Journal Corner of Education, Linguistics, and Literature
Vol. 4 No. 001 (December, 2024), pp. 503-514
https://doi.org/10.54012/jcell.v4i001.426

Automatic Fish Feed Design and IoT Based Monitoring Using NodeMCU ESP8266 Microcontroller

Muhammad Ali Sobri[1]✉, Salman Topiq[2]
[1 2]Universitas Adhirajasa Reswara Sanjaya, Indonesia
✉ email: muhamadali.ma0822@gmail.com

Received: December 11, 2024
Revised: December 17, 2024
Accepted: December 22, 2024
Published: December 30, 2024

ABSTRACT

Fish farming in Pasaman Regency is growing rapidly, but still faces the challenge of uncontrolled feeding, which increases production costs and reduces water quality. This study develops an IoT-based automatic feeding system with NodeMCU ESP8266 to precisely set the schedule and amount of feeding, monitor water conditions in real-time, and enable remote control via smartphone. As a result, this system increases efficiency, reduces operational costs, and supports the sustainability of fish farming, so it is expected to be a model for the development of aquaculture in Indonesia. Aquaculture plays a significant role in food production, and efficient fish feeding is essential for optimal growth and resource management. Traditional feeding methods often lead to overfeeding, underfeeding, and inconsistent feeding schedules, affecting fish health and increasing operational costs. This study proposes the design and implementation of an automatic fish feeder integrated with an IoT-based monitoring system using the NodeMCU ESP8266 microcontroller. The system enables precise control over feeding times and portions, reducing feed waste and ensuring better fish nutrition. Real-time monitoring is achieved through IoT connectivity, allowing users to track feeding activities and environmental conditions remotely via a mobile application or web interface. The research focuses on system design, hardware development, software implementation, and performance evaluation. The results demonstrate the system's effectiveness in optimizing fish feeding, enhancing aquaculture efficiency, and providing a user-friendly monitoring solution. This innovation contributes to smart aquaculture practices, promoting sustainability and cost-effective fish farming.

Keywords: *Fish Feed Design; IoT; NodeMCU ESP8266; Microcontroller*

INTRODUCTION

Fish farming is the management of fish in a controlled environment for food and commercial production. In Indonesia, the sector is growing rapidly, especially in areas such as Pasaman Regency, thanks to government support and community participation. Through the selection of superior fish seeds, water quality management, and proper feeding, fish farming contributes to local economic growth, job creation, and sustainable food security (Mashur et al., 2020).

Uncontrolled feeding can be a challenge in fish farming. Besides increasing production costs, it can also lead to a decline in water quality, which affects fish health. Farmers often face time constraints and must handle multiple tasks simultaneously, increasing the risk of feeding errors. As a result, fish quality decreases, affecting harvest outcomes and reducing overall profit potential (Fernanda, 2022).

IoT-based automated feeding systems can be a solution to ensure fish receive feed on time and in the correct amounts. This technology allows for efficient regulation of feeding schedules and quantities, even remotely, thereby maintaining water quality and supporting optimal fish growth (Abu-Khadrah et al., 2022).

This research focuses on the design of an automatic fish feeding and monitoring system based on the Internet of Things (IoT). The objective is to improve the organization and efficiency of fish feeding by utilizing IoT technology with NodeMCU ESP8266 as a microcontroller. This device enables data collection and transmission via a Wi-Fi network, automatically providing real-time information on feeding schedules, feed levels, water temperature, time, and date, while allowing for remote monitoring and control.

Aquaculture is a rapidly growing industry that plays a vital role in meeting global food demands. One of the most critical aspects of fish farming is feeding management, which directly affects fish growth, health, and overall productivity. Traditional manual feeding methods are often inefficient, leading to problems such as overfeeding, underfeeding, and feed wastage. These issues not only increase operational costs but also contribute to water pollution and disrupt the aquatic ecosystem.

With technological advancements, the integration of automation and IoT in aquaculture presents an innovative solution to enhance feeding efficiency. An automatic fish feeder equipped with IoT-based monitoring can optimize feeding schedules, minimize waste, and provide real-time monitoring through a mobile or web application. The NodeMCU ESP8266 microcontroller is a cost-effective and reliable platform that enables remote control and automation of feeding operations, making fish farming more sustainable and productive.

Monitoring is the process of observing and controlling a system to ensure that every component functions properly. In automated systems, such as automatic fish feeders, monitoring is used to oversee feeding schedules, feed portion sizes, and the surrounding environmental conditions (Safitri et al., 2022).

Aquaculture plays a crucial role in global food production by providing a sustainable source of protein. One of the key challenges in fish farming is managing feeding schedules efficiently. Traditional manual feeding methods often result in overfeeding, underfeeding, and feed wastage, which can negatively impact fish health, increase operational costs, and degrade water quality. Ensuring an optimal feeding process is essential for maximizing fish growth, maintaining water conditions, and improving overall productivity.

With technological advancements, automation and IoT offer innovative solutions to improve feeding efficiency in aquaculture. An automatic fish feeder integrated with IoT-based monitoring allows precise control over feeding times and portion sizes, reducing waste and ensuring a balanced diet for the fish. The NodeMCU ESP8266 microcontroller is a cost-effective and reliable platform for automating the fish feeding process while enabling remote monitoring via a mobile or web application. This technology provides real-time data on feeding activities and water conditions, helping fish farmers optimize their operations efficiently.

The Internet of Things (IoT) is a network that enables devices to connect with humans or other devices via the internet to share data and information. In this process, ensuring data security during transmission is crucial (Rofii et al., 2021). The technology embedded in these devices allows IoT to adapt to both internal conditions and the surrounding environment, supporting decision-making processes. IoT connects devices to the internet, allowing them to communicate with each other and share data related to usage and environmental conditions (Febrianti et al., 2021).

NodeMCU is an open-source IoT platform that includes hardware based on the ESP8266 system from Espressif Systems and uses Lua scripting language as its firmware. The term NodeMCU typically refers to the firmware rather than the hardware development kit. However, it can also refer to Arduino-based ESP8266 boards. In addition to Lua, NodeMCU supports Arduino IDE with some adjustments, including adding a custom URL to download the NodeMCU board in the board manager (Hendriawan et al., 2023).

NodeMCU is also an open-source IoT platform that utilizes the ESP8266 system from Espressif Systems and the Lua scripting language as its firmware. The term NodeMCU generally refers to the firmware, although it can also mean Arduino-based ESP8266 boards. In addition to Lua, NodeMCU supports Arduino IDE with some modifications, including adding a custom URL to download the NodeMCU board (Ibrahim & Setiyadi, 2021).

METHODS

The research stages carried out in this study are as follows:

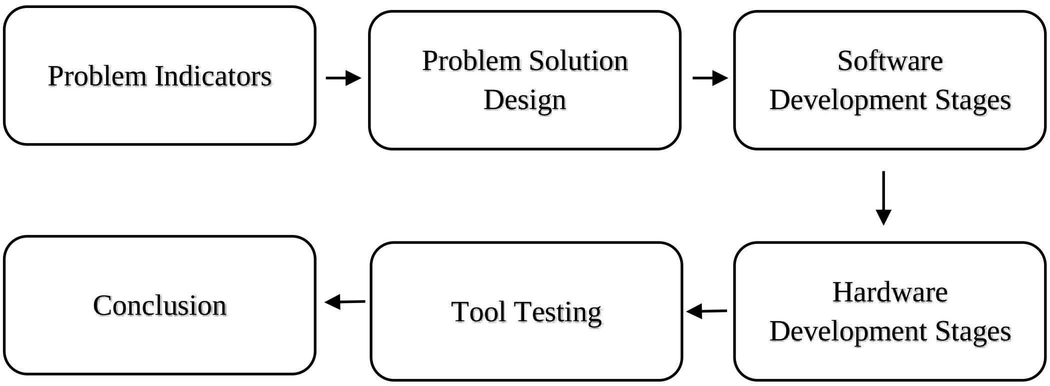

Figure 1. Research Framework

Below is a brief description of each process:

Problem Indicators – This stage identifies the issues or challenges that need to be addressed. It involves analyzing the current conditions and determining key problem areas. Problem Solution Design – Based on the identified problems, a suitable solution is designed. This phase includes conceptualizing and planning the system's architecture, both in terms of hardware and software. Software Development Stages – This step involves coding, programming, and implementing the software components required for the system. It ensures that the software meets functional and performance requirements.

Hardware Development Stages – In parallel with software development, this phase focuses on designing and constructing the necessary hardware components. It ensures compatibility with the software for seamless integration. Tool Testing – After both hardware and software components are developed, testing is conducted to verify that the system functions as intended. This includes debugging, troubleshooting, and performance evaluation. The last, conclusion – The final stage involves drawing conclusions based on testing results. If successful, the system is ready for implementation; if not, refinements are made before deployment.

FINDINGS AND DISCUSSION

1.1. Tool Scheme

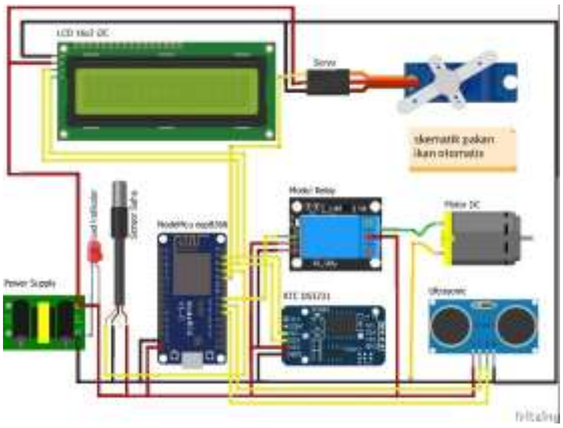

Figure 2. Tool Schematic

Table 1. Digital Pin Address

Module Pins	Digital Pin	Power	
SCL LCD&RTC	GPIO O4 (D2)	5V	Gnd
SDA LCD&RTC	GPIO O5 (D1)	5V	Gnd
TRIG	GPIO12 (D6)	5V	Gnd
ECHO	GPIO13 (D7)	5V	Gnd
Sensor Data	GPIO0 (D3)	5V	Gnd
Servo	GPIO2 (D4)	5V	Gnd
In Relay	GPIO14 (D5)	5V	Gnd

1. The 12V power supply which is stepped down to 5V is used to power the NodeMcu esp8266, Relay module, and LCD16x2, RTC ds3231, Ultrasonic, temperature sensor.
2. The esp8266 MCU node can be connected to the internet so that it can process input or output results that can be displayed on a 16x2 LCD screen and Blynk.
3. The SSID in the coding must match the name of the available WiFi so that the ESP8266 can connect to the Internet.
4. With connected to the internet, esp8266 can have a connection to the Blynk server
5. RTC DS 3231 Real-Time Clock module that functions to track time accurately, even when the main device is turned off or loses power.
6. Ultrasonic is used For measures the level of available pellets based on the travel time of ultrasonic waves.
7. Temperature Sensor used to measure the water temperature conditions in the pool

8. The measurement results of the RTC, Ultrasonic, and Temperature Sensors are sent via the esp8266 to the 16x2 LCD and Blynk.
9. The servo motor is used to open the tap on the pellet tube.

10. Relay is used For turn on the DC motor to launch the pellets according to the conditions specified on the esp8266.

1.2. Software design

Table 2. Digital Pin Functions

Digital Pin	Pin Name	Function
GPIO5 (D1)	SCL	As a data sender
GPIO4 (D2)	Natural Resources	As a clock signal sender
GPIO14 (D5)	motorPin	To turn on the DC motor
GPIO2 (D4)	servo motor	To open the pellet tap
GPIO12 (D6)	trigPin	To give a high pulse signal
GPIO13 (D7)	echoPin	To receive reflected ultrasonic waves/pulses
GPIO0 (D3)	OneWire	To provide temperature values

Table 3. Datastream

Virtual Pin	Pin name	Data Type
V1	Manual feed	Integer
V2	Temperature	Double
V3	Pellet Level	Integer

Datastream in Blynk is a critical component that manages data transfer between devices and Blynk.Cloud. Its main function is to provide a communication path to send and receive data, such as sensor information, telemetry, or actuator status from your IoT devices. Datastream settings can be done through Blynk.Console by specifying data types, minimum and maximum value ranges, units (e.g. °C or %), and other metrics to process data more efficiently.

Figure 3. Arduino Ide code

Figure 4. Arduino Ide code

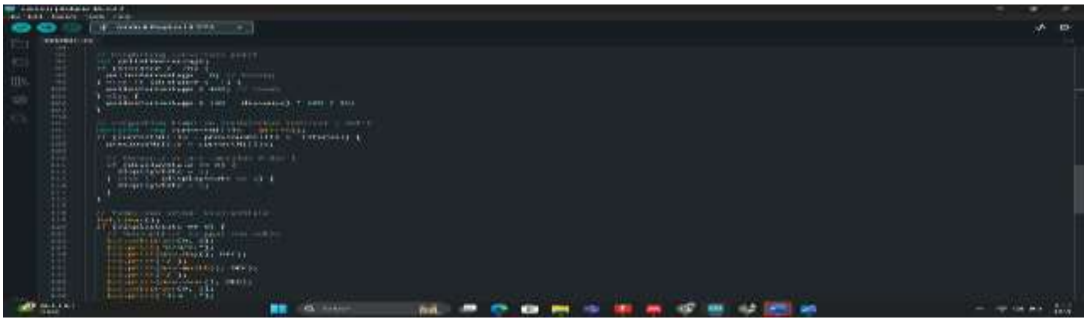

Figure 5. Arduino Ide code

1.3. How the Tool Works

The way the tool works is divided into 2 modes, automatic and manual , with an LCD that displays the command being executed. The DS3231 RTC is used to track time accurately, even when the main device is off or loses power. At 6:00 AM and 5:00 PM, the device will operate for 5 seconds or according to the specified time.

Figure 6. Normal tool condition

The servo motor will open the pellet tube cover for 5 seconds, then the DC motor will throw the pellets forward so that the pellets are distributed more evenly.

Figure 7. Condition of the tool ON

During the feeding process, the LCD will display the message "Feeding..." and " Wait a moment ... " . After the feeding is complete, the LCD will display the message " Feeding complete".

Figure 8. LCD display when the tool is ON

Ultrasonic sensor is used as an indicator of pellet level in the tube, with a value of $i \leq 20$. The calculation is as follows:
Formula: Percentage = 100 − (i/20×100)
Example :
Percentage = 100 − (0/20×100)=100 − 0=100% Percentage = 100 − (20/20×100)=100 − 100=0%
With LCD display "Pellet : i% ".

Figure 9. Pellet level display on LCD

The ds18b20 temperature sensor monitors the water temperature in the automatic feeder with a range of -55°C to +125°C and an accuracy of ±0.5°C. The LCD displays "Temperature: i C". With its waterproof version, it is suitable for fish ponds, maintaining the optimum water temperature for fish health.

Figure 10. Temperature sensor display on LCD

When the Manual Switch on Blynk is activated (ON), the device will operate for 5 seconds or according to the specified time. Automatic mode will disabled while the Manual Switch is in the ON position, and will return to automatic mode when the Manual Switch is turned OFF.

Figure 11. Switch view on blynk

1.4. Installation and Testing of Equipment

For the installation of the tool, namely above the aquarium. Connect Power supply 12V to AC 220V electricity. Make sure the device is on and the red indicator LED is on. Make sure the Wifi is connected to the device/device and the LCD displays the Status "Initialization...". When the Wi-Fi is connected, it will display the sensor Status, pellet level, date, and time.

Figure 15. Tool Installation

Connect the DS18B20 temperature sensor connector to the NodeMCU shield, then insert the sensor into the water. Connect the ultrasonic sensor connector to the pellet tube to measure the pellet level in the tube.

Figure 16. Installation of Temperature and Ultrasonic Sensors

Connect the Servo motor connector to the NodeMCU shield, connect the DC motor to the connector on the right, then calibrate the number of pellets that come out and the distance of the pellets spread thrown by the DC motor.

The Blynk dashboard display will be Online when the device has been successfully installed and connected to the Internet. The Temperature and Pellet Level widgets will display the same temperature and percentage as displayed on the LCD on the device.

Figure 18. Blynk Dashboard View

Table 4. Feeding data for 1 week

No	Temperature	Pellet level	Time	Date
1.	26.25C	100%	06.00	11/04/2024
2.	26.45C	98%	06.00	11/05/2024
3.	27.14C	96%	06.00	11/06/2024
4.	25.34C	94%	06.00	11/07/2024
5.	25.15C	92%	06.00	11/08/2024
6.	26.35C	90%	06.00	11/09/2024
7.	26.50C	88%	06.00	11/10/2024

Table 5. Temperature and level data for 1 week

No	Morning	Afternoon	Manual	Date
1.	06.00	17.00	12.03	11/04/2024
2.	06.00	17.00	12.15	11/05/2024
3.	06.00	17.00	12.18	11/06/2024
4.	06.00	17.00	12.04	11/07/2024
5.	06.00	17.00	12.24	11/08/2024
6.	06.00	17.00	12.09	11/09/2024
7.	06.00	17.00	1205	11/10/2024

CONCLUSION

This research has successfully developed an automatic fish feeding system and monitoring based on *the Internet of Things* (IoT) using NodeMCU ESP8266. This system ensures that feed is given on time and in the right amount, maintains water quality, and supports optimal fish growth. Uncontrolled feeding can increase production costs and reduce water quality and fish health . The use of NodeMCU ESP8266 allows real-time data collection and transmission via Wi-Fi, as well as real-time remote monitoring and control.

REFERENCES

Abu- Khadrah , A., Issa, G.F., Aslam, S., Shahzad, M., Ateeq, K., & Hussain, M. (2022). IoT Based Smart Fish-Feeder and Monitoring System. *2022 International*

Conference on Business Analytics for Technology and Security, ICBATS 2022 . https://doi.org/10.1109/ICBATS54253.2022.9759058

Febrianti, F., Wibowo, SA, & Vendyansyah, N. (2021). IMPLEMENTATION OF IoT (Internet Of Things) WATER QUALITY MONITORING AND ADMINISTRATION SYSTEM IN SMALL-SCALE CLEAN WATER MANAGEMENT. In *Jurnal Mahasiswa Teknik Informatika)* (Vol. 5, Issue 1).

Hendriawan, Subandi, Chandra, JC, & Ferdiansyah. (2023). PROTOTYPE OF WEB-BASED AUTOMATIC CHILI PLANT WATERING SYSTEM USING NODEMCU ESP8266 MICROCONTROLLER. *2nd National Seminar of Students of the Faculty of Information Technology (SENAFTI)* , *2* (1).

Ibrahim, AM, & Setiyadi, D. (2021). PROTOTYPE OF REMOTE LIGHTING AND AIR CONDITIONING CONTROL WITH INTERNET NETWORK USING TELEGRAM APPLICATION BASED ON NODEMCU ESP8266. *Infotech: Journal of Technology Information* , *7* (1), 27–34. https://doi.org/10.37365/jti.v7i1.103

Mashur, D., Azhari, FM, & Zahira, P. (2020). *Community Empowerment Through Freshwater Fish Cultivation Development in Pasaman Regency* . *13* (1), 172–179.

Fernanda, R. (2022). *Design and Implementation of Feeding System* . *9* .

Rofii, A., Gunawan, S., & Mustaqim, A. (2021). DESIGN OF WAREHOUSE DOOR SECURITY SYSTEM BASED ON Internet of Things (IoT) AND FINGERPRINT SENSOR. *JOURNAL OF ELECTRICAL ENGINEERING STUDIES* , *6* (2).

Safitri, S., Sari, DM, Insani, CN, & Rachmini, SA (2022). IOT-Based Automatic Fish Feeder Control and Monitoring System. *Journal of Informatics Management, Information Systems and Computer Technology (JUMISTIK)* , *1* (1), 74–82. https://doi.org/10.70247/jumistik.v1i1.12