Jurnal E-Komtek
Vol. 5, No. 2. (2025) pp. 16 -25
https://jurnal.politeknik-kebumen.ac.id/index.php/E-KOMTEK
p-ISSN : 2580-3719 e-ISSN : 2622-3066

Design of Automatic Fish Feeding Device Based on Arduino with RTC and Servo Motor in Ornamental Fish Pond

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https://doi.org/10.37339/e-komtek.v9i1.1980

Published by Politeknik Piksi Ganesha Indonesia

Artikel Info
Submitted:
10-09-2024
Revised:
10-02-2025
Accepted:
10-03-2025
Online first :
30-06-2025

Abstract

Ornamental fish care requires regular feeding, but the owner's busy schedule is often an obstacle. This study aims to design an Arduino-based automatic fish feeder, using an RTC (Real Time Clock) module for time scheduling and a servo motor to drive the feeding mechanism. This system is designed to ensure that feed is given at the right time without manual intervention. The prototype of this tool was tested in an ornamental fish pond and showed satisfactory results. This tool is able to provide feed accurately according to a predetermined schedule, and the servo motor functions well in controlling feed distribution. The use of RTC has proven effective in maintaining time accuracy, ensuring that fish eating patterns remain consistent. This tool is also efficient in energy use and provides convenience for ornamental fish owners, reducing the risk of missed or excessive feeding. The results of this study indicate that this automatic feeding system can be a practical solution in ornamental fish care, with the potential to be further developed through the integration of IoT technology.

Keywords: *Arduino, Motor Servo, RTC (Real Time Clock)*

Abstrak

Perawatan ikan hias memerlukan pemberian pakan yang teratur, namun kesibukan pemilik seringkali menjadi kendala. Penelitian ini bertujuan untuk merancang alat pemberi pakan ikan otomatis berbasis Arduino, menggunakan modul RTC (Real Time Clock) untuk penjadwalan waktu dan motor servo untuk menggerakkan mekanisme pemberian pakan. Sistem ini dirancang untuk memastikan pakan diberikan pada waktu yang tepat tanpa intervensi manual. Prototipe alat ini diuji di kolam ikan hias dan menunjukkan hasil yang memuaskan. Alat ini mampu memberikan pakan secara akurat sesuai jadwal yang telah ditentukan, dan motor servo berfungsi dengan baik dalam mengontrol distribusi pakan. Penggunaan RTC terbukti efektif dalam menjaga akurasi waktu, memastikan pola makan ikan tetap konsisten. Alat ini juga efisien dalam penggunaan energi dan memberikan kenyamanan bagi pemilik ikan hias, mengurangi risiko pemberian pakan yang terlewat atau berlebihan. Hasil penelitian ini menunjukkan bahwa sistem pemberi pakan otomatis ini dapat menjadi solusi praktis dalam perawatan ikan hias, dengan potensi untuk dikembangkan lebih lanjut melalui integrasi teknologi IoT.

***kata kunci**: Arduino, Motor Servo, RTC (Real Time Clock)*

1. Introduction

At this time, rapid technological developments are utilized to facilitate work. Where technological advances in the field of electronics are developing rapidly and have an influence on the manufacture of sophisticated tools, namely tools that can work automatically and have high accuracy so that they can facilitate a job done by humans to be much more practical, economical and efficient. The development of this technology at this time has encouraged many human lives for efficient and automated things, namely in all sectors that cannot be avoided, so that the use of what was originally manual has shifted to automation **[1]**.

Many people are interested in fish farming because of the many choices of media that can be used to raise fish such as in ponds, aquariums, and many more. However, fish farming requires regular care and maintenance. Scheduling and monitoring are needed for feeding fish so that the health and quality of the fish are maintained **[2]**. Manual fish feeding is a conventional method where fish farmers add feed to the pond periodically. However, this method has several limitations. Manual feeding can be very time-consuming, labor-intensive, and carries the risk of overfeeding or underfeeding, both of which can be detrimental to fish health.

Arduino is a platform consisting of software and hardware. Arduino hardware is the same as microcontrollers in general, only on Arduino pin naming is added to make it easier to remember. Arduino software is open source software so it can be downloaded for free. This software is used to create and enter programs into Arduino. Arduino programming is not as many stages as conventional microcontrollers because Arduino has been designed to be easy to learn, so beginners can start learning microcontrollers with Arduino. Based on the two definitions stated above, it can be concluded that Arduino is an electronic kit or electronic circuit board which contains the main components, namely a microcontroller chip with the AVR type from the Atmel company and open source licensed programming software **[3]**.

RTC (Real Time Clock) is a module that functions as a time counter designed using electronic components in the form of chips that are capable of performing work processes like clocks in general, such as calculating seconds, minutes, and hours. These calculations are calculated accurately and stored in real time. This RTC chip will later be integrated with a controller by performing certain work functions **[4]**.

Servo motor is a driving tool that is usually used to move something. A servo motor consists of a motor, gearbox, potentiometer and control circuit. A potentiometer is used to set the

servo rotation angle limit. Servo motors can only move up to a certain angle **[5]** Based on the analysis of previous research, there are several gaps that can be filled through this research, including; Implementation of RTC module with servo motor to improve the accuracy of feeding schedule and precise feed quantity regulation.

Application of Arduino as a low-power and user-friendly microcontroller in programming for automatic feeding systems. The implementation of this system is specifically for ornamental fish ponds, which require stricter regulation of the frequency and dosage of feeding compared to fish ponds for consumption.

By overcoming these shortcomings, this research is expected to be able to create an automatic fish feeding device that is more reliable, energy efficient, and meets the needs of ornamental fish ponds.

Despite the importance of automation in fish feeding, there is still a research gap on the development of an automatic fish feeding system using Arduino, RTC, and servo motor. This study aims to fill this research gap by designing and developing an automatic fish feeding system using Arduino, RTC, and servo motor for ornamental fish ponds.

2. Method

The method used in this study is the quantitative experimental method. The quantitative experimental method is an experiment or trial that is planned, carried out systematically, and strictly controlled, such as functional design and factorial design [6].

A research process in which a researcher uses scientific methods to systematically collect data for analysis. The following flowchart of data collection techniques can be seen in Figure 1.

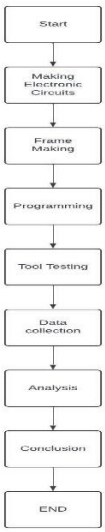

Figure 1. Research Flow Chart

The block diagram functions to show the components that are system input, system controllers, and components that are system output. The tools and materials used are generally designed as in **Figure 2**.

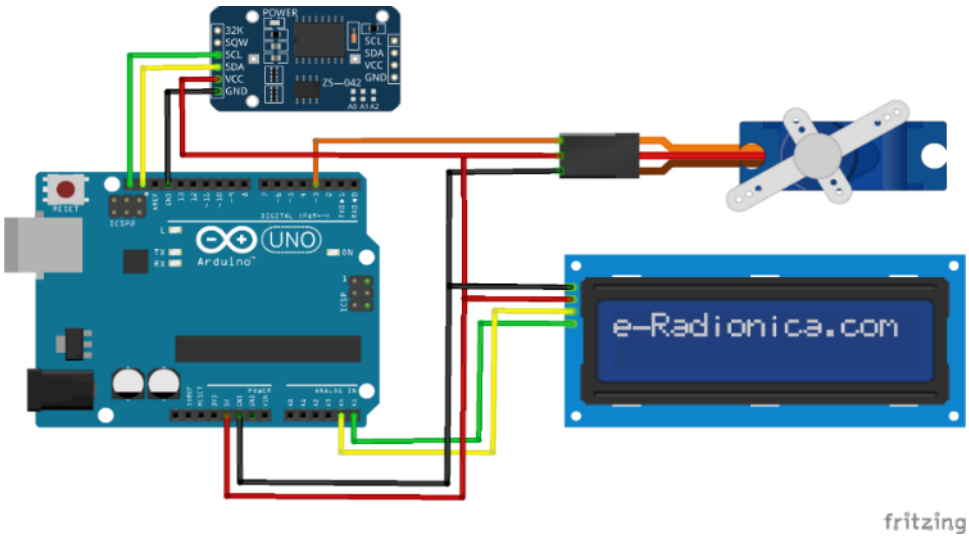

Figure 2. Form of Tool Series

This study aims to design and evaluate an Arduino-based automatic fish feeder with an RTC module and servo motor in an ornamental fish pond. To gain a comprehensive understanding of the needs and implementation of this tool, field analysis and observation were conducted involving several key stages.

1. Needs Analysis

The initial step in this study was to conduct a needs analysis to understand the challenges faced by ornamental fish owners in terms of manual feeding. Data were collected through in-depth interviews with ornamental fish pond owners, aquascape experts, and ornamental fish enthusiasts. These interviews aimed to identify feeding patterns, desired frequencies, and common problems, such as inconsistent feeding due to the owner's busyness or unavailability

The main findings of this analysis indicate that users need a system that can provide feed regularly at a predetermined time, with easy control and minimal maintenance. In addition, the system must be able to operate independently and reliably, even when the owner is away from the site for a long time.

2. Field Observation

Field observations were conducted to understand the real conditions in which the device will be used. Observations were conducted in several ornamental fish ponds with varying sizes,

types of fish, and their surrounding environments. The focus of these observations was to understand how the feeding system would interact with the pond environment, including device placement, feed distribution, and potential obstacles that may arise, such as disturbances from weather or other animals.

3. Prototype Testing

After analysis and observation, a prototype of an automatic fish feeder was developed and tested in the field. The test was conducted in an ornamental fish pond owned by respondents who had participated in previous interviews. During the testing period, qualitative data were collected through direct observation of the device's performance, as well as feedback from users regarding the ease of use, reliability, and effectiveness of the system in maintaining fish diets. The test revealed that the device successfully provided feed regularly and on schedule. The servo motor functioned well in controlling feed distribution, while the RTC module ensured high time accuracy.

4. Control Analysis

The control analysis in this study shows that the Arduino-based automatic fish feeding system with RTC and servo motor can function reliably with precise control over time and motion. The use of RTC ensures accuracy in scheduling, while the servo motor provides precise control in the feeding mechanism. With adequate monitoring and feedback, this system provides an effective solution for automatic ornamental fish care, with the potential for further development to improve reliability and functionality. In testing the program, it is necessary to pay attention to errors that may occur at the coding stage and component circuits.

5. System Design

The design of an Arduino-based automatic fish feeding system with RTC and servo motor aims to create a practical solution that ensures ornamental fish receive food regularly and on time. With a modular design, this system can be adapted and upgraded according to user needs, providing a reliable and efficient tool in ornamental fish pond maintenance.

Data Flow Diagram can be seen in **Figure 3.**

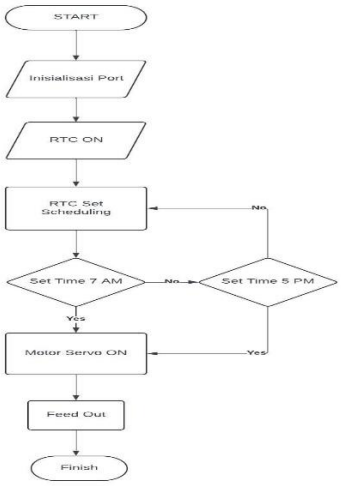

Figure 3. Data Flow Diagram

A graphical representation of the steps and procedures of a tool system design.

3. Results and Discussion

The development of an Arduino-based automatic fish feeder with RTC and servo motor for ornamental fish ponds has shown significant potential in overcoming the challenges of manual feeding. The device offers a practical solution for fish enthusiasts by automating the feeding process, ensuring timely and consistent feed distribution. Here, we analyze the main findings, compare them with previous studies, and highlight the implications and limitations of the developed device.

1. Tool Performance

This device successfully integrates an Arduino microcontroller, RTC module, and servo motor to automate the feeding process. The RTC module ensures punctuality in the feeding schedule, while the servo motor provides precise control over feed distribution. Testing in ornamental fish ponds showed that the device is able to distribute feed evenly throughout the pond, reducing feed waste, and ensuring all fish have access to feed.

2. Comparison with Previous Research

Previous research on automatic fish feeders has generally focused on small-scale aquariums or indoor tanks. While these devices are effective for confined environments, they often lack the capacity and adaptability needed for larger aquariums. However, few studies have explored advanced features such as IoT integration and control via mobile apps, which have not

been implemented in this design. Future iterations of the device may incorporate these technologies to enhance user convenience and remote monitoring capabilities.

Arduino-based automatic fish feeder with RTC and servo motor offers a reliable and efficient solution for ornamental fish ponds **[8]**. Although the device overcomes some limitations of existing designs, there is still room for improvement in terms of energy independence, feed type compatibility, and advanced monitoring features. Future research can focus on the integration of IoT technologies and renewable energy sources to make the device more versatile and user-friendly.

All these functions will work if all are assembled according to the scheme and tools that have been programmed through the Arduino IDE software and connected to the electric current so that all components or devices run their functions according to the program created **[9] [10]**.

3. Complete Tool Set

Assembly begins with creating a circuit design or electronic schematic of the hardware to be used. After all the designs are complete, the actual assembly of the device is carried out by racing against the schematic that has been made, thus saving time during assembly, avoiding the risk of short circuits in the electric current and minimizing errors in pin matching that make component readings inaccurate.

The entire Arduino Uno-based fish feed device circuit works automatically. This system uses an Arduino Uno microcontroller as the main control, its function is to manage input data from the RTC DS323 module. The power supply is obtained from the PLN current which is Alternating Current (AC) into the power supply/Adapter then converted into Direct Current (DC) then distributed to the components that need it. In the output section there is a servo that is directly connected to the fish feed device which functions to dispense fish feed/pellets while the LCD (Liquid Crystal Display) functions as a Display monitor for reading the day, date, year and temperature sent from the RTC DS3231**[11]**.

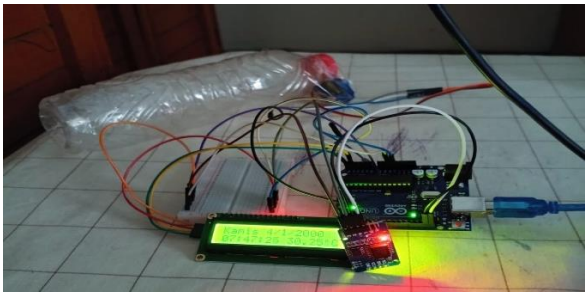

Figure 4. Circuit Results

For testing the RTC DS3231 Module tool operates based on a timer or schedule that has been set on the Arduino Uno microcontroller. This timer scheduling is then used to regulate feeding. During testing, the timer is set to provide feed twice a day, namely in the morning and evening.

Table 2. Scheduling Results from Fish Feeding Equipment

No	Scheduling Hours	Meal Time	Active Status
1	07.00 WIB	Morning	Active
2	17.00 WIB	afternoon	Active
3	07.00 WIB	Morning	Active
4	17.00 WIB	afternoon	Active
5	07.00 WIB	Morning	Active
6	17.00 WIB	afternoon	Active

4. Input Arduino

After the pins on each module are connected using jumper cables, then the input process into the Arduino UNO circuit as a whole uses the Arduino UNO software. The process of inputting program code to the Arduino microcontroller also requires a cable connector, namely a USB A to B cable.

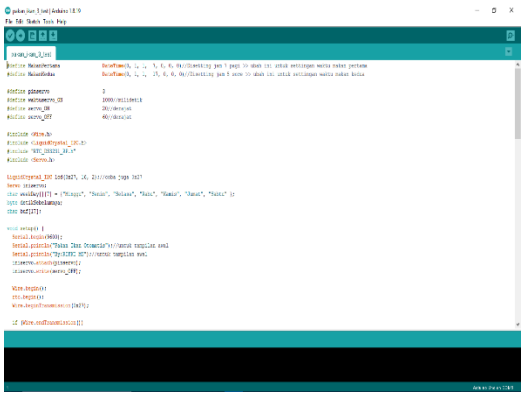

Figure 5. Source Code for Automatic Fish Feeder

In **Figure 5**, The Arduino code designed for this automatic fish feeder utilizes the RTC module for accurate timing and the servo motor for the feeding mechanism. Through this code, the system can work independently, providing fish feed regularly and on time without manual intervention from the user. This code can also be customized to the specific needs of the user, such as setting different feeding times or adjusting the servo opening angle according to the type of feed used. The implementation of this system shows the potential of using simple technology

for automation in ornamental fish maintenance, providing convenience and reliability in daily care.

4. Conclusion

Research on the Design of an Arduino-Based Automatic Fish Feeder with RTC and Servo Motor in Ornamental Fish Ponds has succeeded in creating an effective and efficient system in automating the process of feeding ornamental fish. This system is designed to answer the main problem often faced by ornamental fish owners, namely the need to provide feed regularly and on time without having to do it manually. By using an Arduino microcontroller, RTC (Real Time Clock) module, and servo motor, this system is able to carry out its tasks with a high level of accuracy and reliability.

The system is designed to provide feed automatically at a predetermined time, according to a programmed schedule. This ensures that the fish receive consistent feed, which is essential for maintaining fish health and growth. The use of the RTC module allows the system to maintain good time accuracy, so that feeding can be done on time every day. The RTC also ensures that the time keeps running because the data is stored in the battery. The servo motor used in this system can precisely control the opening of the feed container, ensuring that the amount of feed dispensed is as required.

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