.

Formulation of The Problem

The health of fish is very influential on the benefits obtained when the harvest takes place, therefore feeding with the right time and temperature will help the growth of the fish itself, while for a good time in feeding fish according to [4] namely at 8:00, 13:00, and 18:00. A good temperature in feeding is when the optimal temperature for fish growth is between 25-30°C, a reduction in the amount of feed will also be done when the temperature is below optimal and above optimal because according to Hermanto (2000) fish will consume a little feed if there is a decrease in temperature and will increase again when the next temperature increase to reach the optimal temperature then will decrease again if it rises above optimal. The reduction of feed is done when temperatures below 25°C to 18°C are conditions where the fish decreases its appetite and if below 18°C will be a dangerous condition to the fish and for a dangerous temperature increase for tilapia and can cause stress if it is 2 hours at 34°C [3].

Identification of Needs

The equipment needs used in the design of this IoT-based automatic fish feeder are Arduino Uno, ESP8266 V1, Motor Servo, Sensor DS18B20, Real-Time Clock (RTC), and used gallon feed storage with a capacity of 15 kg.

Tool Planning

System design is done by considering the price of the materials needed so as not to incur unnecessary costs. The material selected in the design of this automatic fish feeder uses the ESP8266 wifi module due to its relatively cheap price and small module size so it does not take up much space. The servo motor was selected SG90, RTC used namely DS1302 and arduino used arduino uno R3 CH340 clone. Automatic fish feeder controller selected using the app Blynk, this application was chosen because of its easy use and can be downloaded by anyone for free. An automatic fish feeder is designed using a 9 volt battery, so it is more energy efficient. The assumption for the reduction of feed that occurs is 50% for the decrease or increase in temperature that occurs with a maximum decrease limit of 18°C and a maximum limit of 34°C increase, if it exceeds the limit then there will be no feeding.

Implementation of Tools

Automatic fish feeder implementation is done by connecting the entire component to the microcontroller so that all components can work accurately. The implementation of the tool is also related to writing code so that the tools made can move in accordance with the given commands. Code writing must also be in accordance with the wire diagram created so that the tool can work according to the design made. Wire diagrams in this design are used to connect temperature sensor modules, ESP8266 V1, RTC, and servo motors to microcontrollers.

Integrating Tools

Integration between the application and the tool is done by entering the unique code of the application blynk into the program in microcontroller. When the internet is connected. The microcontroller will connect to the blynk application with the help of unique code and wifi module ESP8266 this condition is characterized by the appearance of connected writing on the display application.

Tool Testing

Tool testing is first done by testing the suitability between code written with wire diagrams to make sure the designed tool is working in line with expectations. The next test is testing component that is done is the testing of ESP8266 components, temperature sensors, and servo motors. ESP8266 testing is done to determine the effective distance from the use of ESP8266. Sensor testing is done to know that the sensor is working properly, and for servo motor testing is done so that when applying the servo motor as a fish feed lid opener there are no problems.

RESULT

The design of automatic fish feeder made using gallons of unused water and then arranged using wood formed like a chair as a buffer and for microcontroller components are stored in a black plastic box so that it can be protected from rain as shown in Figure 1. How to use this tool is that the user simply connects the device to the power source can use an adapter or battery, then the tool will turn on and connect to the wifi network that has been applied before. This tool will calculate the time in real time and if it meets the conditions at 8.00 WIB or 13.00 WIB or 18.00 WIB then the tool will provide feed. The display of feeding operation control is shown in Figure 2. At the optimal temperature, the tool will release 100% feed, while at non-optimal temperatures, the amount of feed released is reduced by 50%. Next the user will get a notification through the application on the user's smartphone and email, as illustrated in Figure 3. In addition, users can also set the feed output time through a smartphone.

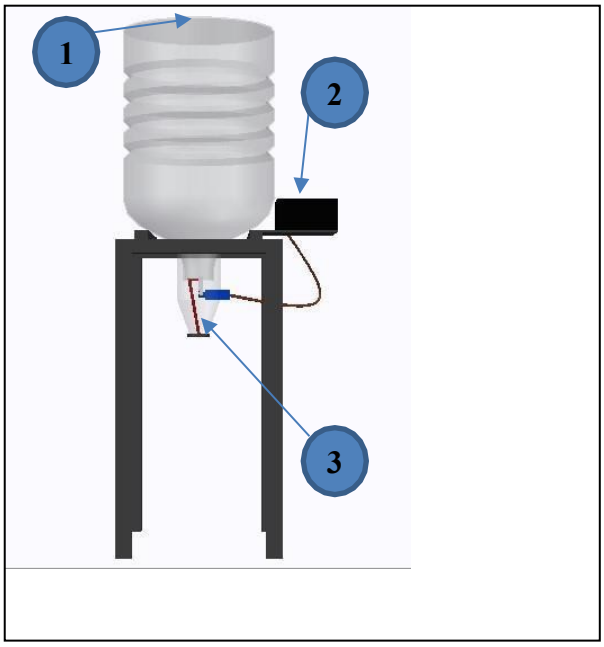

FIGURE 1. Illustration of Automatic Fish Feeder

FIGURE 2. Automatic Fish Feeder Controller Page

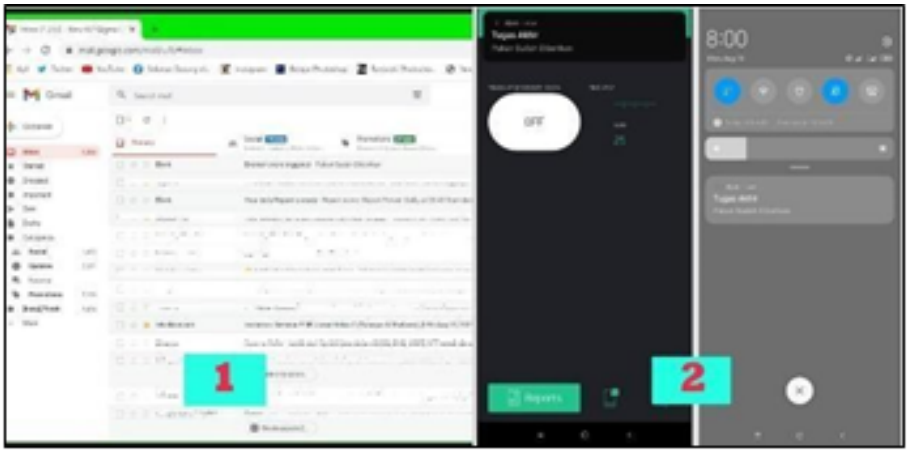

FIGURE 3. Notification View

Automatic fish feeder testing is initially done testing the components first whether it can work as desired or not. The first test is that the DS18B20 water temperature sensor component is tested by placing the sensor with gea S-006 thermometer in a glass containing water and for testing is done using 3 glasses of high temperature water, medium temperature, and low temperature the results of the test can be seen in Table 1.

TABLE 1. DS18B20 Sensor Testing

Testing	DS18B20 Sensor	GEA S-006 Thermometer
High Temperature Water	37°C	37°C
Medium Temperature Water	28°C	28°C
Low Temperature Water	19°C	20°C

The second test is to test the movement of the servo motor whether it can move to any angle +90° and angle -90°, the test is done by storing the servo motor above from the arc image degrees and then in the test whether it moves to the desired angle what not and for the results of the test produced according to Figure 4 the servo motor can move to an angle of +90° and -90°. The third test is to test the range of the ESP8266 V1 when blocked by the wall and when it is not blocked by the wall.

FIGURE 4. Servo Motor Testing

The third test is to test the range of the ESP8266 V1 when blocked by the wall and when it is not blocked by the wall. Test results are shown in Table 2.

TABLE 2. ESP8266 V1 Range Testing

Obstacle	Range	Connected (Y/N)	Obstacle	Range	Connected (Y/N)
None	1 Meter	Y	Wall	1 Meter	Y
	2 Meter	Y		2 Meter	Y
	3 Meter	Y		3 Meter	Y
	4 Meter	Y		4 Meter	Y
	5 Meter	Y		5 Meter	Y
	6 Meter	Y		6 Meter	Y
	7 Meter	Y		7 Meter	Y
	8 Meter	Y		8 Meter	Y
	9 Meter	Y		9 Meter	Y
	10 Meter	Y		10 Meter	Y
	11 Meter	Y		11 Meter	Y
	12 Meter	Y		12 Meter	Y
	13 Meter	Y		13 Meter	Y
	14 Meter	Y		14 Meter	Y
	15 Meter	Y		15 Meter	Y
	16 Meter	Y		16 Meter	Y
	17 Meter	Y		17 Meter	Y
	18 Meter	Y		18 Meter	Y
	19 Meter	Y		19 Meter	Y
	20 Meter	Y		20 Meter	N
	21 Meter	Y		21 Meter	N
	22 Meter	N		22 Meter	N
	23 Meter	N		23 Meter	N
	24 Meter	N		24 Meter	N
	25 Meter	N		25 Meter	N
	26 Meter	N		26 Meter	N

The last test is to test the automatic fish feeder tool that has been made. The test was done using a small glass of water with varying temperatures to test the suitability of the servo opening time. The results of the test can be seen in Table 3.

TABLE 3. ESP8266 V1 Range Testing

No.	Temperature	Time	Servo Movement	Duration of Open Servo (seconds)	Status
1	25	6.00 WIB	Opened	10	Appropriate
2	29	6.30 WIB	Opened	10	Appropriate
3	28	7.00 WIB	Opened	10	Appropriate
4	25	7.30 WIB	Opened	10	Appropriate

TABLE 3. ESP8266 V1 Range Testing (continued)

No.	Temperature	Time	Servo Movement	Duration of Open Servo (seconds)	Status
5	27	8.00 WIB	Opened	10	Appropriate
6	27	8.30 WIB	Opened	10	Appropriate
7	26	9.00 WIB	Opened	10	Appropriate
8	26	9.30 WIB	Opened	10	Appropriate
9	25	10.00 WIB	Opened	10	Appropriate
10	25	10.30 WIB	Opened	10	Appropriate
11	19	13.00 WIB	Opened	5	Appropriate
12	19	13.30 WIB	Opened	5	Appropriate
13	21	14.00 WIB	Opened	5	Appropriate
14	20	14.30 WIB	Opened	5	Appropriate
15	20	15.00 WIB	Opened	5	Appropriate
16	19	15.30 WIB	Opened	5	Appropriate
17	19	16.00 WIB	Opened	5	Appropriate
18	19	16.30 WIB	Opened	5	Appropriate
19	20	17.00 WIB	Opened	5	Appropriate
20	20	17.30 WIB	Opened	5	Appropriate
21	34	19.00 WIB	Opened	5	Appropriate
22	33	19.30 WIB	Opened	5	Appropriate
23	32	20.00 WIB	Opened	5	Appropriate
24	32	20.30 WIB	Opened	5	Appropriate
25	33	21.00 WIB	Opened	5	Appropriate
26	33	21.30 WIB	Opened	5	Appropriate
27	33	22.00 WIB	Opened	5	Appropriate
28	32	22.30 WIB	Opened	5	Appropriate
29	31	23.00 WIB	Opened	5	Appropriate
30	32	23.30 WIB	Opened	5	Appropriate

In addition to testing the feasibility of the automatic fish feeder tool is also carried out trials on the ground. The results of the trial directly on the ground obtained a distribution of feed about 80% of the entire pool. From the test results, it is known that the pool that is suitable for the application of automatic fish feeder is a pool that has a large water current and has an in and out path of opposing water. Another limitation of this tool is that if applied in areas that are difficult internet network then users will not get notifications from feeding that has been done.

CONCLUSION

This research shows that an automatic fish feeder designed is able to work well under expected conditions. Each component selected, also works well on every test scenario, which means each component is fit for use in an automatic fish feeder tool. The automatic fish feeder design produced in this study can detect temperature and time well so that it can make the output of servo movement and servo length with proper opening time. Further development can be done by adding GSM modules so that they can be used to overcome the limitations of wifi and internet networks.

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