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Automatic fish feeder system using Arduino Uno

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Abstract

This research project focuses on developing an Arduino-based automatic fish feeder system designed to enhance the care and feeding process for pet fish owners in the San Jose Occidental Mindoro community. The system aims to automate the feeding process at specific intervals, improving aquatic pets' overall health and well-being using Arduino technology and various components such as a servo motor and real-time clock. Moreover, betta fish were used to test the effectiveness of the device. The result shows that the automatic fish feeder system got an overall mean of 3.57 in dispensing an accurate amount of feed for fish and an overall mean of 3.43 in adding LCD with the time and date. The amount of feed may be on an average of 0.13 grams in the morning and more than 0.07 grams in the evening. There was a significant difference between the manual and the automatic fish feeder—the automatic delivery of food at predetermined times, like six in the morning and six in the evening. There is a significant difference between the performance of automatic fish and manual fish feeding regarding the amount of feed dispensed. Through a structured research methodology involving design, construction, experimentation, and data recording stages, the researchers demonstrate the effectiveness and reliability of the automatic fish feeder system. It is recommended that sensors be incorporated to monitor water quality parameters such as temperature, pH, dissolved oxygen, and ammonia levels to ensure optimal conditions for fish health and growth.

Keywords: Arduino Uno, automatic fish feeder, pet fish care, betta fish, fish feeds

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1. Introduction

Feeding is one of the most essential elements in fish development and productivity (Mohd et al., 2020). Maintaining a proper feeding schedule is essential for the health of the fish since living things require a certain amount of nutrients, which means that the timing and amount of food given at each feeding should be the main priorities. Anusuya et al. (2017) stated that the amount of food required by different kinds of fish for their daily meals depends on their population. Humans have kept fish for centuries for various uses, including trade, scientific study, and aesthetic pleasure. These aquatic animals require regular feedings and are typically kept in aquariums, ponds, or other enclosures (Ogunlela & Adebayo, 2016). Traditional feeding practices require fish owners to manually distribute food at predetermined intervals, which can result in scheduling errors and inaccurate portion sizes. On the other hand, automatic fish feeders are electronic gadgets that effectively dispense fish food at predetermined intervals. As Al-Ruqaie (2007) stated, fish owners can use them by adding food to the feeder's storage tank, and the feeding process will be handled automatically.

In most cases, fish feeders are attached to the tank wall and placed just above the water line. They consist of a narrowing container, typically filled with dry food, that can release its contents at the base. A built-in timer rotates the container and dispenses food every predetermined amount of time. Additionally, the feeding schedule and amount of food provided can both be modified using this timer. By simply falling to the water's surface, the food released is accessible to the fish. The automatic feeders are helpful additions for aquarists because keeping a regular feeding schedule can be difficult because they might need to remember or be away. An automated system must allow users to control or modify it in response to their demands and needs. The term "automatic" suggests that the feeder should be able to operate without human supervision, at least occasionally. Because microcontrollers are so inexpensive, automatic feeders are the best option for feeding fish because they provide a practical and highly accurate alternative to manual methods (Dada et al., 2018).

Aquarium enthusiasts and fish hobbyists often face challenges in maintaining a consistent and reliable feeding schedule for their aquatic pets. The manual feeding process, influenced by human factors, can lead to several issues that an automatic fish feeder system aims to address. This study explores the design and implementation of an automatic fish feeder using easily accessible materials. The researcher aimed to produce an automatic fish feeder using Arduino Uno that is user-friendly, inexpensive, and appropriate for aquariums. With the help of an Arduino Uno as a timer and a servo motor, the researchers intend to create a precise feeding plan for fish. Additionally, the researchers want to keep the food pellets for use in indoor aquariums clean and well-aerated. Moreover, the researchers used betta fish to test the effectiveness of the developed device. Given the rising popularity of fish farming, this idea shows promise for innovation in the manufacturing industry. It can reduce unemployment by providing young people with valuable and lucrative skills while increasing the nation's revenue through manufacturing and selling such devices.

Statement of the Problem - This research aimed to produce an automatic fish feeder using an Arduino Uno to assist those struggling to provide for their fish while away. It sought to answer the following questions: (1) What is the level of performance of the automatic fish feeder system in terms of the ability to dispense an accurate amount of food for fish and add an LCD with the time and date? (2) Is there any significant difference between the automatic fish feeder system using Arduino Uno and the fish manual feeding? (3) Does the fish feeder automatically dispense based on different amounts of feed?

Significance of the Study - This study aimed to maintain consistent feeding schedules, ensure the well-being of aquatic pets, and prevent overfeeding or underfeeding, thus promoting a healthier and more stable aquatic environment. The following are the beneficiaries of this study. For aquarists and fish keepers, this study can be

helpful to individuals who maintain aquariums or fish tanks and can benefit from automated feeding systems by ensuring their fish receive consistent and timely meals, even when they are away. This can lead to healthier and happier fish. For the aquaculture industry, this study can be helpful to larger-scale fish farming operations. Automated feeding systems can optimize the feeding process, reduce labor costs, and improve fish health. They can also enhance the control and efficiency of feed distribution. Researchers studying fish behavior, nutrition, or habitat conditions can use automated feeding systems to control and standardize feeding experiments for research and conservation. This helps in obtaining accurate data for their studies and conservation efforts. Educational Institutions. In this study, educational institutions offering aquaculture or biology programs can use such systems as teaching tools to demonstrate automation and IoT concepts while teaching responsible fish care. For environmental conservation, this study can provide precise feeding control and reduce the overfeeding of fish in natural ecosystems, which can lead to water pollution and harm to native species. Automated systems can help minimize this environmental impact. In this study, the researchers and hobbyists within the Arduino Uno community can benefit from the project as it provides a practical example of using Arduino Uno for automation, helping them learn and innovate further. Future researchers may use this study as a theoretical and research literature source. They can broaden the scope of the current investigation to draw a more conclusive generalization.

Scope and Delimitation of the Study - This research focused on producing an Arduino Uno automatic fish feeder designed to assist aquarium owners by automatically dispensing food at specified feeding times. This research project exclusively focused on the San Jose, Occidental Mindoro community, specifically targeting individuals who own fish. This study focuses on designing and implementing an automated fish feeder system specifically designed to meet the requirements of local fish enthusiasts. Aqueon Inc. stated that feeding fish once or twice a day is sufficient. Therefore, we restricted it to a 6 am and 6 pm feeding schedule. The main goal is to develop a hands-free feeding solution that improves pet fish's overall care and health within the designated community. The researchers used betta fish in their experiments. This science investigatory project was conducted within the time frame of August 2023 to April 2024.

2. Methodology

Research Design - This study utilized an applied experimental research design that focuses on producing an automatic fish-feeding system using Arduino Uno technology to maintain consistent feeding schedules and ensure the well-being of aquatic pets. This approach aimed to establish a cause-and-effect relationship between the variables. This design was chosen to assess the effectiveness of the feeding schedule created by the researchers. This design incorporates elements to uphold the cleanliness and aeration of food pellets, making it particularly suitable for indoor aquariums. Unlike basic experimental research, applied research focuses on real-world problems, aiming to produce tangible outcomes and solutions. In the context of the automatic fish feeder using Arduino Uno, an applied experimental research design is necessary to bridge the gap between theoretical knowledge and practical application, ensuring the development of a functional and effective feeding system.

Data Gathering Procedure - The researchers used direct observations to determine the functionality of the developed device. They aimed to gather firsthand information to determine the difference between automated and manual fish feeders. The researchers prepared an evaluation checklist to assess the effectiveness and applicability of the device. It was validated by their adviser and expert in the field of research at Divine Word College of San Jose. This research project used an Arduino Uno to monitor and record data in an automatic fish feeder system. The researchers could track feeding times, food levels, and other details using a variety of sensors and programming. The control system usually employs a microcontroller Arduino board to receive sensor data and transmit commands to the feeder mechanism. For instance, a servo motor dispensed fish food at predetermined intervals and recorded the feeding time. The feeding schedule was mainly built into the system, enabling careful monitoring of feeding cycles over predetermined times. The researchers spent ten days testing a betta fish and answering the validated evaluation checklist for two days.

Research Process: Stage 1 Preparation and Gathering of Materials - This study developed an automatic fish feeder system using Arduino Uno. After selecting the appropriate parts costing PHP 2800, the researchers ordered them online. A detailed list of all materials used is provided, covering both electronic components and non-electronic housing materials: Arduino Uno, Aquarium (6x12x8), Battery Holder, Battery (Rechargeable), Chopstick, Edge Banding, Fish, Jumper Wires, Plastic bottle, Paneling, Real-time clock (DS1302), Servo motor, Solar Controller, Solar Panel, Switch and Tie Wire.

Stage 2: Building and Development of the Project - The researchers used a servo motor that serves as a lock or a door, which opens to dispense fish food. In addition, an RTC (real-time clock) has been used to have a systematic time flow for the time the fish food is dispensed. Lastly, this item is triggered at a specific time, depending on the code we have uploaded to the Arduino Uno. The researchers conducted this and simulated it by programming and encoding pins. During assembly, the prototypes are wired together using jumpers and connectors. From March 3 to March 10, 2024, the researchers dedicated seven days to coding and assembly tasks, meticulously crafting the project's framework. Following this, from March 7 to March 15, 2024, they focused on case-making, investing six days in refining the physical housing of their creation. Transitioning into the finalization stage from March 19 to March 27, 2024, the researchers spent eight days ensuring thorough polishing and conducting quality assurance checks. This structured approach allowed them to meticulously attend to each aspect of the project, culminating in a robust and polished final product that can be tested in a betta fish.

Figure 1. Actual Product of Automatic fish feeder system using Arduino Uno

Stage 3: Experimental Stage, Observation and Data Recording - The researchers were designing an automatic fish feeder system. This step assesses the system's ability to operate effectively. They utilized the program to create a virtual model, considering the integration of various components essential for the automatic fish feeder. The researchers examined the material's potential connection to an automatic fish feeder system. This involved evaluating the compatibility and functionality of each component, ensuring that they are integrated seamlessly within the constructed system. The experimental process encompassed the entire journey from virtual design to physical assembly and assessment of the system's operational capabilities. The experiment began with the virtual design of an automatic fish feeder system. After acquiring the necessary physical components, the researchers assembled the system, aligning it with the virtual model. Functional testing involved powering up the system to assess the feeding mechanism's operation, checking sensor responsiveness, and ensuring the control system functioned as programmed. The operational assessment extended over time, evaluating the system's reliability in dispensing food at scheduled intervals and adapting to potential variations in environmental conditions. Comprehensive documentation of observations of betta fish and solutions guided the refinement process, leading to an optimized automatic fish feeder system for practical use.

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Researchers assessed feeding frequency and consistency using this comprehensive schedule, providing valuable information about optimal feeding intervals. Accurate tracking of food dispensing amounts throughout every cycle was an important finding. By ensuring controlled portion amounts and averting possible problems from overfeeding or underfeeding, this tracking system helped preserve the health of the fish. The Arduino Uno's capabilities as the primary control unit were crucial to this project. Integrated sensors, including water quality or load cells, measure accurate food amounts and collect real-time data. The Arduino Uno received this data for instant analysis and recording. It took 25 days to finish the device and ten days to test it using betta fish.

Statistical Treatment of the Data - The researchers used descriptive statistics to summarize and present essential characteristics of their data. This tool could provide a clear overview of feeding patterns, frequency, and duration. For the statistical analysis of determining the difference between automatic fish feeder systems using Arduino Uno and manual fish feeders, the t-test was used. This test was suitable for comparing means, making it appropriate for determining the difference between automatic and manual fish feeding. Its effectiveness with small sample sizes and assumption of normal distribution in the data further justified its selection, allowing for a focused assessment of the statistical significance of observed differences between the two feeding methods.

3. Results and Discussions

Table 1

Mean Level of Performance of the Automatic fish feeder system in terms of the ability to dispense an accurate amount of food for fish and adding LCD with the time and date

Indicators	4 (SA)	3 (A)	2 (DA)	1 (SDA)	Weighted Mean	Descriptive Indicator
An automatic fish feeder system dispenses an accurate amount of fish food.	4	3	0	0	3.57	Strongly Agree
Adding an LCD with the date and time of an automatic fish feeder system improves the monitoring of fish feeding schedules.	3	4	0	0	3.43	Strongly Agree
Overall Mean					**3.50**	**Strongly Agree**

Legend: 3.26 - 4.00 Strongly Agree, 2.51 - 3.25 Agree, 1.76 - 2.50 Disagree, 1.00 - 1.75 Strongly Disagree

Table 1 shows the mean level of performance of the automatic fish feeder system in terms of its ability to dispense an accurate amount of feed for fish and add an LCD with the time and date. An overall mean of 3.50 proved that the automatic fish feeder is performing well based on the testing and observations conducted by the researchers. Previous studies by Licardo et al. (2024) emphasize incorporating visual displays like LCDs in automated systems to enhance user interaction and monitoring capabilities. This supports the positive outcomes observed in the table regarding the improvement in monitoring fish feeding schedules by adding an LCD, date, and time features. This means a successful rate of improvement in monitoring fish feeding schedules. Therefore, adding an LCD, date, and time to an automatic fish feeder system improves the tracking of fish feeding schedules.

Table 2

Automatic fish feeder system's ability to dispense an accurate amount of food for fish in the Morning (6 am) and in the Evening (6 pm)

No. Trial	Amount of feeds (morning)	First dispense (Morning)	Amount of feeds (evening)	Second dispense (Evening)	Overall estimated feeds for 8 fish (0.15 - 0.19 gram)
1	0.11 gram	0	0.06 gram	0	1
2	0.01 gram	0	0.02 gram	0	0
3	0.12 gram	1	0.14 gram	0	0
4	0.07 gram	1	0.11 gram	0	1
5	0.06 gram	1	0.08 gram	0	1
6	0.04 gram	1	0.02 gram	0	0
7	0.02 gram	1	0.04 gram	1	0
8	0.08 gram	1	0.11 gram	1	1
9	0.13 gram	1	0.02 gram	1	1
10	0.7 gram	1	0.11 gram	1	1
Average	0.13	0.8	0.07	0.4	0.6
Percentage		**80%**		**40%**	**60%**

Legend: 0 = Did Not Function Properly, 1 = Function Properly

Table 2 shows the observed data on an automatic fish feeder system's ability to dispense an accurate amount of feed for fish in the morning (6 am) and evening (6 pm) using betta fish. This research tracked the dispenser's lid-closing ability over ten days. In Table 1, the first two days did not function properly, while days 3 to 6 functioned only in the morning but not in the evening, while days 7 to 10 did function properly. As stated previously, similar studies, such as Mohd et al. (2020), discuss the design and development of a microcontroller-based automatic fish feeder system, emphasizing the benefits of automation in fish care. Thus, it has a successful trial rate of 80% in the morning and 40% in the evening, with a 60% success rate. The researchers set the number of feeds in the morning and evening for ten days to determine if the device could dispense it automatically. Thus, it proved that the device can function well in the morning compared to the evening. This implies that the feed should be, on average, 0.13 grams in the morning and more than 0.07 grams in the evening. On the contrary, Al-Ruqaie (2007) may present differing views on the accuracy of feeds dispensing in automatic fish feeders based on their research findings. It is essential to compare and contrast these perspectives to understand the implications and outcomes of accurate feed dispensing in automatic fish feeder systems. It has 60% accuracy, which means that the ability to dispense the amount of feeds for fish was dispensed accurately based on the set amount.

Table 3

t-Test Results in the Difference between the performance of Automatic Fish and Manual Fish Feeding in terms of the Amount of Feeds dispensed

t-Test: Two-Sample Assuming Unequal Variances		
	Automatic fish feeding (Variable 1)	**Manual fish feeding (Variable 2)**
Mean	3.846938776	2.918367347
Variance	0.306851312	0.118075802
Observations	10	10
Hypothesized Mean Difference	0	
Df	8	
t Stat	3.122498999	
P(T<=t) one-tail	0.010259762	
t Critical one-tail	1.943180281	
P(T<=t) two-tail	0.020519524	
t Critical two-tail	2.446911851	

*Legend: *Highly Significant at p≤0.01 *Significant at p≤0.05*

Table 3 shows the t-test results for the difference between the performance of automatic fish and manual fish feeding regarding the amount of feed dispensed. The results show the rejection of the null hypothesis since the t statistic (3.122) is greater than the t critical (2.447). Therefore, there is a significant difference between the performance of automatic fish and manual fish feeding regarding the amount of feed dispensed. The findings were also supported by a p-value of 0.02, less than the 0.05 alpha level. This aligns with the study conducted by Anusuya et al. (2017), who emphasize the importance of designing and developing microcontroller-based automatic fish feeder systems that can accurately dispense feeds to meet the dietary needs of specific fish species. This supports the positive outcomes observed in the table regarding the system's ability to dispense food accurately. Moreover, Balaji (2020) discusses the importance of precise timing and automation in feeding systems to ensure consistent and timely meals for aquatic pets. This supports the positive outcomes observed in the table regarding automatic food dispensing at specific times. The coding instructs the feeder to activate its dispensing mechanism at particular times, synchronized with the feeding schedule set for the fish. This automated process ensures timely and consistent feeding without the need for manual intervention, enhancing convenience and maintaining the well-being of the fish.

4. Conclusions

The researchers concluded the following based on the data collected. The automatic fish feeder system got an overall mean of 3.57 (strongly agree) regarding the ability to dispense an accurate amount of feeds for fish and an overall mean of 3.43 (strongly agree), adding LCD with the time and date. The date and time of each feeding session and other pertinent real-time feeding information are easily accessible through the visual interface provided by the LCD screen. The amount of feed may be an average of 0.13 grams in the morning and more than 0.07 grams in the evening. There was a significant difference between the manual and the automatic fish feeder—the automatic delivery of food at predetermined times, like six in the morning and six in the evening. There is a significant difference between the performance of automatic fish and manual fish feeding regarding the amount of feed dispensed. The automatic system offers a range of advantages over manual feeding, including consistency, precision, convenience, reduction of human error, and time-saving benefits. Monitoring fish feeding

schedules is greatly improved when an automatic fish feeder system has an LCD, date, and time function. This function increases accuracy and convenience while guaranteeing that the fish are fed regularly and at the appropriate intervals.

Recommendation - Based on the conclusions drawn, the researchers recommend the following: Business establishments may introduce a user-friendly interface, such as a smartphone app or an LCD screen with easy controls, making it easier to determine feeding regimens. By removing the coding barrier, more consumers, regardless of their technical background, may easily change feeding schedules. It is recommended that dispensing time be added to improve the functionality of the automatic fish feeder system, including the opportunity to alter dispensing times. It is recommended that the feed container be improved. The container serves as a fish food reservoir, and its design is critical to keeping the food fresh and preventing infection. A sealed, airtight container with a solid locking mechanism can protect food from moisture and pests while maintaining its quality over time. Furthermore, using a transparent or translucent material for the container is also recommended, for users can easily monitor the remaining food levels, allowing for timely refills without disrupting the feeding schedule. Design the system with modularity, allowing for easy expansion and integration of additional features such as water quality monitoring, oxygenation, and surveillance tailored to fish ponds' requirements. Lastly, it is recommended to the users to incorporate sensors for monitoring water quality parameters such as temperature, pH, dissolved oxygen, and ammonia levels to ensure optimal fish health and growth conditions.

5. References

Al-Ruqaie, I.M. (2007). Extruded Leftover Food as Animal Feed. I: Effect of extruded feed on growth and feed utilization of Tilapia (Oreochromis niloticus) in Saudi Arabia. *Pakistan Journal of Biological Sciences,* 10: 3248–3253

Anusuya, D. P., Padmavathy, P., Anand, S. & Aruljothi, K. (2017). Design and Development of a Microcontroller-Based Automatic Fish Feeder System.

Balaji, A. S., Lokitha, T., Suvetha, P., Prabhakar, R. & Kumar, K. (2020). Automatic fish feeding and monitoring system foraquarium using 555 timers. International Journal of Technical Research & Science, 5(6). 20-23. DOI: 10.30780/IJTRS.V05.I06.005

Dada, E. G., Theophine, N. C. & Adekunle, L. (2018). Arduino Uno Microcontroller Based Automatic Fish Feeder.

Licardo, J.T.; Domjan, M.; Orehovački, T. (2024). Intelligent Robotics—A Systematic Review of Emerging Technologies and Trends. Electronics 2024, 13, 542. https://doi.org/10.3390/electronics13030542

Mohd, I.I., Hikmah, N., Azizan, B., Elfadil, N. & Pahang, M. (2020). Designand Development of Microcontroller Based Automatic FishFeeder System. *International Journal of Engineering Science and Computing* 10:25380-25383.

Ogunlela A. O. & Adebayo A. A. (2016). Development and Performance Evaluation of an Automatic Fish Feeder. https://www.walshmedicalmedia.com/open-access/development-and-performance-evaluation-of-an-automatic-fish-feeder-2155-9546-1000407.pdf