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Review IJESET

Automated Pest Feeder

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Abstract

Maintaining regular feeding regimens for pets can be a challenging task for many pet owners, especially in today's fast-paced and demanding lifestyle. To address this issue, this project introduces a smart pet feeder powered by the ESP8266 NodeMCU, a Wi-Fi-enabled microcontroller that facilitates Internet of Things (IoT) applications. The system allows pet owners to remotely manage and automate feeding schedules, ensuring timely and accurate meal delivery even in their absence. Key features include scheduled feeding, remote activation through a smartphone application, and precise portion control using a servo motor-driven dispensing mechanism. To enhance functionality, sensors, such as load cells, are used to measure the weight of dispensed food, while infrared sensors monitor food levels in the storage bin to avoid empty feedings. The entire system is integrated with a cloud-based platform, like Blynk or Firebase, which enables real-time data visualization, notifications, and remote control. This smart pet feeder not only enhances pet welfare by maintaining consistent feeding routines but also showcases the potential of embedded systems and real-time automation. The design is scalable and can be upgraded in the future with additional features, such as voice command support, camera-based pet monitoring, and AI-driven feeding schedule predictions, for smarter pet care management.

Keywords: IoT, Smart Pet Feeder, ESP8266, NodeMCU, Internet of Things (IoT)

INTRODUCTION

One of the biggest pleasures is having a pet at home. However, one of the primary issues with a pet's upkeep is consistent feeding. Each pet's eating and feeding habits need to be closely examined to raise a healthy pet. Pets' health is directly impacted when they are not fed on time. As a result, issues, like obesity and malnutrition, will be resolved by the suggested machine [1–5]. Since you only need to replenish it every few days, the convenience of this clever automatic pet feeder is by far its greatest advantage. Because they use timers that may dispense food multiple times a day to meet the pet's nutritional needs, this saves you both time and effort. Because the machine is Internet of Things (IoT) based, electronic automation and IoT help to make the user's experience considerably more individualized. To lower the chance of sickness, it can be used to track how much food is given to the pet at each meal. For pet owners who are often on the move and have unpredictable schedules, an automatic pet feeder is perfect since it can feed the animal according to a personalized schedule and makes it simpler to keep up a regular feeding plan. It is especially helpful for senior dog owners who find it difficult to reach down and fill their pet's food bowls every day.

Traditional methods may exacerbate physical and emotional pressures, which these appliances help to alleviate. When compared to other machines with more intricate designs, where cleaning can be difficult and the unit may require disassembly to

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adequately clean moving parts, the proposed design is simple to clean and maintain. Every year, the pet care industry and business expand, thus necessitating the development of new technology-based solutions [6–10].

RELATED WORK

One of the main unresolved issues with IoT automated systems is the integration of heterogeneous data from various devices and their ability to perform joint job execution. Interoperability seems to be the main objective in these systems by providing [1] a consistent way to access and conceal the heterogeneity of various home devices. Every pet owner has a unique lifestyle, so using this machine will differ from the conventional approach of owners feeding their dogs by hand because it will allow for more precise feeding at the times we designate and remote management, which the traditional method is unable to offer. Using a sensing tag on the collar, the smart pet door in [3] enables the pet owner to monitor their pet's movements. An automated system is constructed using an IP camera and a microcomputer to remotely control the car [11–15]. The microcomputer acts as an MQTT (MQ Telemetry Transport) server and receives MQTT messages from mobile phones. The microcomputer sends GPIO (General Purpose Input/Output) signals to the motor hardware through its programmed pin configuration and simultaneously receives the video streaming from the IP (Internet Protocol) camera.

The screen of the mobile phone can receive this streaming. This design makes use of a new embedded development board as well as a new Wi-Fi development board. The CC3200 [7] uses the compiling feature of the Yocto Project Linux kernel to perform regular and quantitative feeding processes and to automate watering and feeding of pets. The feeder has more precise control over the food and water delivery because of its IoT-enabled remote control. The behavior of the pet can be observed in real time using a remote camera, and the feeding situation can be observed in real time using a phone [14]. Features in this pet feeder design [10, 13] make taking care of pets easier for both the pet and the owner.

PROPOSED WORK

System Design

Hardware Design

ESP8266 Node MCU

The ESP8266 NodeMCU microcontroller is the core component of the smart pet feeder system. It features built-in Wi-Fi, making it ideal for IoT applications. The NodeMCU can be programmed using the Arduino IDE and supports C/C++ through its SDK. It controls all connected peripherals, including the servo motor, sensors, and handles data transmission to cloud or mobile applications. It operates at 3.3V and includes GPIO pins for interfacing with digital and analog devices.

The microcontroller supports wireless communication protocols and allows the system to send and receive data such as food levels and feeding confirmations. The NodeMCU is also responsible for triggering scheduled feedings and sending alerts to the user.

Servo Motor (SG90)

The smart pet feeder's food distribution mechanism is operated by the SG90 servo motor. It runs on 5V and rotates the motor shaft to predetermined angles (usually 0°–180°) by receiving a PWM signal from the ESP8266. The servo's VCC and GND pins are connected to a steady 5V power source, and the signal pin is connected to a digital GPIO pin (such as D4). Accurate portion control is made possible by the motor's exact control over the feeder flap's opening and closing.

16x2 LCD Display

Important information, like system status, feeding schedules, and connectivity messages, are shown on the 16x2 LCD display. It can show two lines with 16 characters each. An I2C module is used in this project to link it to the ESP8266, reducing the number of GPIO pins needed from 6 to 8 to just 2 (SDA and SCL). This facilitates easy integration with other components and simplifies the wiring. The display uses the I2C protocol to connect with the microcontroller and is powered by 5V.

LCD I2C Module

To reduce wiring and conserve GPIO pins, the ESP8266 is connected to the 16x2 LCD in this project via an I2C module. ESP8266's SDA (connected to D2) and SCL (connected to D1) are the only two lines that the I2C module permits communication across. The VCC and GND pins are used to supply power. By using the I2C protocol to transfer data to the display using the default address (usually 0x27 or 0x3F), this configuration streamlines the circuit and increases system efficiency.

Software Design

Adafruit IO Integration

The system is linked to Adafruit IO, a cloud-based platform for real-time data monitoring and control, to make the pet feeder IoTs-capable. To authenticate the ESP8266 device, the first step is to create an Adafruit IO account and acquire the AIO key. A feed (such as "feed-now") is formed after logging in, serving as a virtual conduit for data transmission and reception. After subscribing to this feed, the ESP8266 turns on the servo motor to dispense food whenever it gets a trigger from the Adafruit IO. The status of the display is simultaneously updated by the LCD. I2C connection makes LCD interfacing easier while using less GPIO.

System Logic and Control Flow

Using the AIO key, the system first connects the ESP8266 to Wi-Fi and Adafruit IO. To get commands, it subscribes to a feed (such as "feed-now"). The ESP8266 recognizes a command provided through the Adafruit IO dashboard or activated by IFTTT with Google Assistant, and it turns on the servo motor to dispense food. The 16x2 LCD (via I2C) shows the current system status while it is operating such as "Feeding" or "Waiting." The motor returns to its initial position after feeding, and the system starts watching for the subsequent order. The pet feeder is automated and controlled in real time thanks to this loop.

IFTTT Setup with Google Assistant

The system takes advantage of IFTTT (If This Then That), a platform that links web services with straightforward conditional statements, to provide voice control using Google Assistant. With "This" set to Google Assistant and "That" connected to Adafruit IO, an applet is made in IFTTT. For example, Google Assistant uses IFTTT to transmit the user's command, "Feed my pet," which causes the Adafruit IO feed to update. After listening to that feed, ESP8266 recognizes the update and starts the feeding process. This makes interacting with the feeder system smooth and voice activated.

Flow of Functional Code

The Arduino IDE is used to write the C/C++ program for the ESP8266. It has setup features to connect to Adafruit IO, start Wi-Fi, and subscribe to feeds. The code continuously searches the feed for fresh data in the loop part. The SG90 servo motor is controlled by the feedNow() function when a trigger is received (either through the dashboard or IFTTT). To open the feeder, the motor rotates to a certain angle before going back to its starting position. As a result, the LCD changes to display messages like "Feeding..." and "Idle." Modularizing functions improves readability and upkeep.

Control in Real Time and User Engagement

IFTTT and Adafruit IO work together to offer voice and remote control. From any location, the system may be viewed and activated by a mobile device, web dashboard, or Google Assistant voice command. The user is always aware of the feeder's current condition thanks to the LCD's live feedback. In addition to improving user ease, this integration gives conventional pet feeding a clever automated layer.

Flow Chart

system for smart pet feeders. After initializing the system, it establishes connections with Adafruit IO and Wi-Fi to receive commands via the internet. After connecting, it keeps looking for a feed command. It continuously checks if no command is received. The system starts with the servo motor to dispense food when it detects a command. It updates and shows the feeding status on the 16x2 LCD screen after dispensing. The procedure then resumes, allowing for ongoing observation and food management using Adafruit IO, guaranteeing prompt pet care through remote access (Figure 1).

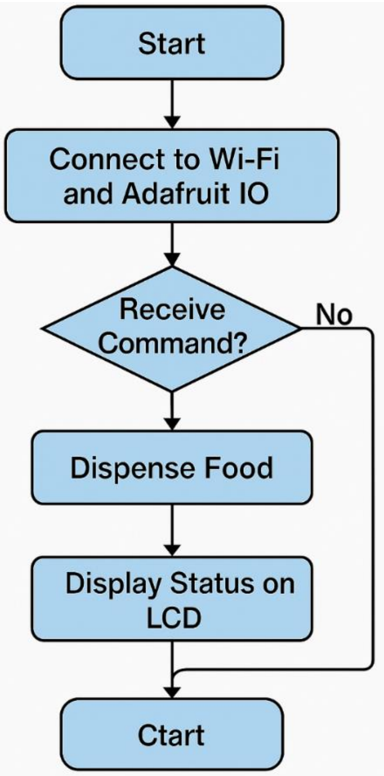

Figure 1. Flowchart of pet feeder.

METHODOLOGY

Circuit Diagram

The NodeMCU ESP8266 microcontroller serves as the primary controller, controlling components and the Wi-Fi connection.

- *Servo Motor (SG90):* A digital pin (such as D4) on the NodeMCU is connected to a servo motor (SG90), which turns to distribute food in response to commands.
- *16x2 LCD Display:* Shows system statuses like "Waiting for Command" or "Feeding."
- *I2C Module for LCD:* By utilizing only SDA (D2) and SCL (D1) pins for communication, the I2C module for LCD minimizes the number of connections required.
- *Power Connections:* The LCD display and servo motor are powered by VCC and GND from the NodeMCU (Figure 2).

ALGORITHMIC STEPS

Initialization of the System

The NodeMCU (ESP8266) microcontroller boots up when the Smart Pet Feeder is turned on. All required hardware components are initialized at this point. This entails connecting the SG90 servo motor to the appropriate control pin, configuring GPIO pins, and starting I2C communication with the 16x2 LCD module. To debug, the system also initiates serial communication. This stage guarantees that every part is prepared to carry out its specific duties, including text display, motor rotation, and Wi-Fi data handling.

Create a Connection Between Adafruit IO and Wi-Fi

Following component initialization, the NodeMCU uses program-coded password credentials and a predetermined SSID to try to connect to the Wi-Fi network. The system creates a secure connection with cloud-based IoT platform Adafruit IO following a successful Wi-Fi connection. Here, the NodeMCU watches for incoming signals or orders from the user dashboard by subscribing to a particular feed (such as “Feeder-Control”). This phase transforms the feeder into an intelligent, internet-based gadget that can be controlled from a computer or mobile device.

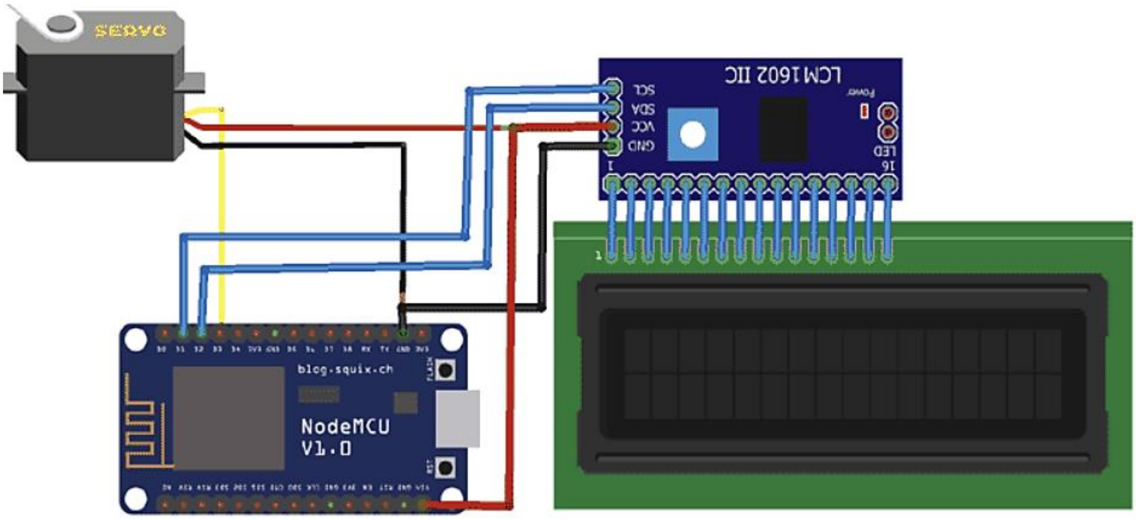

Figure 2. Circuit diagram.

Keep an Eye on Feed Command and Servo Motor

The Adafruit IO feed status is continuously checked by the system as it enters a loop. In the absence of a command, it continues to loop without taking any action. NodeMCU instantaneously reads a “Feed” command sent by the user from the Adafruit IO dashboard. When it detects something, it gives the SG90 servo motor a PWM signal, which causes it to rotate to a certain angle (such as 90°), opening the food slot and enabling food to be dispensed. The feeding motion is finished when the servo rotates back to its starting position (0°) after a brief pause of one to two seconds.

Reset Loop and LCD Status Update

The 16x2 LCD receives a message from the NodeMCU (via I2C) as soon as the feeding procedure is finished, displaying confirmation such as “Food Dispensed” or “Feeding Done.” After a brief period, this notice either scrolls or disappears to show that the system is once again ready. The user (or observer) can better understand what is going on in real time thanks to this status. This enables the system to function as an automated smart feeder around-the-clock by resetting the monitoring loop and preparing to accept the subsequent feeding command.

RESULTS AND DISCUSSION

The SG90 servo motor, 16x2 LCD with I2C module, Adafruit IO platform, and NodeMCU (ESP8266) microcontroller were used to successfully design, build, and test the Smart Pet Feeder system. In a variety of test settings, the technology operated as anticipated. The system connected to the Wi-Fi network and communicated with Adafruit IO as soon as it was turned on during operation. The Adafruit IO dashboard allowed the user to transmit commands from a computer or mobile device. The servo motor smoothly revolved to deliver a predetermined amount of food after receiving the feed order. Accurately responding, the LCD panel displayed real-time status updates like “Waiting for Command” or “Feeding Done.” In just a few seconds, the feeding procedure was over, and the machine automatically went back to its monitoring condition. The effectiveness of IoT-based control was demonstrated by the short response time between the cloud platform and the hardware. This study shows how embedded systems and the IoTs can be successfully combined to address practical issues. It saves human labor.

Observations

Wi-Fi Connectivity: Shortly after turning on, the NodeMCU ESP8266 was able to create a reliable connection with the Adafruit IO platform and Wi-Fi. Servo Motor Operation: When the feeding order was received, the SG90 servo motor rotated to the proper angle, dispensing the food. LCD Display Functionality: To aid in system monitoring, the 16x2 LCD with I2C module showed real-time messages such as "Connected to Wi-Fi," "Feeding in Progress," and "Feeding Completed." Command Execution: The NodeMCU received commands from Adafruit IO quickly, and the system carried them out without delay, exhibiting effective cloud-to-device connectivity.

Observations Table

The Adafruit IO platform and Wi-Fi network were swiftly and flawlessly connected to by the NodeMCU ESP8266. When an instruction was given, the SG90 servo motor turned precisely, distributing food efficiently. Throughout the process, the 16x2 LCD with I2C module showed unambiguous status messages. Adafruit IO commands were received and carried out quickly, ensuring seamless cloud-to-device connectivity (Table 1).

Table 1. Observation table.

Component/Function	Observation
Wi-Fi Connectivity	NodeMCU ESP8266 connected to Wi-Fi and Adafruit IO quickly and reliably.
Servo Motor Operation	SG90 servo motor rotated accurately to dispense food when command was received.
LCD Display Functionality	16x2 LCD (I2C) displayed real-time system messages clearly.
Command Execution	Commands from Adafru.

The completed working model of our Smart Pet Feeder prototype is displayed in the image above. It contains every crucial part that needs to be linked to a breadboard to properly test the system. The NodeMCU ESP8266 microcontroller, the brain of the system, is utilized in this configuration. It manages all functions, including information display and servo motor rotation. The 16x2 LCD display, which is connected via an I2C module, helps users understand the feeder's status by displaying real-time information like "Feeding Time" or "Food Dispensed." When activated, the servo motor, which is connected to a food container, turns to drop the appropriate quantity of food, and prepares for practical usage with the right enclosure and power source (Figure 3).

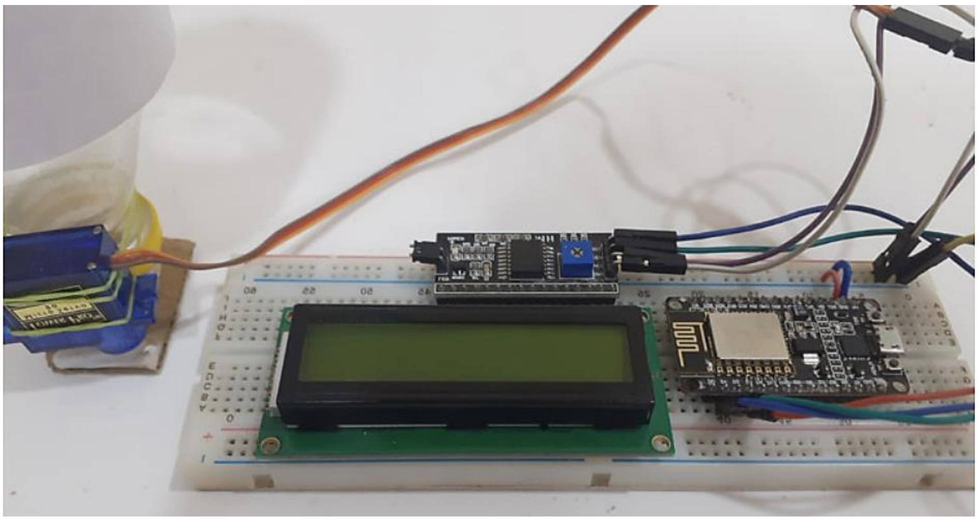

Figure 3. Smart pet feeder hardware.

CONCLUSION AND FUTURE SCOPE

The Smart Pet Feeder project has effectively illustrated how embedded systems and the IoTs can be used to effectively and economically address real-world issues. The NodeMCU ESP8266, SG90 Servo

Motor, and 16x2 LCD with I2C module used to build this system proved to be quite helpful in automating the pet feeding procedure. The feeder functions as planned, precisely turning the servo motor to dispensing food and showing pertinent messages on the LCD to show the state of the system. This project offers convenience, dependability, and peace of mind by making it simple for pet owners to feed their animals on schedule, even when they are not there. The system is appropriate for home use due to its straightforward, portable, and user-friendly design. There is a great deal of room for this system to grow and be improved in the future. A smartphone app may be used to add a Wi-Fi-based remote control to the feeder, allowing customers to feed their pets from anywhere. To notify users when feeding takes place or when the food container is low, real-time alerts and notifications can be put in place. For increased effectiveness, sensors can be added to evaluate food levels and identify the presence of pets. An additional degree of convenience would be added if the feeder could be controlled by voice commands thanks to integration with voice assistants like Google Assistant or Alexa. Additionally, a camera module may be added for real-time feeding process monitoring, which is particularly helpful for pet owners who wish to check on their animals from a distance. A real-time clock (RTC) module allows the system to adhere to a set feeding schedule without requiring continuous internet connectivity. A power backup system can also guarantee continuous operation in the event of an electrical outage. The Smart Pet Feeder would become more sophisticated, intelligent, and appropriate for contemporary smart homes with these upcoming improvements.

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