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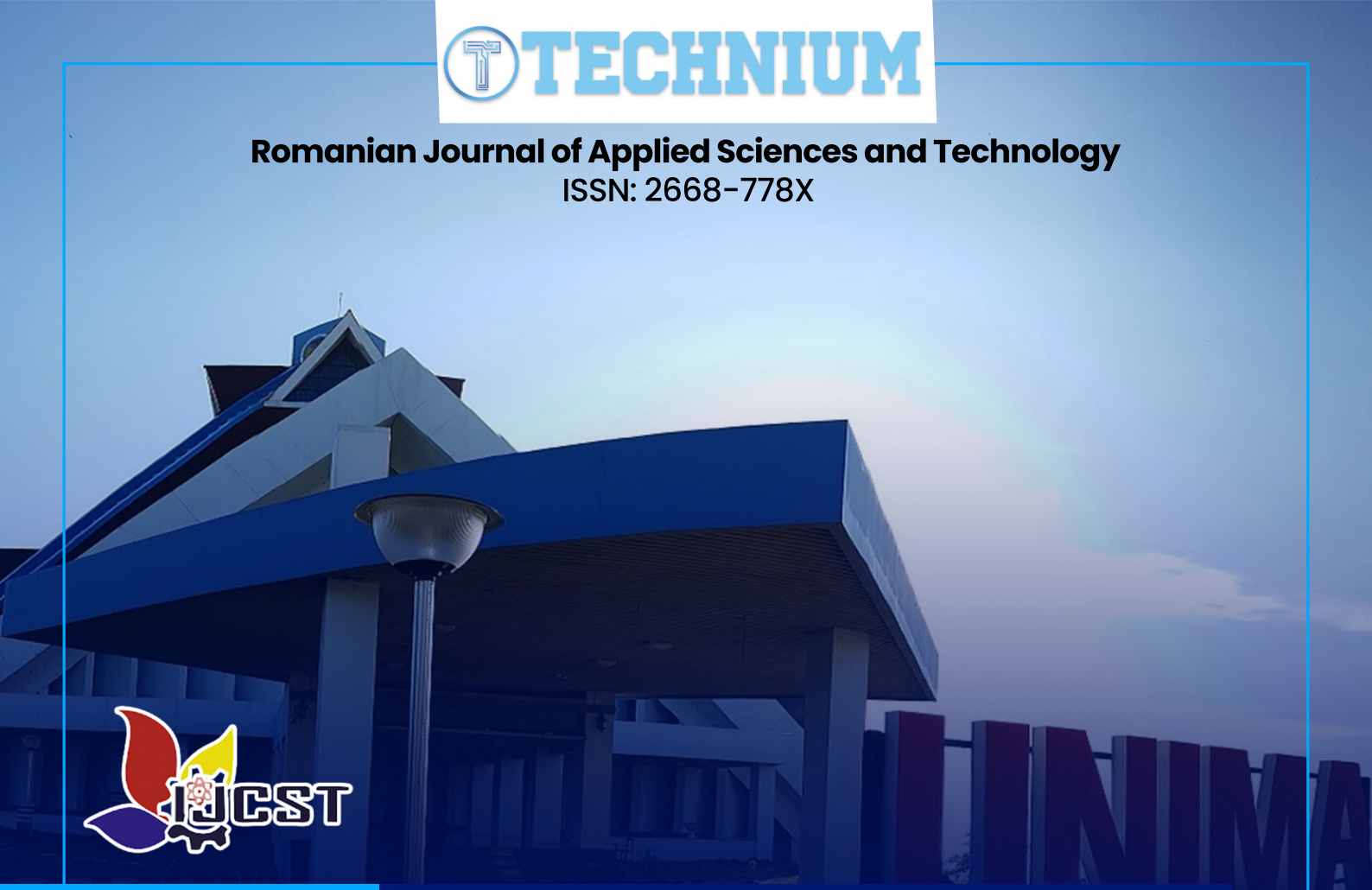

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Internet of Things Implementation in Automatic Fish Feeding

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Abstract. One of the world's fastest-growing food industries is aquaculture. As a result, aquaculture is a successful industry. Lack of care in the preparation of fish feed is a problem for this industry because it leads to the production of low-quality livestock.This study uses the Arduino microcontroller and ESP 8266 to create an automatic fish feeder that can be remotely controlled using a smartphone. Setting the fish's feeding routine is one way to exercise control. The test method used is the experimental method by conducting 5 times the scheduling time test and 10 times the feed weight measurement test.The test results shows that the tool can control a more regular fish feeding schedule. The percentage accuracy of the automatic fish feed scheduling test reaches 100%, while the percentage accuracy of the feed weight measurement test reaches 90%.

Keyword: Automatic feeders, arduino, microcontroller, android.

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1 Introduction

Aquaculture is one of the world's food industries that is expanding the quickest [1]–[3]. Since there are numerous fish species that are not only delicious to eat but also nutritious, aquaculture is one of the most successful industries [4]. The fish farming sector in Indonesia generates cash for the local community. Lack of attention to fish feed supply creates a problem in this industry since it leads to the production of low-quality livestock [5]. For the purpose of delivering fish feed, various businesses or industries have adopted robotic or machine technology. In order to ensure that the fish's weight is maintained as required, feeding must be regulated to occur at the designated time and in the proper quantity [2], [6]. The dead fish can also frequently occur from overfeeding [7]–[9].

Automation is being pushed forward in human life by technological advancements [10], [11], one of which is fish farming [12]. Several researchers have created fish feeding devices or instruments [6], [9], [13]–[19]. Currently, microcontroller technology, such as Arduino [20], can be used to create gadgets for feeding fish. Using an automatic fish feeder might make it simpler to plan fish feeding times in accordance with the advised dose [21]. A vital source of energy for maintaining growth and reproduction is food. Fish are fed three times per day, with the nutrients they contain strictly under control [22], [23]. Breeders may find it simpler to measure and feed fish if they use automatic instruments [24], [25]. Using microcontroller technology to automatically feed fish is one method of improving work efficiency [26]. When done directly by hand, the distribution of fish food is regarded as being uneven. An IoT-based regulating time system can be used to regulate automatic feeding. Cost-effectiveness, labor needs, and the ability to apply to huge volumes of feed are some of the benefits of this automatic feeding [27]. With the automatic feeder, feed can be distributed in accordance with the chosen size and schedule [28].

Several attempts have been made to replace ineffective and unproductive manual feeding systems, according to prior studies. For instance, a straightforward time-controlled automatic fish feeder that dispenses pellets. The system's capacity to expel pellets at a consistent pace is its limiting factor. Additionally, because the pellets are concentrated in only one area, this approach results in imbalanced fish growth. The shortcomings of the current automated feeding system have spurred research to create a system that may address such shortcomings and offer more advantages and benefits for both owners and employees. This novel technology may disperse pellets in one section by delivering them to the desired location based on the spinning speed of the motor, combined with a predetermined time. This system produces a more systematic feeding schedule which will directly reduce labor costs.

This new automated technology is made to be able to take the place of people in tasks as well. Depending on the system's timer and the feeder's selectable reset time, it gives the user control over feeding periods up to a 24-hour cycle per day. The amount of pellets emitted is determined by the feeding cycle's duration, which is customized for the feeder. The pellets' journey distance until they land in the target location will depend on the newly designed system's spinning speed. One of the conventional speed control methods is the resistance coupled to the rotor circuit or the voltage regulator circuit of the electric machine. This approach is simple to change, but there have been some issues with it. As a result, the new feeding system is taking into consideration PWM (pulse width modulation), a novel form of speed control technique. Currently, motor speed regulation uses such a speed control system that are common.

Based on these issues, a fish feeder that can automatically feed fish at predefined periods was devised. This tool was selected since it can be managed and automatically provides information from a distance using a smartphone. This tool's ability to communicate with cellphones through an internet network is made possible by the use of the ESP 8266 module and Arduino Uno microcontroller technology. Fish owners may manage and get tool notifications from anywhere and at any time by using a smartphone to set up fish feeding regimensUse A4 paper size (210 x 297 mm) and adjust the margins to those shown in Table 1. The final printed area will be 172 x 252 mm.

2 Research Methods

Figure 1 shows the conceptual framework that illustrates the logical progression of this study. The research process began with an analysis of the issues and potential solutions, followed by the design and development of the proposed solutions, in this case, an automatic fish feeder. The black box method of testing will be used, along with testing the tool's performance accuracy. To determine the tool's performance accuracy, test data will be compared to the number of accurate decisions. To check the timing of feeding and the precision of the dose the tool delivers, the accuracy of the level of accuracy is tested. The accuracy value is calculated using the equation below.

$$accuracy = \frac{\sum correct decision}{\sum true value} \quad (1)$$

Generally, the following formula can be used to determine the daily feed amount: [29].

$$DFA = W \times N \times SR \times R \quad (2)$$

wherein,
DFA = the quantity of food consumed
W = the fish were weighed on average.
N = pond fish population
SR = During the period of fish rearing, estimates of fish survival are calculated
R = a lot of fish food was provided

The feed used in this study was artificial feed (2 mm pellets).

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The workflow of the designed tool can be seen in Figure 2.

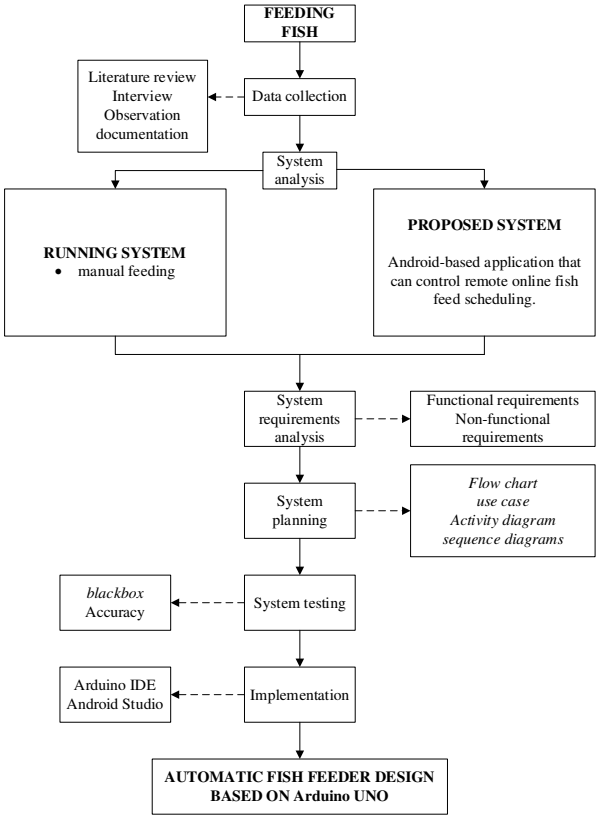

Fig. 1. The research flow.

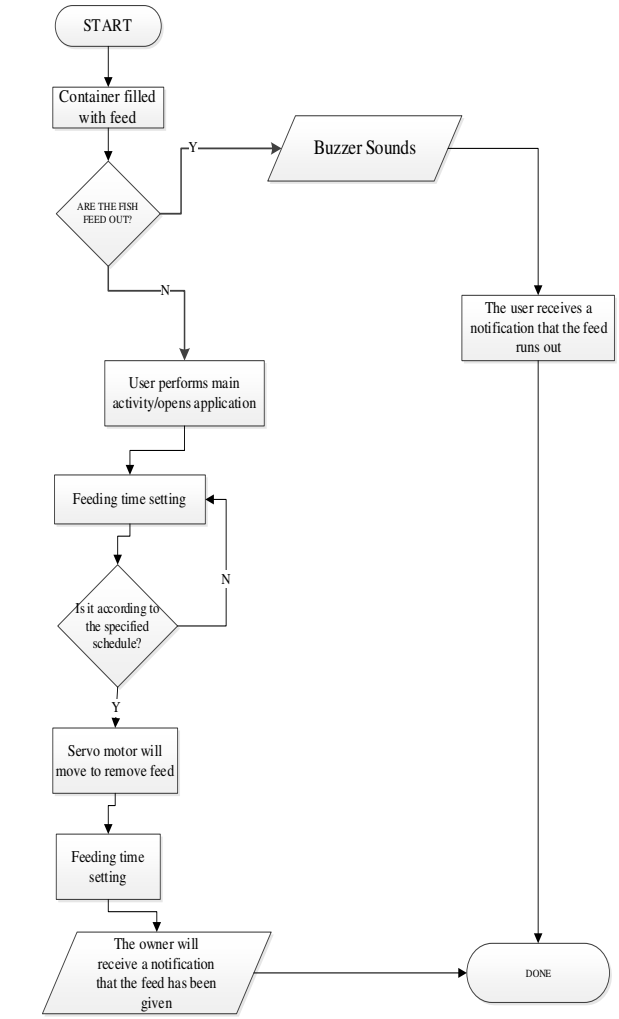

Fig. 2. Flowchart system.

When the feed in the container runs out and when it has been supplied at the appointed times, the user will be notified.

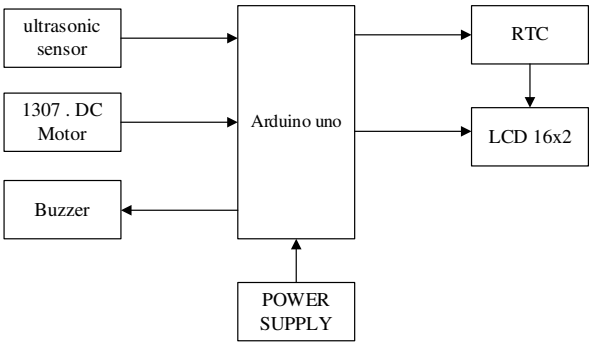

Fig. 3. Block diagram.

The picture up top is described as follows:

1) Ultrasonic sensors are used to check whether there is fish food in storage containers.
2) When the feed in the container runs out, the buzzer serves as an alarm or warning.
3) An Arduino Uno is used to set the RTC DC1307 following the clock or in real time.
4) The time and the amount of fish food still in the container are shown on an LCD.
5) The feed is opened and closed using a servo motor.

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6) The power supply is utilized to connect Arduino and act as an adaptor for electric current.

On the basis of Figure 3 above, it is possible to describe how the Arduino Uno fish feeding system functions. The sort of sensor employed in the creation of this device is an ultrasonic sensor, which can determine whether there is fish food present in the container. Additionally, a buzzer that sounds when the feed runs out will alert users of the situation, and a notification will be sent to the fish feed application.

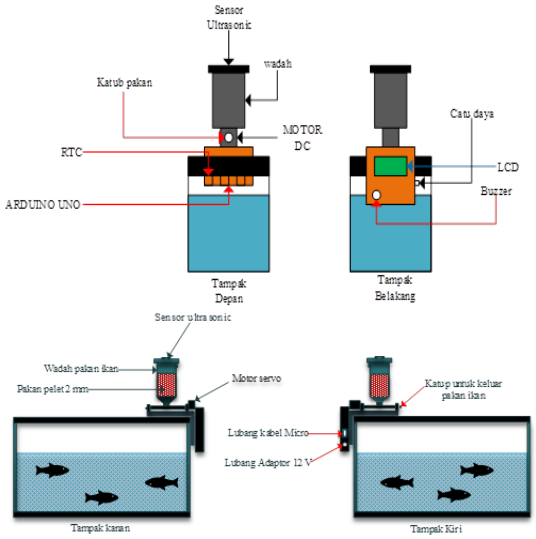

Fig. 4. The Design of an automatic fish feeder.

As seen in the image above, the container serving as the reservoir for the fish food will function as a reservoir for the ultrasonic sensor, which will detect when the feed runs out. If there is still feed available, the sensor will display the feed percentage on the LCD and the fish food application. In addition, it will also sound like a buzzer to warn users when the feed is running low. Arduino is connected to the internet using the ESP8266, and Arduino can later be controlled using the fish feed application.

The user can configure the desired schedule through the fish feed application once Arduino and the feed are connected via the internet. After scheduling the meal, Arduino will check the database to see if there have been any schedule changes. If there have, Arduino will then read the planned instruction. then a feed valve to open and close the feed that comes out is located below. Additionally, a servo motor can be seen in the image above, which is used to steer fish food that is dropped into the tank.

Ultrasonic sensors and fish feed containers will be used to determine whether there is still feed available or not. On the LCD screen and application, the amount of feed that is now in the reservoir will be shown. Through the program, users may specify feeding times.

The desain using case diagram can be seen in Figure 4Use a two-column format, and set the spacing between the columns at 8 mm. Do not add any page numbers.

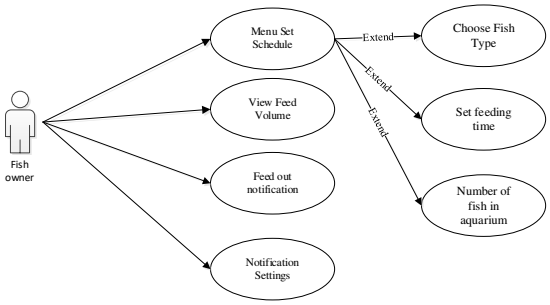

Fig. 5. Use case diagram.

The tool is used by users to monitor feed availability and regulate feeding. With the help of the Nodemcu ESP 8266, users can communicate with Android and learn when a feed is available.

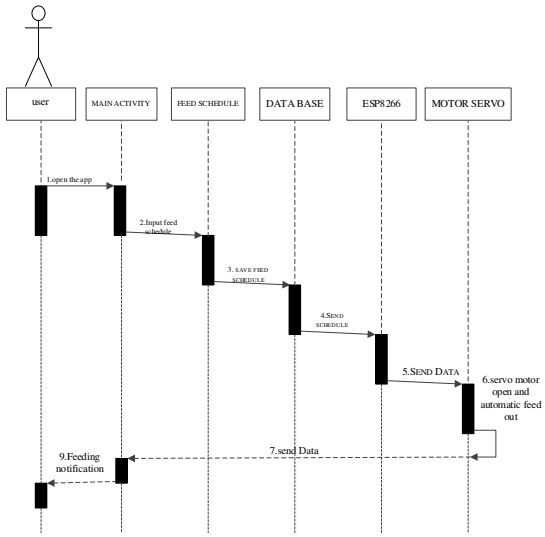

Fig. 6. The Sequence Diagram.

A sequence diagram of automatic fish feeding is shown in Figure 5 to show how it works. Using an Android smartphone, users can watch how fish are being fed. Additionally, users receive occasional reminders with information about feeding.

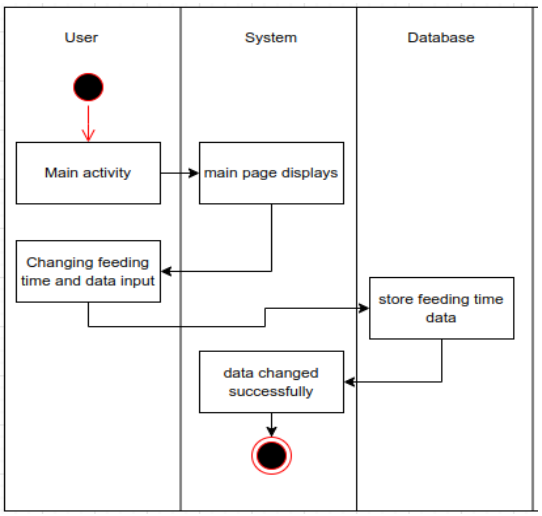

Fig. 7. Activity Diagram.

The activity on the intended system is depicted in Figure 6. from the beginning place to the final

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destination. Currently running parallel processes can also be shown in this diagram. This diagram illustrates the broad processes and pathways of activity rather than the internal processes or interactions between subsystems of a system.

3 Results and Discussions

Fish owners can schedule feeding with the help of an Arduino Uno-based automatic feeding tool, which can also lessen the likelihood of human error during the feeding procedure.

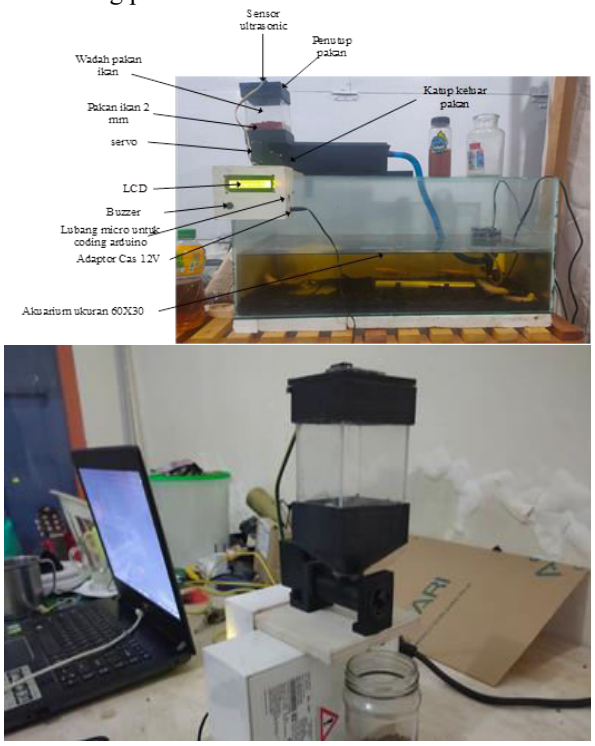

Fig. 8. fish feeder.

The resources offered by this application:
1. The system launch page
The user will receive information about the available feed, standard tool conditions, feed state, ON schedule, and schedule reset menu when the application is first opened.

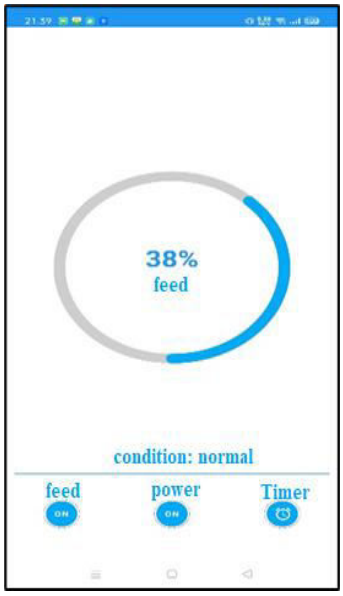

Fig. 9. Front Page View.

2. Setting up a schedule page
Each ornamental fish has a different feeding plan; some feed twice daily, while others feed three times daily. This form allows users to modify the feeding pattern. One of our suggestions is to give participants a form on which to schedule events in accordance with the requirements of owners of ornamental fish.

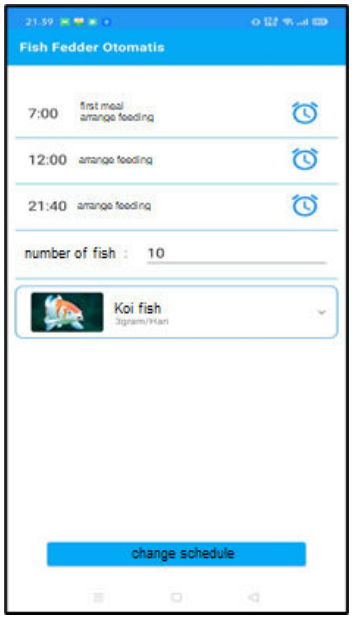

Fig. 10. Schedule settings page display.

3. App Notification display
In this form the user will get a notification from the application if the feeding has been carried out according to a predetermined schedule, the notification display from the application is as follows.

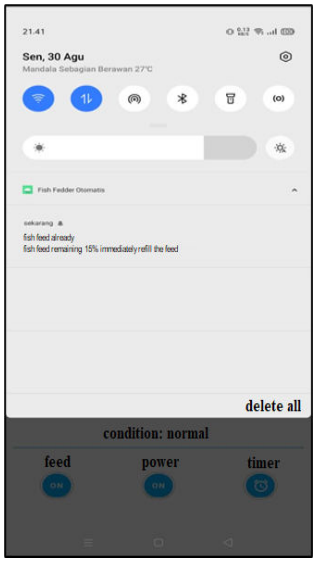

Fig. 11. The display of application notifications.

The feed is first put into the container as part of the testing procedure, which is then scheduled based on demand. The instrument automatically performs feeding following the application-set schedule. The timing of the feeding plan, which was repeated five times, was used as the basis for the data used in this test. Table 1 displays the outcomes of the testing of the schedule time.

Table 1. Scheduling time test results.

Date	Time	Servo motor open time	Result
17-03-2022	15.50	15.50	Worked
17-03-2022	15.52	15.52	Worked
17-03-2022	15.54	15.54	Worked
17-03-2022	15.56	15.56	Worked
17-03-2022	15.58	15.58	Worked

The experimental tests, which were conducted based on Table 1, demonstrate that the tool can function in accordance with the time indicated by the application.

The test for measuring feed weight was run ten times, and the outcomes are displayed in Table 2 below.

Table 2 shows the results of evaluating the feed's weight.

Table 2. Feed weight measurement results.

Date	Amount of Feed (gr)	Measure in System (gr)	Scales (gr)	Difference	Result
17-03-2022	10	3	3	0	Pass
17-03-2022	20	9	9	0	Pass
17-03-2022	30	12	12	0	Pass
17-03-2022	40	15	15	0	Pass
17-03-2022	50	17	17	0	Pass
17-03-2022	60	20	20	0	Pass
17-03-2022	70	23	23	0	Pass
17-03-2022	80	26	26	0	Pass
17-03-2022	90	29	29	0	Pass
17-03-2022	100	31	31.2	0.2	Not pass

The test is conducted by comparing the dose of feed that should be administered based on the dose of feed formula with the dose administered by the tool. Of the 10 trials, it was discovered that the dosage was not correct in the 10th experiment, with a weight difference of 0.2 grams.

4 Conclusions

Following are some inferences that can be made from the outcomes of the system design and all the testing that have been done for every scenario that could occur in the arduino-based autonomous fish feeder. When evaluating the automatic fish feeding system's dosage, measure 10 times with an accuracy rate of 90%. Create a system that can regulate more regular feeding times for fish. There were no wrong feed scheduling results after testing the automatic fish feeder's scheduling five times. The accuracy rate is 100 percent.

The outcomes of the investigation show a number of references that have been made and attained. Despite these successes, the system still has to be developed. The following are some strategies that can be used to advance system development: The creation of elements like temperature sensors and the creation of features to track the pH and temperature ranges of water.

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