Automated Fish Pond Feeding and Detection of Water Turbidity

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Fish has become increasingly popular as a source of protein and essential nutrients over the past few decades. Consequently, the aquaculture sector has emerged as a potential solution to meet this growing global demand (Subasinghe et al., 2009; Garlock et al., 2022). However, sustainable fish farming faces several challenges, including maintaining optimal water quality, employing efficient feeding methods, and minimizing environmental impacts (Mansour, 2025; Karimanzira, 2025; Bohnes et al., 2022; Abdikadir et al., 2024; Cortes et al., 2025). Understanding the causes and consequences of fish kill incidents and fish health-related hazards in fishponds resulting from underfeeding and overfeeding practices is crucial. Researchers must evaluate feeding practices, monitor feeding rates, assess feed composition, and analyze fish growth and health parameters to develop effective guidelines for optimized feeding strategies (Hossain et al., 2025; Huang et al., 2025; Thornburg, 2025). Awareness campaigns, educational programs, and technological innovations can further promote responsible feeding management, improve efficiency, and mitigate risks.

Automatic fish feeders are widely recognized by aquarists as practical devices that can supply a calculated amount of food several times per day, promoting fish health and reducing food waste. These feeders, which range from simple battery-powered models to complex electronic systems (El Shal et al., 2021), can operate at any time of day or night. They provide fish with a consistent food supply, ensuring proper nutrition and growth. This is especially convenient for aquarists or fishpond owners who may not always be available to feed their fish manually. Automated fish feeders can be programmed to dispense food at predetermined times, allowing users to customize feeding schedules to the specific needs of their fish and maintain appropriate nutrition levels for growth and well-being.

Feeding fish manually can be time-consuming and physically demanding, particularly under extreme weather conditions, and determining the correct amount of food can also be challenging. The development of an automated fish feeding system aims to reduce the time and labor associated with traditional feeding methods. Through automation, fishpond operators can increase productivity, lessen human error, and ensure consistent feeding. By adopting aquaculture practices, communities can establish their own fish farming operations, improve their livelihoods, and become more self-sufficient in producing valuable seafood products. This provides economic opportunities, enhances resilience, and contributes to local economies while improving fish health, growth rates, and yield.

Decisions regarding the acceptance or rejection of technology can be difficult because technology continuously evolves, particularly in ICT-related applications. Several theories and models have been developed to better understand technology usage, but the Technology Acceptance Model (TAM) remains one of the most recognized in explaining factors that influence users' acceptance of modern technologies. TAM helps in understanding the usefulness and usability of new systems. In this study, the concept of perceived usefulness (PU) is relevant, as fishpond owners believe that using an automated feeding system benefits both fish and owners compared to traditional methods. Another important aspect is perceived ease of use (PEOU), which reflects users' ability to accept and operate electronic devices effectively for fish feeding purposes.

A missed feeding schedule in a fishpond can have serious consequences for the health and survival of the fish. Fish require consistent and appropriate amounts of food to thrive, and failure to follow a feeding schedule can lead to underfeeding or overfeeding, both of which can cause health and water quality issues (Assan et al., 2021). Depending on the pond's size, automated fish pond systems can adjust feeding schedules accordingly. Smaller ponds, less than 1,000 square meters, may require two to four feedings per day, while medium-sized ponds ranging from 1,000 to 5,000 square meters may need two to six feeding cycles daily. When creating a feeding plan, careful consideration must be given to fish species, size, age, and environmental conditions. Automated fish pond systems using Arduino technology allow precise control over feeding schedules to ensure proper fish development and resource efficiency.

The health of fish in ponds also depends on water turbidity. Clean water with a turbidity or visibility range of 40–60 cm is considered optimal for fishponds, as it promotes good fish growth. Turbidity caused by plankton is generally beneficial because it indicates a healthy environment and abundant food sources for fish (Rodrigues et al., 2023). However, poor water quality can lead to fish kills and health-related hazards. Maintaining appropriate water conditions is therefore critical for fish survival and development. Researchers emphasize the need for proper water testing, filtration systems, regular water changes, and treatment applications when necessary (Yusoff et al., 2024; Yavuzcan Yildiz et al., 2017; Liu et al., 2024).

Water turbidity refers to the concentration of dissolved materials, such as salts or minerals, in the water (Hidayana et al., 2024). The ideal turbidity level varies depending on the species being cultured. Most freshwater fish thrive in water with a turbidity of 1.000 to 1.025 g/cm^3, although specific preferences may vary by species. Proper turbidity levels are vital for maintaining buoyancy, regulating oxygen availability, and ensuring overall fish health (Raghavendra et al., 2025; Adjovu et al., 2023).

The main objective of this study is to assess the functionality of the automated fish pond feeding and detection of water turbidity using Arduino UNO. This system aims to eliminate common problems in fishpond culture by improving feeding efficiency, maintaining ideal water quality, and enhancing the health and productivity of cultured fish.

Theoretical Framework

Fishpond

Feeding management plays a vital role in ensuring the health, growth, and overall well-being of fish in aquaculture systems. Insufficient food availability can lead to aggressive behavior among fish as they compete for limited resources whereas restricted feeding not only triggers aggression but also hinders carp from reaching their full growth potential (Oh et al., 2007; Duan et al., 2025; Gao et al., 2022; Duan et al., 2011). To mitigate these challenges, producers must implement effective feeding management strategies that ensure fish receive adequate nutrition, thereby promoting optimal growth and reducing aggressive interactions during feeding periods.

Automatic fish feeders are central to achieving consistent and reliable feeding management. These devices ensure that fish receive the correct amount of food at regular intervals, helping them meet their dietary requirements and grow healthily. According to Karimanzira (2025), providing the appropriate amount of feed is crucial for maintaining water quality, as both overfeeding and underfeeding can negatively impact aquatic environments. Overfeeding leads to waste accumulation and deteriorating water conditions, while underfeeding results in malnutrition and poor fish health. Establishing a regular feeding schedule, such as feeding at the same time each day, promotes healthy feeding behavior and ensures fish receive balanced nutrition for growth and development.

Moreover, automatic fish feeders provide numerous advantages for both aquaculture and aquarium management. They offer convenience, precision, and flexibility in feeding schedules, which are particularly beneficial for aquarists with busy lifestyles or fish located in remote or deeper areas of ponds and oceans. El Shal et al. (2021) describe how automatic fish feeders, ranging from simple battery-powered devices to sophisticated electrical systems, deliver measured amounts of food at predetermined intervals. This not only guarantees consistent nourishment but also reduces food waste and maintains better water quality. Fantatto et al. (2024) further note that these systems can be customized to accommodate the nutritional needs of different species, ensuring optimal feeding conditions and promoting the health of aquatic populations.

Water Turbidity and Feeding Control

Proper feeding management also contributes to maintaining water clarity and preventing excessive turbidity (Hridoy et al., 2025). Hence, controlling both the quantity and timing of feed is essential for balancing fish health with water quality. Excess feed decomposes into waste that deteriorates water conditions and may cause oxygen depletion, while insufficient feeding limits growth potential. Automatic fish feeders help regulate these factors by dispensing precise portions of food, ensuring that fish obtain adequate nutrients without overloading the aquatic environment. In this way, they support both healthy fish growth and the sustainability of aquaculture systems.

Automatic feeders can be used at any time, not only when the owner is absent. Many aquarists use them as part of a regular feeding routine to provide measured amounts of food several times per day. This practice benefits fish health, minimizes waste, and ensures steady water quality. As Karningsih et al. (2021) highlighted, modern automatic feeders offer flexibility, allowing aquarists to design feeding programs that cater to the unique needs of different species. Such systems provide reliability and convenience, making them ideal solutions for maintaining healthy aquatic ecosystems.

Fish Feeder Prototypes and Innovations

Several innovations have advanced the development of automated fish feeding systems. Noor et al. (2019) introduced a Microcontroller-Based Fish Feeder designed for aquariums, featuring timed feeding setups and controlled feed release. The system, operated by a PIC microcontroller, accommodates different feed types such as pellets, flakes, and powders, ensuring accurate and consistent feeding. Similarly, Susilawati et al. (2023) highlighted the benefits of such systems in preventing overfeeding and maintaining water quality. These feeders enable users to establish exact feeding times and portions, which are crucial for maintaining optimal fish nutrition and pond hygiene.

Karningsih et al. (2020) developed a self-feeding device designed for individuals with busy lifestyles who struggle to feed fish regularly. The portable and low-maintenance system provides multiple advantages but is limited to indoor use due to susceptibility to adverse weather conditions. In contrast, Niez et al. (2025) designed and tested an Automatic Fish Feeder system for aquaculture applications to address inefficiencies in manual feeding. This automated solution eliminated major issues related to hand feeding, saving time and effort for aquarists and fish farmers alike. Mohamed et al. (2024) supported this development, affirming that automated feeding provides a practical and efficient method that enhances feeding consistency and convenience in aquaculture operations.

In addition to these technological advances, Nave (2025) underscored the importance of establishing a self-sustaining forage base in ponds and aquariums. By creating ecosystems capable of naturally supplying the nutritional needs of fish, producers can reduce dependence on artificial feeding systems while promoting long-term ecological balance. Integrating plants, animals, and microorganisms into such systems supports the health and sustainability of the entire aquatic environment.

Research Framework

Data

The system evaluation data were collected through a survey involving ten respondents. The total number of respondents was determined using Slovin's formula, and questionnaires were distributed using a random sampling technique. The questionnaire was developed based on the Technology Acceptance Model (TAM), which includes four key constructs: Perceived Ease of Use, Perceived Usefulness, Attitude Toward the

Prototype, and Intention to Use the Prototype. The researchers utilized the weighted mean formula to analyze the data. A Four-Point Likert Scale was employed, consisting of the categories Strongly Agree, Agree, Disagree, and Strongly Disagree. Each scale point was assigned a corresponding mean range, which was used to interpret the evaluation results.

Experimental Design

The experimental design for automatic fish feeders involves setting up controlled conditions, such as an aquarium or fish tank, where the performance of the feeders can be accurately assessed. This process includes selecting the specific automatic fish feeder technologies to be evaluated and establishing the parameters and guidelines for the experiment. Researchers first determine the type and quantity of feed to be used in the trials to assess the sensitivity and accuracy of the various feeder systems. They then define the feeding parameters, such as the amount of food to be dispensed, as well as the frequency and duration of feeding cycles, to ensure consistency and reliability in testing.

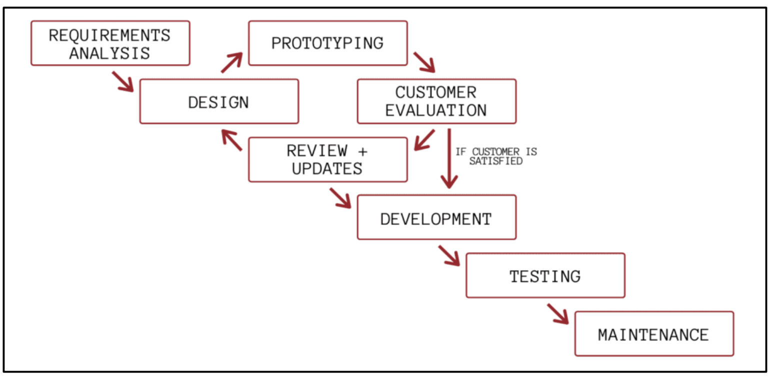
Once the experimental setup and procedures are established, testing can begin. The automatic fish feeders are activated under controlled conditions, and the behavior of the fish is carefully observed. The data collected from these trials are then analyzed to evaluate the feeders' precision, sensitivity, and overall effectiveness. This experimental design allows researchers to systematically assess different automated fish feeder technologies by constructing controlled environments, selecting appropriate devices, establishing standardized guidelines, and conducting performance evaluations to determine their efficiency and reliability.

Modeling

The choice of development model plays a crucial role in the testing and evaluation process. It determines the scope, timing, and methodology of testing, influences regression testing strategies, and shapes the overall testing framework. These structured approaches, known as development models, provide systematic procedures for system design, implementation, and testing. Over time, various software and system development life cycle models have been formulated to meet differing project requirements and achieve desired outcomes effectively.

Figure 1

Prototyping model



The study employed the prototyping paradigm to actively test and enhance the functionality and performance of the automated fish pond feeding system. This approach involves constructing and evaluating a prototype of the system, incorporating Arduino-based sensors to detect water turbidity and control feeding operations.

Planning and design phases. The planning and design phases begin with identifying the research question or hypothesis and defining the study's specific aims and objectives. A thorough literature review is conducted to assess the current state of knowledge, identify gaps, and determine areas requiring further investigation.

Requirements gathering and analysis. A methodical approach is adopted to ensure the effective deployment of the system. Requirements gathering involves conducting interviews and collecting user feedback to understand the needs and expectations of potential users. Equipment and materials are carefully evaluated to guarantee timely availability. The system is designed using Arduino technology to enable precise automated feeding, while sensors are integrated to provide real-time monitoring of water turbidity.

Design phase. In the design phase, a preliminary and conceptual layout of the fish-feeding system is created. This basic design serves as a rough sketch that outlines the system's components and functionality, providing stakeholders with an overall understanding of the intended system without being fully comprehensive.

Prototyping phase. During prototyping, the researchers develop a preliminary working model of the system. This includes selecting hardware components, designing circuitry, integrating turbidity sensors and feeding mechanisms, and developing the software code for the Arduino UNO. The prototype undergoes initial testing to verify basic functionality, and iterative refinements are made based on the results.

User evaluation. The prototype is then presented to users for initial evaluation. At this stage, feedback is collected regarding the system's strengths and weaknesses. This input helps the development team refine the prototype. If the users are satisfied with the initial design, the team may proceed to the next development stage. Otherwise, the feedback informs updates and adjustments to improve system performance.

Review and updates. When user feedback indicates areas for improvement, the researchers analyze the suggestions and implement necessary modifications. A revised prototype is produced, incorporating client recommendations and addressing identified deficiencies. This iterative cycle ensures that the system meets user requirements effectively.

Development phase. The development phase involves detailed system design, hardware integration, and software implementation. Researchers finalize the placement of components, integrate sensors and actuators, and program the Arduino UNO to control feeding operations and detect water turbidity. A functional prototype is created and tested rigorously to validate system performance.

Testing phase. Comprehensive testing is conducted to assess both the automated feeding mechanism and the Arduino sensors for water turbidity detection. Experiments under various conditions evaluate the system's accuracy, reliability, and overall functionality, ensuring it meets performance expectations.

Maintenance phase. The maintenance phase ensures the system remains functional and efficient over time. This involves regular inspections, system checks, software updates, and component upkeep. Continuous monitoring allows for timely resolution of issues and optimization of system performance.

Technical Framework

This section describes the key components of the automated fish-feeding system. Central to the system is the feeding technology, which enables automatic and controlled feeding according to preset schedules. The system utilizes Arduino sensors, which are responsible for regulating feed delivery and monitoring water turbidity in real time. These components work together to ensure precise feeding, maintain water quality, and support optimal fish health and growth.

Software

Table 1 presents the software requirements for the developed system, outlining the different software tools used to construct the system using Arduino UNO. These software components work together to process sensor data, execute control decisions, and enable users to monitor and manage the system effectively. The specific software required may vary depending on the system's needs and typically includes tools such as an integrated development environment (IDE) for coding and a web browser for monitoring or interface purposes.

Table 1

Software specifications

Software	Description
IDE Platform	The Arduino Integrated Development Environment - or Arduino Software (IDE) - contains a text editor for writing code.
Operating System	A Microsoft Windows operating system that runs on a 32-bit or 64-bit architecture used in the development of the system
Web browser	Chrome (recommended) or any web browser installed.
Blynk App	Platform for iOS or Android smartphones that allows users to remotely control devices like Arduino, Raspberry Pi, and NodeMCU.

Hardware

Table 2 presents the planned hardware requirements for the system, listing the components needed to build the automated fish pond feeding system using Arduino UNO.

Table 2

Hardware specifications

Hardware	Specification
ARDUINO UNO 	microcontroller board based on the ATmega328P (datasheet).USB 2.0 Cable Type A/B
NODEMCU ESP8266 	The NodeMCU ESP8266. The open-source NodeMCU firmware and development board.
SERVO MOTOR MG996 	The MG996R is a metal gear servo motor with a maximum stall torque of 11 kg/cm. RC servos the motor rotates from 0 to 180 degree.
DS1302 RTCMODULE 	The DS1302 real time clock module is a cheap module with high accuracy that can be used in different projects.
TURBIDITY SENSOR 	5V operating voltage sensor can detect water turbidity linearly within the test range 1.873 NTU to 1011.93 NTU.
LOADCELL HX711 	The HX711 is a precision 24-bit analog-to-digital converter (ADC) intended for scales.
SOLAR PANEL 	12V with Clip Flexible Power Solar Panel Battery Panels Modules Charger

The hardware includes an Arduino microcontroller to process sensor data and make control decisions, a servo motor for rotational feed dispensing, and various modules to support system operation. Additionally, a solar panel provides power, and a load cell ensures accurate measurement and efficient system performance. Together, these components enable the full automation of fish pond feeding using the Arduino UNO platform.

System Design

As shown in Figure 2, the fish-feeding system operates through a series of steps to ensure proper functionality. After completing the coding process, all sensors and modules are initialized in a connected state. Once initialized, the sensors begin monitoring the environment to detect any potential restrictions or limitations. The microcontroller then analyzes the sensor outputs and compares them against predetermined specifications to verify that the system is operating correctly. This process ensures that the system functions as intended, with accurate monitoring and control of feeding operations.

Figure 2
System architecture design of the prototype

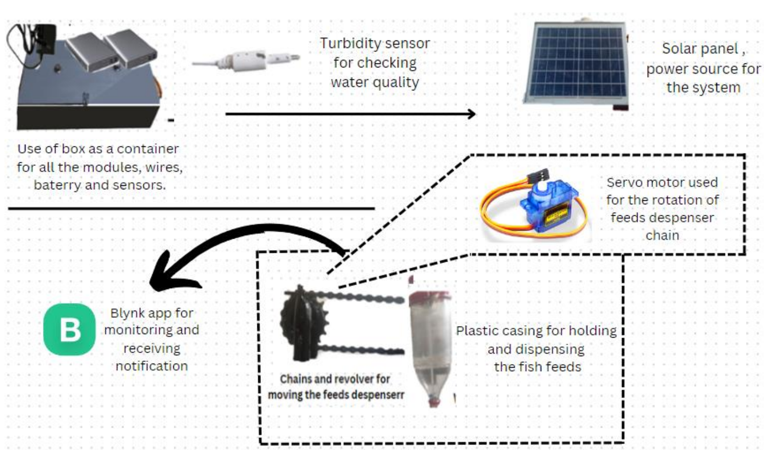
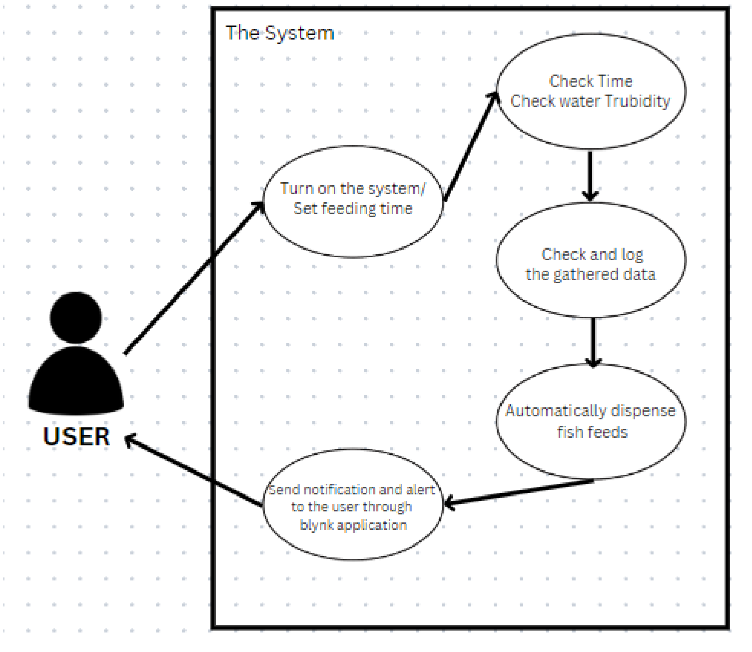


Figure 3

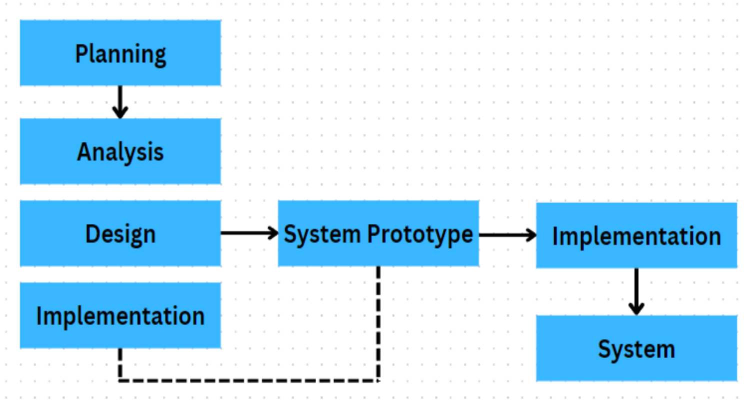
Use case diagram of the prototype



As illustrated in Figure 3, the fish pond feeding and water turbidity detection system reduces the need for direct human intervention by increasing automation in pond management. During initial installation, the system undergoes an initialization process that sets up all necessary components and parameters. Once operational, it continuously collects essential data on fish feeding behavior and water turbidity levels. This information is then transmitted to users via Wi-Fi notifications, providing timely updates and critical insights. By automating monitoring and reporting tasks, the system minimizes human involvement, allowing users to focus on other important activities while ensuring optimal fish health and water quality.

Figure 4

Implementation flow chart of the prototype



In Figure 4, the initial setup process is critical for the proper operation of the fish feeding system. Once the sensors and components are activated, the system begins scanning the area to detect potential restrictions or obstructions. This step allows researchers to identify issues early and make necessary adjustments to enhance system performance. Continuous monitoring, evaluation, and adjustment are essential throughout development and deployment, enabling researchers to fine-tune components and optimize the system to ensure it operates at peak efficiency.

Figure 5

Circuit diagram of the prototype

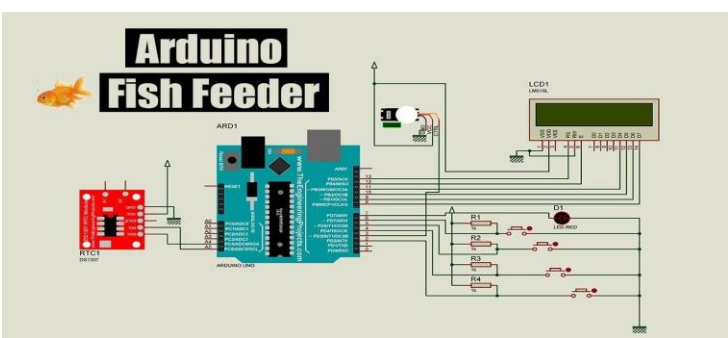


Figure 5 illustrates the circuit diagram of the automatic fish feeder system, providing a comprehensive overview of the system's layout, components, and their interactions. The system is designed for simplicity and convenience, ensuring easy setup and operation. Its portable and lightweight construction allows for installation in a variety of settings. Additionally, the user-friendly interface enables users to operate and monitor the system efficiently, requiring minimal technical expertise.

Figure 6

Storyboard of the Prototype

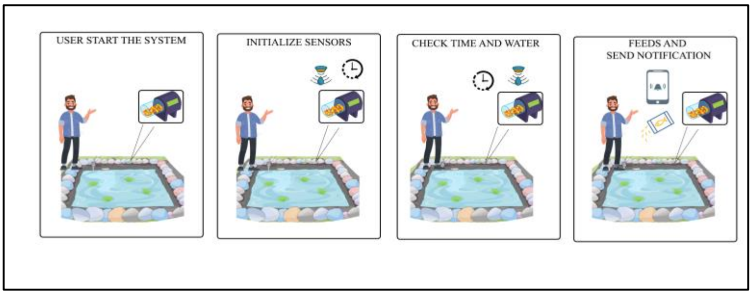
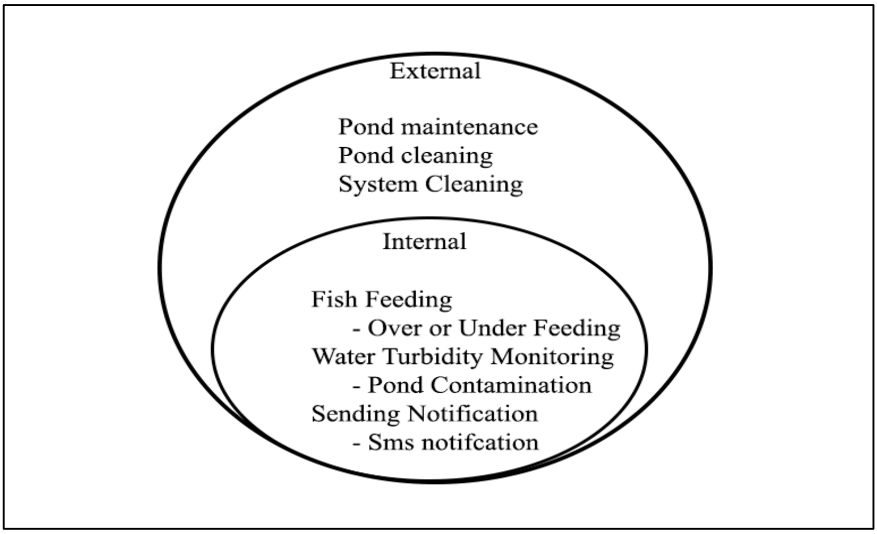


Figure 6 illustrates the workflow of the fish feeding system, from system startup to the user receiving the necessary information. The system is designed to fully automate fish feeding in ponds, addressing issues caused by inconsistent feeding schedules, such as water contamination and health problems in fish. Compact, sleek, and aesthetically designed, the device is easy to install in aquariums or ponds. It features configurable feeding schedules, an automated food dispenser, and a visible display showing the feeding timetable.

By providing regular and consistent feeding, the system promotes better digestion and strengthens the immune systems of the fish, contributing to overall health. Its user-friendly design allows fish owners to easily adjust feeding schedules and refill the dispenser, ensuring efficient operation. The workflow demonstrates how the system manages automated feeding while delivering timely updates and relevant information to the user.

Figure 7

System boundary of the prototype

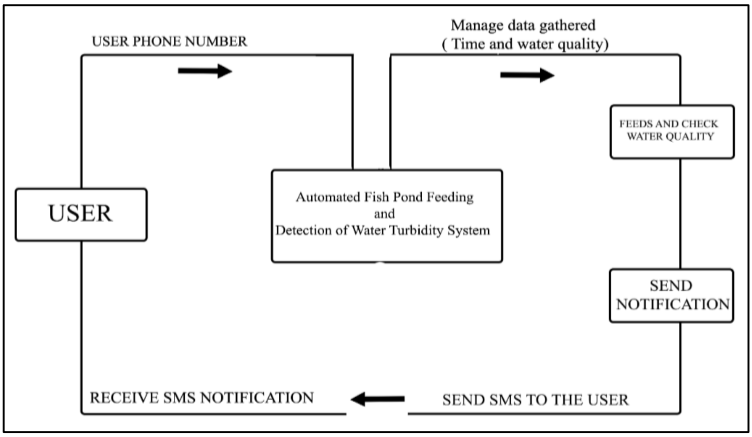


In Figure 7, the scope of the fish feeding system is defined by its system boundary, which encompasses both internal and external components. Internal components include the fish feeding device, the food dispenser, and the configuration of feeding schedules, while external components involve pond maintenance, pond cleaning, and system upkeep. Defining this boundary is essential for understanding the system's impact on its environment, guiding the design, development, and maintenance processes, and identifying potential limitations or risks associated with its implementation.

Figure 8 illustrates how information is transmitted and processed within the system. It begins when the owner inputs their phone number and sets the feeding schedule through the system device.

Figure 8

Dataflow diagram of the prototype



The system processes this information to control the food dispenser, releasing the specified amount of food into the fish pond at designated times. Simultaneously, the system monitors water quality in the pond and provides feedback to the owner via Wi-Fi notifications. This data flow is essential for maintaining a consistent and automated feeding process, promoting the health and well-being of the fish, and keeping the owner informed about feeding activities and water conditions.

Figure 9

System Activity of the Prototype

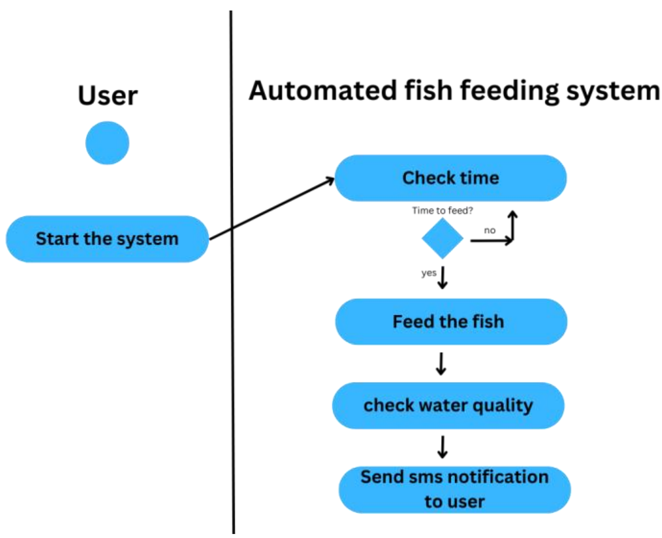


Figure 9 illustrates the various tasks involved in an automated fish feeding system, providing a comprehensive overview of its operation from start to finish. The process begins with the initialization of all components, including the feeding mechanism, sensors, and controllers responsible for monitoring the environment and managing fish feeding. Once initialized, the sensors collect data on the pond environment, such as water temperature, pH levels, and other relevant parameters.

Following data collection, system requirements and specifications are analyzed, leading to the design and construction of a prototype. The prototype is then tested to ensure it meets the desired criteria before installation and operation. Long-term maintenance procedures are also established to ensure consistent performance. Overall, the automated fish feeding system functions cohesively to provide fish with the necessary nutrients while maintaining optimal health and environmental conditions.

Figure 10

The developed system

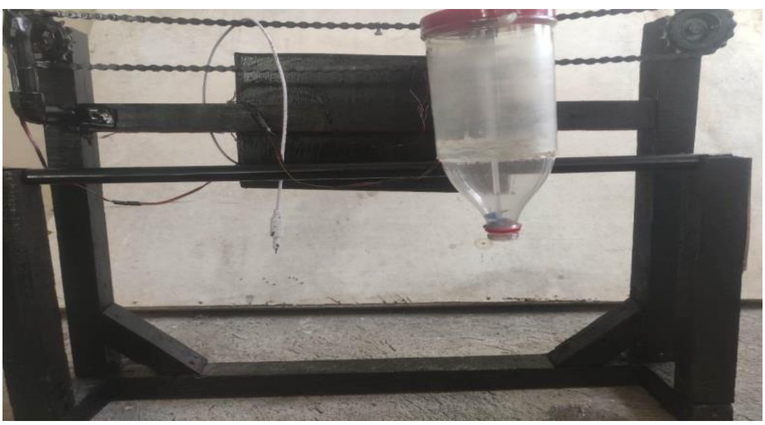


Figure 10 shows the developed system. Users reported that the system was easy to use and intuitive, facilitating its integration into their fish pond operations.

System Evaluation

This section presents the survey results collected from ten respondents. The questionnaire was based on the TAM, which includes the constructs of Perceived Ease of Use, Perceived Usefulness, Attitude Toward the Prototype, and Intention to Use the Prototype. A Four-Point Likert Scale was employed, consisting of the categories Strongly Agree, Agree, Disagree, and Strongly Disagree, from which respondents could select their answers for each question.

Table 3

Weighted mean distribution of the criteria for the developed system

Technology Acceptance Model	Weighted Mean	Remarks
Perceived ease of use (PEOU)	3.27	Agree (A)
Perceived usefulness (PU)	3.38	Strongly Agree (SA)
Attitude toward Prototype	3.43	Strongly Agree (SA)
Intention to use Prototype	3.15	Agree (A)
Average	**3.30**	**Strongly Agree (SA)**

Table 3 presents the average weighted mean of the system assessment survey, which is 3.30, indicating that respondents strongly agree regarding the system's performance. This demonstrates that the fish pond feeding and detection of water turbidity system effectively fulfills the stated requirements. The high weighted mean reflects strong user approval and acceptance, suggesting that the system aligns with user needs and is likely to achieve the stated objectives. Overall, this positive reception indicates that the system meets or exceeds user expectations.

Respondents perceive the system as user-friendly and easy to interact with, highlighting its intuitive design. The interface allows users to navigate and operate the system without encountering significant difficulties, promoting seamless interaction and operational efficiency. This positive perception reflects the successful application of user-centered design principles, ensuring that the system meets the expectations and needs of its users while providing a convenient and satisfying experience.

The system's mobile app further enhances usability and operational control. Respondents reported that the app allows them to remotely control the feeding process, streamlining operations and enabling precise, timely feeding. This functionality contributes to improved fish health and growth, demonstrating the practical utility of the system in real-world pond management.

The respondents' attitudes toward using the system indicate a seamless and satisfying daily experience. Users find it easy to operate due to its intuitive interface and controls, while automated feeding eliminates the need for manual intervention. The system's reliability and accuracy ensure that fish receive appropriate nutrition and that water quality is continuously monitored.

Respondents also recognize that the system helps identify potential challenges early and allows for timely adjustments to enhance overall effectiveness. Users expressed their intention to use the system daily. This confirms that the system provides a practical, automated solution for pond feeding, ensuring consistent nutrition for the fish while offering convenience and efficiency. By integrating automation and real-time water turbidity monitoring, the system effectively supports the regular operation and management of fish ponds.

Economic feasibility. The economic feasibility of the system was assessed to determine whether its expected benefits outweighed or met the anticipated costs. An analysis of both advantages and disadvantages was conducted to evaluate the system's overall viability. The study provided insights into the system's costs and benefits by considering its strengths and limitations. Input on the system's efficiency and economic practicality was collected through a TAM-based questionnaire survey. This assessment method offered a reliable means of comparing the system's actual performance against expected outcomes, helping to determine its economic viability.

Technological feasibility. The technological feasibility of the system was evaluated. This assessment examined the compatibility and capabilities of the Arduino UNO microcontroller with the required sensors, actuators, and communication protocols for automating fish pond feeding and monitoring water turbidity. The robust hardware and software ecosystem of the Arduino UNO, along with its extensive library support and active community, provided an excellent foundation for developing and integrating the system. Comprehensive testing and validation confirmed the system's reliability and accuracy under real-world conditions. This research demonstrated that using Arduino UNO was both effective and sustainable for automating fish feeding and detecting water turbidity, confirming its technological feasibility.

Operational feasibility. Operational feasibility focused on the practicality and ease of use of the system in real-world settings. Factors such as user acceptance, simplicity of operation, and integration with existing fish pond management practices were considered. The system's user-friendly interface allowed pond owners and operators to navigate and interact with it efficiently. Automation of fish feeding and real-time water turbidity detection streamlined pond management, increased productivity, and reduced the need for manual labor, demonstrating the system's strong operational feasibility.

Conclusion

The development of a hardware design using Arduino UNO for automated fish feeding and water turbidity detection represents a significant improvement in fish pond management. This automated approach enhances overall pond management, increases productivity, and reduces the need for manual labor. Furthermore, a comprehensive assessment of the proposed prototype confirmed its compliance with the safety standards established by the Bureau of Fisheries and Aquatic Resources (BFAR). Evaluation of factors such as electrical components, structural integrity, and material safety verified that the system meets the required safety criteria. The Technology Acceptance Model (TAM) assessment highlighted strong user acceptance and adoption of the prototype. These findings suggest that the prototype has considerable potential for widespread implementation in fish pond operations.

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