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Automatic Pet Feeder With Smart Monitoring using IoT

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Abstract: Nowadays, many people have pets, but because of busy daily schedules, they are not always able to feed their pets on time. Irregular feeding can create health problems for pets such as obesity, poor nutrition, and shortage of water. To solve this problem, we developed an IoT-based automatic pet feeding system that helps pet owners manage feeding in an easy way. This system ensures that pets receive food at the correct time and in the required quantity without manual effort. In our project, we used an ESP32 microcontroller with a Wi-Fi connection to control the entire feeding system. A motor and servo mechanism is used to dispense food automatically, while sensors are used to monitor the food and water levels. These sensors help the user know when refilling is required. A mobile application connected through the cloud allows pet owners to check the feeding status and control the system from anywhere. During testing, we observed that the system worked smoothly and delivered food accurately at scheduled times. The system also provided real-time updates through the mobile application. Overall, the system can be easily used at home and does not require high cost.

Keywords: Internet of Things (IoT), Automatic Pet Feeder, ESP32, Sensors, Smart Pet Care.

1. Introduction

Pets have become an important part of many families, providing companionship and emotional support. Over the past few years, pet ownership has increased, especially in cities and nearby towns. One of the most important responsibilities of a pet owner is to ensure proper feeding, as it directly affects the pet's health and growth. However, due to busy daily schedules, work pressure, and frequent travel, many owners are unable to maintain fixed feeding times for their pets. In most households, feeding is still done manually. This often results in irregular feeding times, which can lead to problems such as giving too much food or too little food. Over time, this may cause health issues like obesity, poor nutrition, dehydration, and digestion-related problems. Although automatic feeders are available in the market, many of them work only on simple timers and do not provide accurate portion control or real-time monitoring. In addition, most of these systems do not allow remote access, making them less effective for modern lifestyles.

With the development of Internet of Things (IoT) technology, many daily activities can now be automated. IoT systems use sensors, microcontrollers, and cloud platforms to collect data and perform actions automatically. These technologies are already being used successfully in areas such as smart homes, healthcare, agriculture, and industries. When applied to pet care, IoT helps in monitoring feeding activities, checking food and water levels, and controlling the system remotely, which improves both convenience and reliability. IoT-based pet feeding systems allow owners to set feeding schedules and monitor the system using mobile applications. Owners can also receive updates about food and water levels. However, many existing systems focus only on one or two features, such as scheduling or remote control, and do not provide a complete solution that includes accurate portion measurement and continuous monitoring. To solve these problems, this paper presents an IoT-based automatic pet feeding system that combines scheduled feeding, real-time monitoring, and accurate portion control.

The system uses an ESP32 microcontroller along with sensors and motor-based mechanisms to ensure proper food and water dispensing. The design is simple, low-cost, and suitable for use in smart home environments. A good pet feeding system should work reliably and be easy for owners to use. It should make sure that pets receive the correct amount of food and water at the right time, even when the owner is not at home. Sensors help in controlling the food quantity and reducing wastage, while cloud connectivity allows owners to receive real-time updates and alerts. Such systems support healthier feeding habits and reduce the daily burden on pet owners. Overall, the proposed system helps improve pet care by automating

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feeding tasks and reducing the need for constant human involvement. By combining smart sensors, cloud technology, and automated control, the system provides a practical solution for pet owners facing time constraints.

2. Literature Survey

Many smart pet care systems have been developed in recent years to make feeding easier for pet owners. With the help of IoT technology, feeding tasks can be automated and controlled remotely. This reduces manual effort and saves time for people who have busy schedules. Because of this, many researchers have worked on automatic pet feeders using microcontrollers, sensors, and cloud platforms.

Castillo-Arceo et al. developed a smart pet feeder that uses IoT along with deep learning methods to improve feeding accuracy by analyzing sensor data. Their system works well, but it requires complex hardware and higher cost. It also consumes more power, so it may not be suitable for normal home use. This paper discusses an IoT-based smart pet feeding system that uses deep learning techniques to improve feeding accuracy. Sensor data is processed to support intelligent decision-making. Although the system is technologically advanced, the use of deep learning increases processing complexity, cost, and power usage, which makes it less suitable for affordable household applications.

Kondapalli et al. designed an IoT-based feeder that can be controlled through a mobile app. They used NodeMCU, servo motors, relays, and a water pump to supply food and water. Although the system allows remote control, it does not measure the exact food quantity, which may affect the pet's health.

Koley et al. created a feeder that mainly focuses on scheduled feeding using timers and microcontrollers. Similarly, Castillo Rangel et al. also proposed a timer-based feeding system. These systems can feed pets at fixed times, but they lack proper sensors, so they cannot check the food level or adjust the quantity accurately.

Priya et al. introduced an ESP32-based pet feeding system that uses built-in Wi-Fi for cloud connectivity and real-time monitoring. The ESP32 makes the system faster and more flexible. Some researchers also added extra features like mobile control, voice commands, and cameras.

However, these features increase the system cost and make it more complicated. Other studies used Raspberry Pi for feeding and monitoring with live video streaming. While these systems provide good supervision, Raspberry Pi boards are expensive and consume more power, so they are not ideal for small and low-cost devices.

Aransiola et al. developed a microcontroller-based feeder that uses a load cell sensor and real-time clock to provide correct food portions at the right time. This helps prevent overfeeding. However, their system does not support internet connectivity or remote monitoring. From studying all these systems, we understood that most of them focus only on one or two features like scheduling or remote control. Very few systems provide all features together. So, in our project, we tried to combine portion control, real-time monitoring, cloud connectivity, and low-cost hardware into one complete solution.

Sharma et al. (IJMDES) this paper presents a Raspberry Pi-based IoT pet feeding and monitoring system with live video streaming. Raspberry Pi provides high processing capability but is expensive and power-intensive compared to microcontroller-based systems.

ESP32 Datasheet et al., (Espressif Systems) This paper research mainly provides technical specifications of the ESP32 microcontroller, including Wi-Fi capability, low power consumption, and processing features, justifying its selection for IoT-based applications.

Naik & Jenkins et al., this paper discusses IoT-based smart home automation, demonstrating how embedded systems and cloud connectivity can automate daily tasks. The concepts support the application of IoT in pet feeding systems.

Al-Fuqaha et al., this survey explains IoT enabling technologies, protocols, and applications, providing a strong theoretical foundation for IoT-based system design and communication models.

Banzi & Shiloh (Arduino Book), this book provides foundational knowledge on embedded system programming, sensors, and actuator control, which supports the development of microcontroller-based feeding systems.

Kevin Ashton, this article introduces the concept of the Internet of Things, explaining how interconnected devices can communicate and automate real-world processes, forming the base concept of the proposed system.

3. Proposed Methodology

In our project, we developed an IoT-based automatic pet feeding system that provides timely feeding, correct food quantity, and remote monitoring. The main aim of our system is to make pet care easier for owners who are busy or away from home. We used an ESP32 microcontroller as the main controller along with sensors to monitor food and water levels. A motor and servo are used to dispense food automatically. The system is connected to the internet through Wi-Fi so that users can monitor and control it using a mobile application. Unlike traditional timer-based feeders, our system not

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only feeds pets at fixed times but also checks the food quantity and provides real-time updates. This makes the system more accurate and reliable. Overall, our solution is simple, affordable, and suitable for everyday home use.

3.1. System Architecture

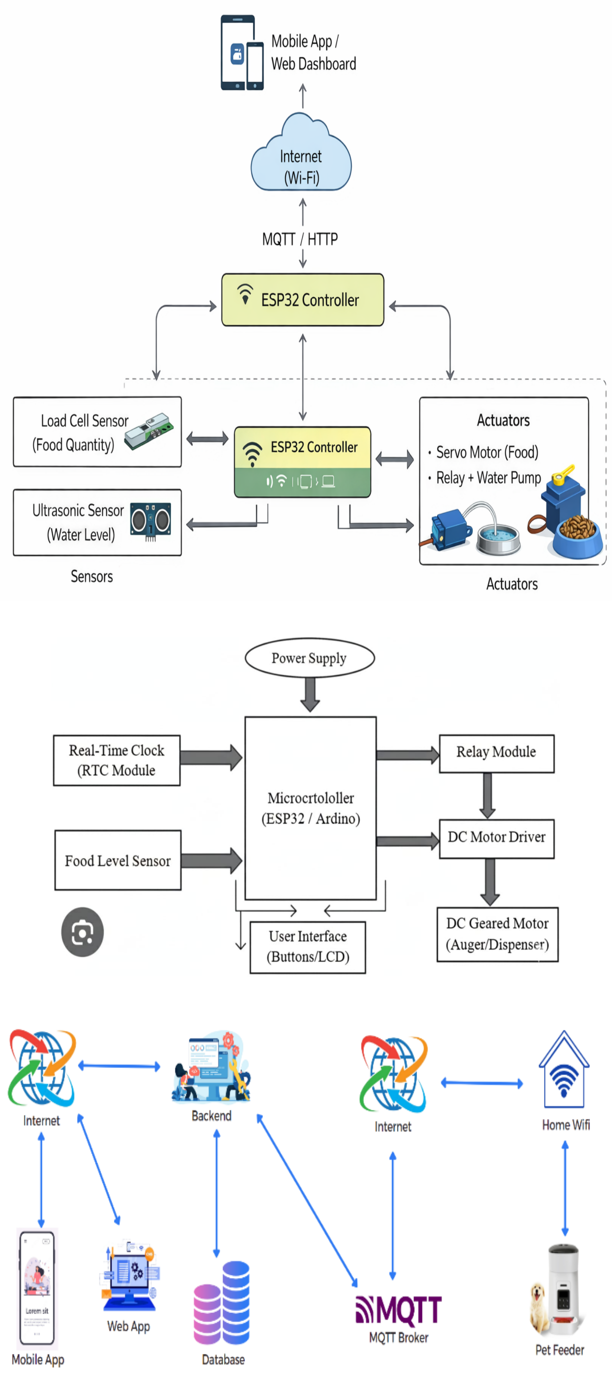

Figure. 1 System Architecture fo the proposed IoT based Automatic Pet Feeding System

3.2. Architecture Description

Sensing Layer: Includes the load cell sensor for food weight measurement and the ultrasonic sensor for water level detection.

Control Layer : The ESP32 microcontroller processes sensor data, executes feeding logic, and controls actuators.

Actuation Layer : A servo motor dispenses food, while a relay-controlled water pump manages water supply.

Communication Layer : Wi-Fi connectivity enables communication between the ESP32 and the cloud server using MQTT/HTTP protocols.

Application Layer : A mobile or web application allows users to monitor feeding status, configure schedules, and control dispensing remotely.

Architecture Flow : Sensors → ESP32 Controller → Actors → Cloud Server → Mobile Application.

3.3. Key Features of the Proposed System

- Automated scheduled feeding
- Accurate portion control using load cell sensor
- Real-time water level monitoring
- Remote monitoring and control via mobile application
- Cloud-based data storage and notifications
- Low-cost and scalable IoT design.

3.3.1. System Design

The system design of the proposed **IoT-Based Automatic Pet Feeding System** consists of two major components: **hardware design** and **software design**. Both components work together to ensure reliable automation, accurate portion control, real-time monitoring, and remote accessibility.

3.3.2. Hardware Design

The hardware components used in the proposed system include:

ESP32 Microcontroller: Provides Wi-Fi connectivity and acts as the central control unit.

Load Cell Sensor: Measures the weight of dispensed food to ensure portion control.

Ultrasonic Sensor: Detects water level in the bowl to prevent overflow or dryness.

Servo Motor: Controls the release of dry pet food from the container.

Relay Module and Water Pump: Dispenses water into the bowl when required.

Power Supply: Provides regulated power to all components.

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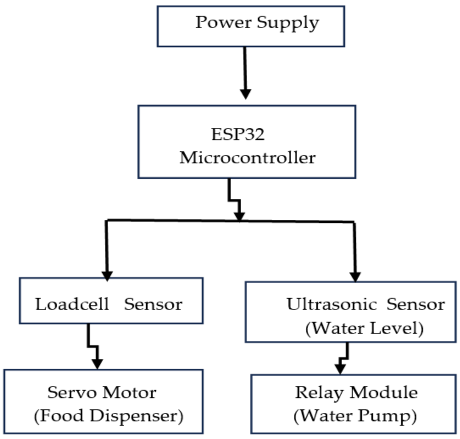
Hardware Block Diagram

The hardware block diagram of the proposed system is shown in Fig. 2. It illustrates the interconnection between the ESP32 microcontroller, sensors, actuators, and power supply.



Hardware block diagram of the proposed automatic pet feeder

3.3.3. Software Design

The firmware is developed using embedded C/C++ in the Arduino IDE. The ESP32 communicates with the cloud server using Wi-Fi protocols. The cloud platform handles data storage and enables communication between the hardware system and the mobile application. The mobile application allows users to: - Set feeding schedules - Manually trigger food or water dispensing - Monitor food quantity and water level - Receive notifications on feeding status.

3.3.4. System Modules

The proposed IoT-based automatic pet feeding system is divided into the following functional modules to ensure systematic operation, easy maintenance, and scalability.

Power Supply Module : Provides regulated DC power to all system components. Ensures stable and reliable operation of ESP32, sensors, and actuators

Sensing Module : Collects real-time data from the environment.

Load Cell Sensor: Measures the quantity of food dispensed to achieve accurate portion control

Ultrasonic Sensor: Detects the water level in the bowl to avoid overflow or dryness

Control Module: Implemented using the ESP32 microcontroller. Processes sensor inputs and executes decision logic. Coordinates all system operations

Food Dispensing Module : Uses a servo motor to control the food outlet. Dispenses food based on scheduled time and required quantity

Water Dispensing Module : Uses a relay module and water pump. Automatically refills water when the level is below a threshold.

IoT Communication Module: Enables Wi-Fi-based communication between ESP32 and cloud server. Transfers feeding status and sensor data in real time

User Interface Module: Provides interaction through a mobile or web application. Allows users to schedule feeding, monitor status, and manually control the system

Data Management Module: Stores feeding schedules and sensor data on the cloud. Supports data analysis and system monitoring.

3. Experimental Results and Discussions

The proposed IoT-based automatic pet feeding system was implemented and tested under various operating conditions to examine its performance, accuracy, and reliability. Several test cases were carried out by setting different feeding schedules through the mobile application and observing how the system responded during operation. The scheduling mechanism worked as expected and triggered food dispensing at the specified time intervals without requiring any manual input. The servo motor released food according to the required quantity, while the load cell sensor continuously measured the food weight. Once the desired weight was reached, the system automatically stopped dispensing, which helped maintain accurate portion control. The ultrasonic sensor effectively monitored the water level in the bowl throughout the testing process. Whenever the water level dropped below the defined limit, the relay-controlled water pump was automatically activated to refill the bowl. This ensured that water was always available for the pet without manual supervision.

Using the ESP32's IoT capabilities, the system supported real-time monitoring and remote control through the mobile application. Information such as feeding status, sensor values, and system updates was successfully sent to the cloud with very little delay. During testing, the system showed stable performance and operated with low power consumption. Overall, the experimental results confirm that the proposed system delivers accurate food dispensing, dependable automation, and efficient remote monitoring. These features make the system suitable for smart home pet-care applications and practical for everyday use by pet owners.

4. Conclusion

This paper described the design and development of an IoT-based automatic pet feeding system with smart monitoring features. The proposed system successfully overcomes the limitations of manual and basic timer-based

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feeding methods by combining scheduled feeding, sensor-based portion control, and IoT connectivity into a single solution. The use of the ESP32 microcontroller allows efficient data processing, wireless communication, and real-time interaction with a cloud-based mobile application. Accurate food portioning is achieved using a load cell sensor, while the ultrasonic sensor continuously monitors the water level and refills it automatically when required. The implemented scheduling mechanism ensures that pets are fed at the correct time without the need for human involvement, improving both pet health and owner convenience. Experimental testing shows that the system operates reliably, dispenses the required quantity of food accurately, and supports remote monitoring and control. The proposed system is economical, scalable, and energy-efficient, making it suitable for both household use and smart home environments. Overall, the system improves pet care by maintaining consistent feeding routines and significantly reducing the need for constant human supervision.

Future scope

- **Camera-Based Monitoring:**
  Integration of a camera module for real-time video monitoring of pets during feeding.
- **RFID-Based Pet Identification:**
  Implementation of RFID tags to identify individual pets and dispense customized food portions in multi-pet households.
- **Mobile Notifications and Alerts:**
  Enhanced notification features such as low food alerts, feeding confirmation messages, and system fault alerts.
- **Machine Learning Integration:**
  Use of machine learning algorithms to analyze feeding patterns and automatically adjust feeding schedules and portion sizes.
- **Voice Assistant Integration:**
  Integration with smart assistants such as Alexa or Google Assistant for voice-based control.

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Declaration

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