

AUTOMATED FISH FEEDER USING SCHEDULER MOBILE APPLICATION

Abstract: Today's fish feeder technology is a device dedicated to reducing labor costs and creating a better feed dispensing system in local fish farming productions. In this study, a newly developed automated fish feeder using a mobile scheduler application is designed and implemented specifically for Milkfish (*ChanosChanos*) production. The development consists of four phases; online research, system design, purchase of materials, and construction. Two types of testing were conducted to evaluate this technology, including a functionality test and a technology acceptance test. The functionality test of the technology was tested using experimental analysis, which uses simulation to test the functionality of the developed system. Seven (7) trials tested the automated fish feeder using the mobile scheduler application for seven days. The study shows that this device was consistent in dispensing 0.43 Kilograms of feeds for one feeding schedule and 0.86 Kg for two feeding schedules, based on the total kilograms put in the system. There were ten respondents that participated in the technology acceptance test. From this test, the mean score values for all items such as availability, aesthetics, and performance were found to be more than 3.7 (using a 5-point Likert scale), which means that the automated fish feeder using the mobile scheduler application is very acceptable according to the technology acceptance test. The developed automated fish feeder using the mobile scheduler application will help the farmers remotely feed fish without hassle and optimize the quantity of feeds for the milkfish.

Keywords: wifi, GSM, Smartphone, Milkfish, Fishpond

1. INTRODUCTION

In the Philippines, aquaculture has a long history. It encompasses a wide range of environments and agricultural operations[1]. The majority of the industry's output comes from seaweed farming, milkfish, tilapia, shrimp, carp, oysters, and mussels[2]. Aquaculture is critical for food security, employment, and foreign exchange revenues[3]. Commercial fishing is lagging behind aquaculture in terms of growth[4]. Unless new markets and technology are identified, the future development of Philippine aquaculture may not be sustainable.

A mobile application is a communications facility or program application that runs on mobile devices[5]. Mobile applications can also be used to access similar services on desktop PCs. A mobile device is referred to as an app, web app, or online app [6]. The number of people developing mobile apps is steadily increasing. Businesses must match consumer needs for real-time, straightforward ways to conduct transactions and obtain information in commerce, communications, finance, medical, and politics[7]. Today, mobile applications on smartphones are the most popular way for people and businesses to connect to the internet[8]. A successful organization must stay relevant and responsive to develop a mobile application that their customers, partners, and employees need[9].

The advantage of a mobile app is that it gives users full software or hardware system access to the device and allows them to monitor and control it[10]. It improves the user's experience, and there are minimal budget costs. Users can perform several functions conveniently and securely from their smartphones with a mobile app[11].

Local fish farmers' method of feeding fish is that they will hire someone every day to feed their fish, and it will cost a significant amount of their budget for that[12]. Some local fish farmers who do not have an adequate hiring budget will work alone and regularly visit their fish cages[13]. We have developed an intelligent fish feeder since the current problem with local fish farmers is still an issue when feeding fish. For it to fully operate, the mobile application comes in[14].

The proposed solution to the problem is to create an automatic fish feeder utilizing a mobile scheduler application. This new and upgraded fish feeder has many additional features and capabilities to aid local fish growers significantly. The technology is easily adaptable to large-scale fish feeding operations in the open sea. It may be accessible via a smartphone app connected via wifi, providing fish farmers with a simple method of communication. As a result, the device solves the problem. Still, it also includes additional beneficial functions for both users and owners. The project's goal was to create a business idea system to solve the difficulty outlined before. Because the system's design and functions are indisputably unique, the intelligent fish feeder with a mobile application is a step towards a better future in technology. This proposed approach provides ease while also assisting in reducing work or human power and engagement.

1 Theoretical Framework

The optimal foraging theory (OFT) is a behavioral ecology model that predicts how an animal, such as a fish, would act while looking for food. Although collecting food provides nutrition to the animal, searching for and catching the food takes energy and time[15]. An animal chooses a foraging strategy that maximizes net energy while providing the most gain (power) to maximize fitness. OFT aids in predicting the most effective way for an animal to accomplish this aim[16].

Natural history is full of observational data on **ingestion**. Still, researchers have only recently started seeing feed intake as a technique for whom the efficacy can be maximized through natural selection[17]. A feeding strategy theory's primary goal is to figure out which behavioral and morphological complex is best for collecting food energy in each environment for a specific animal. As a result, the task is an optimization problem, and the user can trisect it like every other optimization problem. As a result, the job is an optimization problem, and the user can trisect it like any other optimization problem[18].

Before the twentieth century, studies of the composition of fish diets were first published. Milkfish are opportunistic generalists that eat everything in their habitat, including detritus, phytoplankton, zooplankton, filamentous algae, and artificial feed. Algae, detritus, diatoms, animal elements, plant matter, and sand particles make up the diet of juveniles in their natural environment[19]. Pellets are their first choice when milkfish juveniles are given supplementary feed, followed by detritus, diatoms, and filamentous algae. Diatoms, zooplankton (including fish eggs and larvae), algae, litter, and small quantities of sand particles are all eaten by adult milkfish[20].

Milkfish fry, juveniles, and adults are oligophagous substratum-feeders in shallow-water habitats, consuming the top layer of bottom sediments and the micro-and meiofauna[21]. They consume artificial feed whole in culture systems. Their response to feeding is fast, as they provide it on the water surface right away. Feeding takes place in the water column as well as at the bottom. They can be taught to eat artificial feed by making a sound or supplying it at a specific time and location[22].

1.2 Conceptual Framework

The following figure shows the input-process-output diagram of the project.

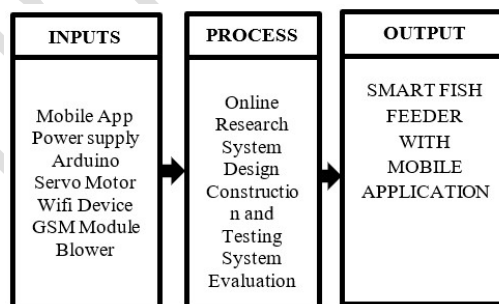


Fig 1. IPO Diagram

Figure 1 starts with the input wherein the researchers determine the materials and equipment necessary to visualize the research project. As shown in figure 1, inputs include; a mobile app, power supply, Arduino, stepper motor, wifi device, GSM module, and blower. The primary power source of this project is the power supply that drives the expected project to run.

After visualizing, the researchers proceed to the process stage where the online research, system design, purchase of materials, construction and testing, and system evaluation occur. This stage is crucial because **it involves** complex calculations, money risk, and trial and error. Knowledge and expertise aren't enough to complete the project; patience, determination, and cooperation with co-researchers.

The **product of this** research project is the automated fish feeder using a mobile scheduler application, wifi device, and SMS using GSM. This efficient and user-friendly **device** was made to give convenience to the users.

This device is designed to fit the consumer's needs, and the materials used are economically and environmentally friendly and affordable.

1.3 Objectives

The overall goal of this project is to design and create/construct an automated fish feeder that uses a mobile scheduler app to assist local fish farmers, cutting costs and removing the inconvenient and time-consuming traditional method of fish feeding. As a result, the researchers devised the following set of precise goals:

1. To design a mobile app as a control mechanism for fish feeding.
2. To develop and implement a system securing the user's connection using a smartphone and the device installed in the fish cage area.
3. To evaluate the system's performance and acceptability using the pre-establish parameters.
4. To determine the economic feasibility of the system.

2. METHODS

2.1 Research Design

The "Experimental Design" method allows researchers to keep a tight grip on all variables that could influence the outcome of an experiment. The researchers are attempting to assess or predict what could happen. Experimental research designs aid the ability to limit possible theories and conclude direct causal interactions in the sample. For single studies, this method offers the highest standard of proof.

2.2 Project Design

The project's block diagram is depicted in the diagram below.

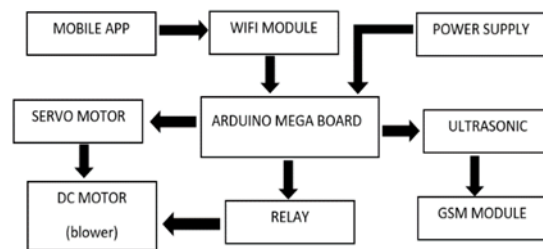


Fig 2. Block diagram of the project

Figure 2 shows the block diagram of the project. The figure shows that the system is powered by an AC source directly attached to the power supply. It gives power to the microcontroller, servo motor, and blower. The central brain of the machine is the microcontroller, and it will do all the logic processing and computation. The Arduino only accepts a DC source, so a DC power supply is needed. Once the user sets feeding time using the designed mobile application connected to the wifi device, it will send a signal telling Arduino when the stepper motor moves and the blower release the feeds. The GSM module is used to deliver brief text messages to signal various events (SMS). This project uses a GSM module to notify the owner whenever the feed tank is empty. The owner will then know that it needs to be refilled.

2.3 Project Development

The block diagram below shows the project development of the research.

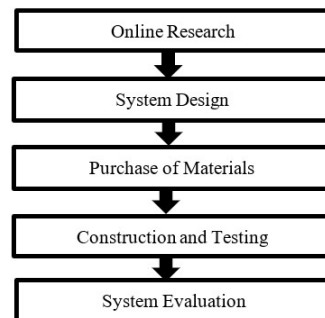


Fig 3. Block Diagram of the project development

Online researching or browsing the internet is the first stage of this project study. Almost everything a person wants to learn or needs to know in this generation is already on the internet. At this stage, the researchers can obtain some information and ideas that could assist them in executing a good project.

System design is the next step in developing this project. Designing a system is an arduous task since the materials, finances, sizes, project mechanisms, packaging, and project settings should all be considered. All should be well prepared for in order to have fewer issues/casualties in the following implementation stage.

The procurement of materials is the third step. All materials should be ordered or ready for the project's construction as soon as possible.

The next step is construction and testing. After purchasing the needed materials, the researchers can now start implementing the project. The internal parts, the solar panel, stepper motor, wifi device, GSM module, and some minor components such as connecting wires and others will be the first to be realized. Trial and error are often needed to verify whether or not the project is working correctly. Then, the project's packaging should be neat and presentable.

Finally, the last stage in this research project is system evaluation. The project will be evaluated based on its efficiency, performance, serviceability, aesthetics, and functionality. The researchers will conduct a survey using paper-based techniques through questionnaires and personal interviews to hear the participants' opinions.

2.4 Project Implementation

The fully developed automated fish feeder using a mobile scheduler application is an electronic-based device designed to feed fish regularly. When the owner is away from the fishery area, this method is often used to minimize uncertainties and difficulties. This design aids in resolving some issues, including overfeeding and underfeeding, both of which result in fish starvation or even contamination of the fishery. Many subsystems make up the intelligent fish feeder system. It is made up of a feeder container used to store fish feed. It has a single outlet operated by a dc motor used to distribute food through a hole in the container. The users can also use the mobile app to customize the feeding time and feed volume according to the needs.

2.5 Project Setting

The project setting has been implemented in one of the fishponds near the coastline of Brgy. Sabang, Surigao City. It is near Makzterz Beach Resort, Sabang Surigao City.



Fig 4. Location of the place

2.6 Participants of the Study

The participants of this project study are mainly the local fish farmers residing in Brgy. Sabang, Surigao City, and representatives from BFAR (Bureau of Fisheries and Aquatic Resources). There are 10 participants, 8 for local fish farmers and 2 for BFAR representatives.

Table 1. Participants of the Study

PARTICIPANTS	f(n=10)	% of Involvement
Fish farmers	8	80
BFAR Representative/s	2	20
Total	10	100

2.7 Instruments

In this work, the following instruments below are used:

Multimeter. A VOM is a multi-function electronic measuring instrument. A conventional multimeter can measure voltage, current, and resistance.^[14]

Arduino IDE Software. The open-source Arduino Software makes writing code and uploading it to the board a breeze (IDE). Any Arduino board will work with this application. ^[15]

Proteus Simulator. It's a software package that includes a schematic simulation and a PCB template. ISIS is an application that lets you build a circuit diagram and simulate it in real-time. Human involvement is possible during the simulation, allowing for real-time simulation. ^[16]

AutoCAD. It is an Autodesk computer-aided drafting (CAD) software program that allows drafters, architects, engineers, and other professionals to build two-dimensional (2D) and three-dimensional (3D) mesh and solid surface models. ^[17]

Adobe Photoshop. It's a well-known image-editing application. Photographers use it to alter images (color correction, noise removal, effects, and brightness/contrast adjustments). ^[18]

Mendeley. It's a free reference manager that can help you organize your citations, collect references, and construct bibliographies. It's also a social network for academics that allows you to share your study with others. Researchers may participate in public or private online groups and scan the Mendeley community database of over 30 million papers for papers to read. ^[19]

2.8 Research Ethics

The researchers adhered to the ethical principles needed in conducting **their study in this project**. First, intellectual property is being considered by the researchers where they give proper acknowledgment or credit for all research contributions to avoid plagiarism. **Secondly, the researchers treated** animals with respect and care when used in research. Finally, researchers **were** socially responsible for advancing social good and preventing or minimizing social damage through study, public education, and advocacy.

2.9 Data Collection Procedure

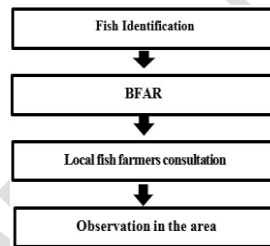


Fig 5. Data Collection Procedure

The flow chart above shows the data collection procedure for this research project. These include web searching, trial & error testing, surveys/interviews, data gathering, and recording results. The first stage is web searching, wherein the researcher collects some information that could help them understand further about the project and how to make it work. Researchers focused on the issues and problems related to the study of interest to avoid errors in implementing the project. Conclusions and recommendations were also noted. A Series of trials and tests were conducted. The researchers gather data about the effectiveness of the project by conducting a survey, personal interviews, and providing some questionnaires to the participants. Researchers also recorded all data collected from survey questions and personal interviews.

2.10 Statistical Tools

This project study uses mean standard deviation and frequency count as its statistical tool.

- A frequency count measures the number of times that an event occurs. It is usually used in the study to determine the number of participants involved in the study.
- The population's mean is calculated by combining all data points and dividing the sum by the number of issues. The formula is as follows:

$$\bar{x} = \frac{\sum x}{n}$$

- The standard deviation measures a set of values' variation or dispersion. The formula is stated below:

$$SD = \sqrt{\frac{\sum (x - \bar{x})^2}{n-1}}$$

3. RESULTS AND DISCUSSIONS

This section presents the output of the development of the automated fish feeder using a mobile scheduler application in terms of the design of the mobile application, system implementation and hardware, system performance, system evaluation, and complete set-up.

3.1 Design of the Mobile App

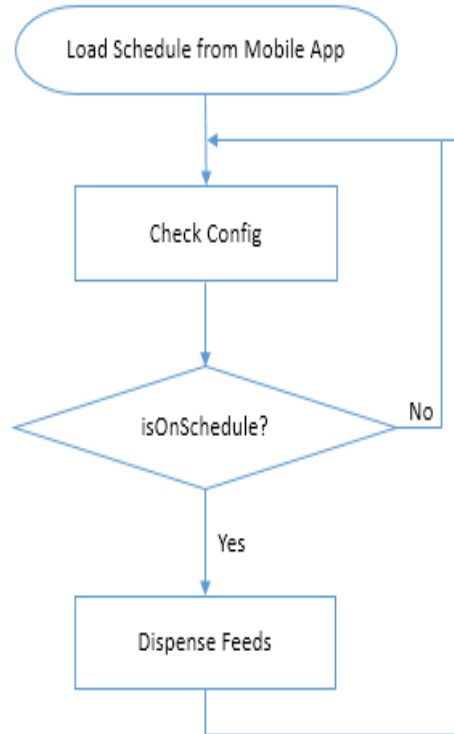


Fig. 6. Flow Chart of the Mobile App

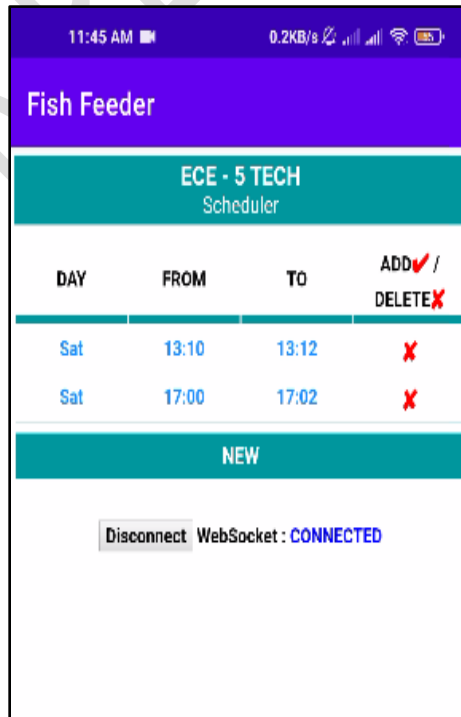


Fig. 7. The Mobile App

3.2 System Implementation of the Fish Feeder

This section shows the different hardware of the system, comprised of Arduino, Wifi Shield, Ultrasonic Sensor, Servomotor, DC Motor, Relay module, Arduino Mega, Arduino GSM Shield, and Schematic diagram.

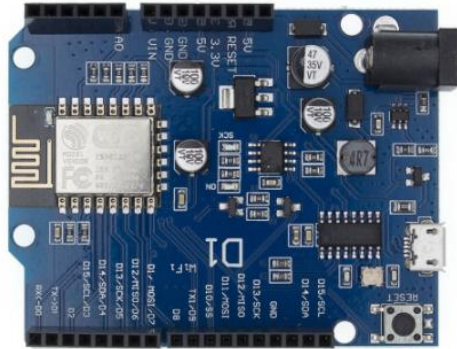


Fig. 8. Wifi Shield

The **Arduino wifi shield** connects an Arduino UNO board to the internet. It allows it to read and write data to an SD card using the wifi and SD libraries.^[23]



Fig. 9. Ultrasonic Sensor

An **ultrasonic sensor** is also an electronics device that uses ultrasonic sound waves to detect the distance between a target item that turns that reflecting sound into an electrical signal.^[24]



Fig. 10. Servo Motor

A **servomotor** is a shut servomechanism that regulates its movement and end position through position information.^[25]



Fig. 11. DC Motor

A **DC motor** is a rotating motor that converts electrical energy into mechanical energy.^[26]



Fig. 12. Relay Module

The relay module is a separate piece of hardware that allows you to control remote devices.^[27]

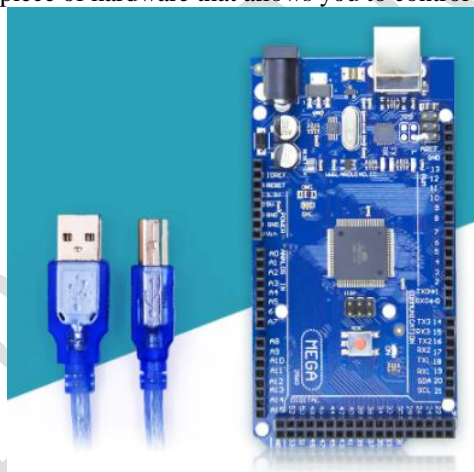


Fig. 13. Arduino Mega

The **Arduino Mega** is a microcontroller module based on the ATmega1280 (datasheet).^[28]



Fig. 14. GSM Shield

The **Arduino GSM shield** uses the GSM library to connect an Arduino board to a network and send and receive SMS.^[29]

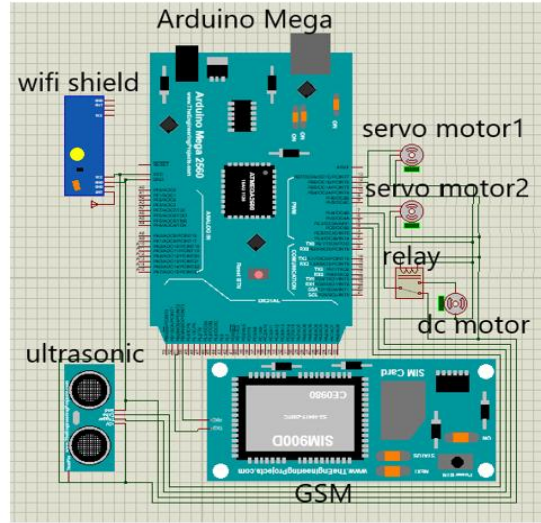


Fig. 15. Schematic Diagram

The Schematic Diagram shows the wiring and different materials of the project.

3.3 System Performance Evaluation

Table 2. Test Result

Number of Days # Of Trials	Measured Weight of Feds/Kilogram Total = 10 Kgs	Feeding Time Schedule (8:00 A.M., 1:00 P.M., 5:00 P.M.)		Number of Feeding/Day	Kilograms Per Day
		Feeds Dispense Between	Feed Dispense Between		
DAY 1 (Trial 1)	9.14 Kgs	Between 1:00 P.M.-1:12PM	Between 5:00 P.M.-5:12 P.M.	Two	0.86 Kgs
DAY 2 (Trial 2)	8.71 Kgs	None (Test w/o Dispensing)	Between 7:00 A.M.-7:12 A.M.	One	0.43 Kgs
DAY 3 (Trial 3)	7.85 Kgs	Between 11:00P.M.-11:12P.M.	None (Test w/o Dispensing)	One	0.43 Kgs
DAY 4 (Trial 4)	6.99 Kgs	None (Test w/o Dispensing)	Between 1:00 P.M.-1:12 P.M.	One	0.43 Kgs
DAY 5 (Trial 5)	6.13 Kgs	Between 3:00 P.M.-3:12 P.M.	None (Test w/o Dispensing)	One	0.43 Kgs
DAY 6 (Trial 6)	5.27 Kgs	None (Test w/o Dispensing)	Between 7:00 A.M.-7:12 A.M.	One	0.43 Kgs
DAY 7 (Trial 7)	3.55	Between 1:00 P.M.-1:12PM	Between 5:00 P.M.-5:12 P.M.	Two	0.86 Kgs

The tables explain the seven-day simulation of the developed automated fish feeder using a mobile scheduler application. The researcher plotted the schedule using the application by simulating one and two feeding per day and checked the number of feeds if the system responded correctly. Based on the table, 0,83kg were dispensed for two feeding schedules and only 0.43kg for one time feeding schedule by measuring manually the number of feeds retained in the fed tank. It shows consistently that the system works for the entire one week off schedule as shown only 3.55kgs was left in the tank for one-week test of the system.

Table 3. System Performance Acceptability Survey

CRITERIA	MEAN	STANDARD DEVIATION	QUALITATIVE DESCRIPTIVE
A. In terms of System Availability			
A Smart Automation on Dispensing Fish Feeds	3.8	0.422	Very Acceptable
A readily available Mobile App for accessing and controlling the whole system	3.9	0.333	Very Acceptable
A Wi-Fi based Connected Device	3.9	0.333	Very Acceptable
A Monitoring System through SMS Alert	3.8	0.422	Very Acceptable
TOTAL	3.85	0.376	Very Acceptable
B. In terms of Aesthetics			
System Packaging is presentable	3.4	0.667	Acceptable
Circuitry is well-designed	3.7	0.494	Very Acceptable
Neatness of Wiring Connection inside	3.7	0.494	Very Acceptable
TOTAL	3.6	0.552	Very Acceptable
C. In terms of Performance			
System Accuracy	3.7	0.494	Very Acceptable
System Durability	3.8	0.422	Very Acceptable
System automation	3.8	0.422	Very Acceptable
TOTAL	3.77	0.446	Very Acceptable
D. In terms of features			
Mobile App is readily available to access the Smart Fish feeder	3.9	0.333	Very Acceptable
System is Connected to a Wi-Fi to ensure the Maximum Range of Connectivity	3.8	0.422	Very Acceptable
Display of SMS alert in the Smartphone/Cellular phone	3.9	0.422	Very Acceptable
TOTAL	3.87	0.392	Very Acceptable
GRAND TOTAL	3.77	0.442	Very Acceptable



Figure 16. Actual Set-up of the Project

4. CONCLUSIONS AND RECOMMENDATIONS

Conclusion:

Based on the result obtained, the researchers captivated the following conclusions. The Mobile App created by the researchers for the automated fish feeder using a mobile scheduler application functions well with the desired output. Smart Fish Feeder with Mobile App is an innovation of the existing fish feeder technology. It can control the expected time of feeding fish using a smartphone. It is a low-cost device but has high performance and efficiency. The Smart Fish Feeder dispenses 1 kilogram of fish feeds every 1 minute. Thus, the user can control how many feeds will be distributed by maintaining the desired time.

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