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Automatic fish feeders for fish farming in aquariumsbased on the Internet of Things (IOT)

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ABSTRACT
In fish farming, there is a lot of time in feeding irregularly or many farmers who have many fish aquariums but have difficulty in feeding because of the inefficiency of very little time and resulting in many fish causing stress and some fish that die. This research presents an innovation that changes the way to care for fish in an aquarium. Using Internet of Things (IoT) technology and Arduino Uno, this automatic fish feeding system was created with a focus on energy efficiency and fish welfare. With an internet connection, farmers can control and monitor the feeders through an app. The system also optimizes the use of electrical energy and monitors the environmental conditions of the aquarium in real time. This research offers a stunning innovation, combining technology and sustainability to better care for fish.

KEYWORD Internet of Things, Fish Feeding Automatic, Fish Welfare

1. INTRODUCTION

In the rapidly evolving digital era, the Internet of Things (IoT) has become one of the technology trends that are changing the way we interact with the world around us. IoT is a concept that connects various physical devices, sensors, and computing systems through an internet network, enabling efficient data exchange and control. In recent years, IoT has been applied in various industries and sectors of life, including agriculture and animal care [1].

One important aspect of animal care, especially for pets, is timely and regular feeding. However, it is often difficult for pet owners to manually feed their pets when they are not at home, such as when they are working or traveling [2, 3]. This is where the development of IoTconnected automatic feeders is important. IoT-based automatic feeders are solutions that integrate IoT technology with automatic feeding devices. Using sensors and internet connectivity, these automatic feeders can be controlled and monitored remotely through connected devices such as smartphones or tablets. Pet owners can set feeding schedules, track food consumption, and even give feed directly through an app or platform connected to the automatic feeders [4, 5].

The main advantage of IoT-based automatic feeders is their flexibility and ease of use. Pet owners do not have to worry about strict feeding schedules, as the automatic feeders can be set to automatically feed according to predetermined times. In addition, pet owners can monitor their animals' food consumption and diet through the data collected by the automatic feeders, which can provide valuable insights into the animals' health and diet.

Despite the potential benefits, the implementation of IoT-based automatic feeders also faces several challenges. One of them is data security and privacy, as these automatic feeders are connected to the internet and vulnerable to cyber threats. In addition, network and connectivity limitations can affect the reliability and performance of the automatic feeders [6, 7]. In this paper, we will further discuss IoT-based automatic feeders, including the basic concepts of IoT, the need for using automatic feeders, and the challenges faced in their implementation. We will also describe the implementation of IoT-based automatic feeders and the evaluation results obtained [8]. It is hoped that this paper can provide insight into the potential use of IoT in pet care and guide the development of more efficient and connected automatic feeding solutions with the latest technology [5, 9].

2. METHOD

The stages of the research carried out. The research in this activity is as follows.

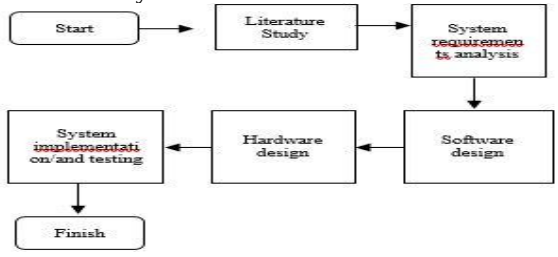

Figure 1. Research Framework

2.1. Literature Study

A literature study was conducted to gain an in-depth understanding of the factors affecting fish growth in aquariums and fish feed requirements in aquariums. Relevant literature on fish feed management and automatic control was also reviewed to support the system design on automatic fish feed [3, 10, 11]. Based on literature studies and knowledge about aquarium fish farming, a system needs analysis is carried out which includes selecting the right servo or Arduino Uno 2. Design the necessary hardware and design the software to control the discharge of fish feed [12, 13].

Software Design

The software is developed to connect the RTC DS3231 sensor with the microcontroller, and control fish feeding. The software program is designed with algorithms that are able to read how long and hours of feeding in real time with predetermined limits and make active and passive feeding decisions [14, 15].

Simulation of Pin Installation on Arduino Uno

- Connect the arduino 5v power pin, GND & I2C pins A4 (SDA), A5 (SCL) to the breadboard each one lane to make wiring easier.
- For servo motors, connect the vcc & gnd pins of the servo motor to the breadboard vcc to 5v & gnd to gnd in line with the arduino power pin, for the PWM pin can be connected to digital pin 9 on the arduino uno.
- For the DS3231 RTC, connect the vcc, gnd, SDA, & SCL pins of the RTC to the breadboard, for vcc to the 5v line, GND to the GND line, SDA to the A4 line, and SCL to the A5 line.
- For the 16x2 SPI l2C LCD, connect the LCD's vcc, gnd, SDA, & SCL pins to the breadboard, for vcc to the 5v line, GND to the GND line, SDA to the A4 line, and SCL to the A5 line.

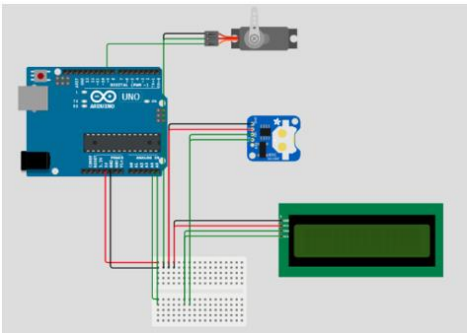

Figure 2. Microcontroller circuit

Writing Code Using Arduino Uno

For details of the program written as follows complete with per-block information:

auto_feed02.ino

```
#include <Wire.h>
#include <LiquidCrystal_I2C.h>
#include <Servo.h>
#include <RTClib.h>

RTC_DS3231 rtc;  // Inisialisasi objek RTC
LiquidCrystal_I2C lcd(0x27, 16, 2);  // Inisialisasi objek LCD dengan alamat I2C
Servo servo;  // Inisialisasi objek servo
int pos = 0;    // Variabel posisi servo
const int servoPin = 9;  // Pin kontrol servo

void setup() {
  lcd.begin(16, 2);  // Inisialisasi LCD
  lcd.backlight();
  lcd.setCursor(0, 0);
  servo.attach(servoPin);  // Menghubungkan servo ke pin kontrol
Serial.begin(9600);  // Inisialisasi komunikasi Serial
  lcd.print("Fish Feeder");  // Menampilkan judul di LCD
  delay(5000);
  lcd.clear();

  // Inisialisasi RTC
  if (!rtc.begin()) {
    lcd.begin(16, 2);  // Inisialisasi LCD
  lcd.backlight();
  lcd.setCursor(0, 0);
    lcd.print("RTC not found");
    while (1);
  }
```

auto_feed02.ino

```

  // Cek apakah RTC berjalan atau perlu diset
  if (!rtc.lostPower()) {
    lcd.begin(16, 2);  // Inisialisasi LCD
  lcd.backlight();
  lcd.setCursor(0, 0);
    lcd.print("RTC is not running!");
    // Uncomment baris di bawah untuk mengatur waktu RTC jika belum diatur
  //rtc.adjust(DateTime(F(__DATE__), F(__TIME__)));

  //Serial.println("RTC reset to current time");
  }
 }

 void loop() {
   DateTime now = rtc.now();  // Mendapatkan waktu saat ini dari RTC
 lcd.begin(16, 2);  // Inisialisasi LCD
  lcd.backlight();
  lcd.setCursor(0, 0);
  lcd.print("Time: ");
  printDigits(now.hour());  // Tampilkan jam
  lcd.print(":");
  printDigits(now.minute());  // Tampilkan menit
  lcd.print(":");
  printDigits(now.second());  // Tampilkan detik


```

auto_feed02.ino

```
  // Jadwal pemberian pakan
  int feedingHour1 = 8;   // Jam pemberian pakan pertama
  int feedingMinute1 = 0;  // Menit pemberian pakan pertama

  int feedingHour2 = 13;   // Jam pemberian pakan kedua
  int feedingMinute2 = 0;  // Menit pemberian pakan kedua

  int feedingHour3 = 18;   // Jam pemberian pakan ketiga
  int feedingMinute3 = 0;  // Menit pemberian pakan ketiga

  // Memeriksa waktu saat ini dengan jadwal pemberian pakan
  if (now.hour() == feedingHour1 && now.minute() == feedingMinute1) {
    feedFish();  // Memanggil fungsi pemberian pakan
  }
  else if (now.hour() == feedingHour2 && now.minute() == feedingMinute2) {
    feedFish();  // Memanggil fungsi pemberian pakan
  }
  else if (now.hour() == feedingHour3 && now.minute() == feedingMinute3) {
    feedFish();  // Memanggil fungsi pemberian pakan
  }

  // Kode lain yang ingin Anda tambahkan di loop()
}
```

auto_feed02.ino

```
  }

  // Kode lain yang ingin Anda tambahkan di loop()
}
void printDigits(int digits) {
  // Fungsi untuk menampilkan angka dengan dua digit
  if (digits < 10) {
    lcd.print("0");
  }
  lcd.print(digits);
}
void feedFish() {
  lcd.setCursor(0, 0);
  lcd.begin(16, 2);  // Inisialisasi LCD
  lcd.backlight();
  lcd.print("Feeding...");

  for (pos = 90; pos <= 160; pos += 3) {
    servo.write(pos);              // Menulis posisi ke servo
    delay(45);                       // Delay untuk perubahan posisi
  }
  servo.write(90);  // Mengembalikan servo ke posisi awal

  lcd.clear();
  lcd.print("Feeding Done");
  delay(2000);
  lcd.clear();
}

```

Figure 3. Arduino IDE coding

Compiling Process and Program Upload Using Arduino IDE

The process of compiling the program that has been made using the Arduino IDE for ease of execution into the hardware that has been prepared.

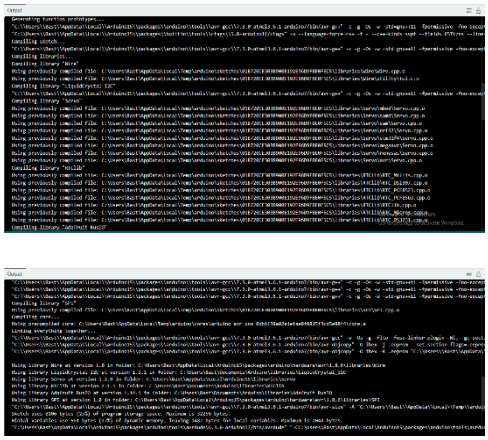

Figure 3. Compiling Arduino IDE

3. RESULT AND DISCUSSION

The results showed that the fish feed control system with automatic servo activation functions properly. Fish feed can come out well and on the LCD screen can display in realtime in the information that has been given feed accurately and automatically based on the time that has been set on the system automatically controls feeding. In this condition, fish feed can be released according to the hourly schedule and can provide convenience and time efficiency as well as saving energy spent. This helps prevent stress in starving fish, otherwise if fish feed is fulfilled on time and can avoid fish stress.

In the discussion, the research results are compared with relevant literature studies. The use of an automatic fish feed control system with automatic feed clock settings can help feed according to the growth of fish in the aquarium, and optimize productivity and reduce the risk of death due to fish that are not in accordance with feeding.

A. System Implementation and Testing

After the hardware and software design is complete. The system is implemented in its proper state by installing the monitoring board box in the aquarium section. The system is then tested to ensure that it is running accurately and the control of fish feed is in accordance with the release of fish feed according to what is set and will be displayed on the LCD that has been provided for monitoring materials.

Figure 4. System running

1) Installation of Feeders in the Aquarium

This ornamental fish feeder is placed on the side of the aquarium so that the beauty of the fish in the aquarium remains visible. The following is a display of the Arduino-based ornamental fish feeder.

2) Power Testing

This test is carried out to find out whether all connected components can receive a voltage source properly and avoid bad or disconnected wiring so that there is no one component that does not turn on due to not supplied with a voltage source. Because all components take power from the microcontroller, power supply testing is enough to connect the microcontroller to a voltage source such as an adapter, power bank, or laptop. Here the author uses a laptop It can be seen that the system is on, meaning that the power supply is working on the device.

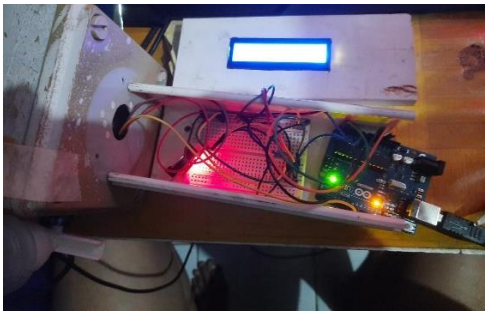

Figure 5. Power On

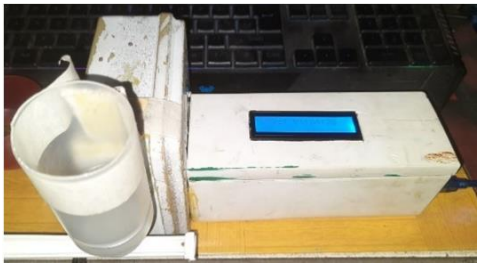

Figure 6. Power Off

3) Feeding Scheduling Testing

This testing was conducted with the aim of determining whether the program being executed is appropriate and the sequence is running normally. The testing was done by observing each fish feeding time, with feedings taking place three times a day. The results of the testing can be seen in the following table:

Table 1. Testing Result

NO	SCHEDULING HOURS	FOOD SCHEDULE	SERVO MOTOR
1	08:00	Morning	Moving
2	13:00	Noon	Moving
3	18:00	Evening	Moving

4. CONCLUSION

After various tests and analysis of the design of Fish Feeders in Aquariums Automatically, both hardware and software, several conclusions can be drawn as follows : The system that simplifies human work in giving fish feed in the Aquarium Automatically Based on Arduino Uno Microcontroller has four parts, namely the power supply, minimum system, Arduino Uno circuit and program. The power supply functions as a voltage supplier. The minimum system is an electronic circuit that functions as a data processor with the Arduino Uno microcontroller as the control center. Servo circuit which functions to regulate fish feeding. And a program that functions to regulate the microcontroller so that the tool can work according to the features offered. For the work of the Arduino Uno Microcontroller - Based Automatic Fish Feeding Tool in Aquarium has shown results in accordance with the plan, namely the tool can provide fish feed automatically at a predetermined time.

5. REFERENCES

[1] A. Alatram, L. F. Sikos, M. Johnstone, P. Szewczyk, and J. J. Kang, "DoS/DDoS-MQTT-IoT: A dataset for evaluating intrusions in IoT networks using the MQTT protocol," Computer Networks, vol. 231, p. 109809, 2023/07/01/ 2023, doi: https://doi.org/10.1016/j.comnet.2023.109809.

[2] A. Gerodimos, L. Maglaras, M. A. Ferrag, N. Ayres, and I. Kantzavelou, "IoT: Communication protocols and security threats," Internet of Things and Cyber-Physical Systems, vol. 3, pp. 1-13, 2023, doi: 10.1016/j.iotcps.2022.12.003.

[3] A. K. Gupta and R. Johari, "IOT based Electrical Device Surveillance and Control System," in 2019 4th International Conference on Internet of Things: Smart Innovation and Usages (IoT-SIU), 18-19 April 2019 2019, pp. 1-5, doi: 10.1109/IoT-SIU.2019.8777342.

[4] K. F. Kantelis et al., "Graph theory-based simulation tools for protein structure networks," Simulation Modelling Practice and Theory, vol. 121, p. 102640, 2022/12/01/ 2022, doi: https://doi.org/10.1016/j.simpat.2022.102640.

[5] T. Hidayat and R. Mahardiko, "A review of detection of pest problem in rice farming by using blockchain and IoT technologies," Journal of Computer Networks, Architecture and High Performance Computing, vol. 3, no. 1, pp. 89-96, 2021.

[6] V. S. A. A. A. Don, S. W. Loke, and A. Zaslavsky, "IoT-Aided Charity: An Excess Food Redistribution Framework," in 2018 3rd International Conference On Internet of Things: Smart Innovation and Usages (IoT-SIU), 23-24 Feb. 2018 2018, pp. 1-6, doi: 10.1109/IoT-SIU.2018.8519856.

[7] W.-q. Zou, Q.-k. Pan, L.-l. Meng, H.-y. Sang, Y.-y. Han, and J.-q. Li, "An effective self-adaptive iterated greedy algorithm for a multi-AGVs scheduling problem with charging and maintenance," Expert Systems with Applications, vol. 216, p. 119512, 2023/04/15/ 2023, doi: https://doi.org/10.1016/j.eswa.2023.119512.

[8] T. Hidayat and R. Mahardiko, "Validation of Information Technology Value Model for Petroleum Industry," in 2020 3rd International Seminar on Research of Information Technology and Intelligent Systems (ISRITI), 10-11 Dec. 2020 2020, pp. 615-620, doi: 10.1109/ISRITI51436.2020.9315382.

[9] V. R. Kebande, P. P. Mudau, R. A. Ikuesan, H. S. Venter, and K.-K. R. Choo, "Holistic digital forensic readiness framework for IoT-enabled organizations," Forensic Science International: Reports, vol. 2, 2020, doi: 10.1016/j.fsir.2020.100117.

[10] C. Sharma and N. K. Gondhi, "Communication Protocol Stack for Constrained IoT Systems," in 2018 3rd International Conference On Internet of Things: Smart Innovation and Usages (IoT-SIU), 23-24 Feb. 2018 2018, pp. 1-6, doi: 10.1109/IoT-SIU.2018.8519904.

[11] W. Liu, "Smart sensors, sensing mechanisms and platforms of sustainable smart agriculture realized through the big data analysis," Cluster Computing, pp. 1-15, 2021.

[12] P. Sanju, "Enhancing Intrusion Detection in IoT Systems: A Hybrid Metaheuristics-Deep Learning Approach with Ensemble of Recurrent Neural Networks," Journal of Engineering Research, p. 100122, 2023/06/19/ 2023, doi: https://doi.org/10.1016/j.jer.2023.100122.

[13] T. Hidayat, R. Mahardiko, and F. D. S. Tigor, "Method of Systematic Literature Review for Internet of Things in ZigBee Smart Agriculture," in 2020 8th International Conference on Information and Communication Technology (ICoICT), 24-26 June 2020 2020, pp. 1-4, doi: 10.1109/ICoICT49345.2020.9166195.

[14] E. P. Yadav, E. A. Mittal, and H. Yadav, "IoT: Challenges and Issues in Indian Perspective," in 2018 3rd International Conference On Internet of Things: Smart Innovation and Usages (IoT-SIU), 23-24 Feb. 2018 2018, pp. 1-5, doi: 10.1109/IoT-SIU.2018.8519869.

[15] J. Shen, C. Xu, and Y. Ying, "Construction of intelligent supply chain system of agricultural products based on big data," Acta Agriculturae Scandinavica, Section B—Soil & Plant Science, vol. 72, no. 1, pp. 375-385, 2022.