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Cloud Enhanced Intelligence Pet Sustenance System

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ABSTRACT: The increasing adoption of smart technologies has enabled the development of intelligent systems for efficient pet care and monitoring. This paper presents a cloud enhanced intelligence pet sustenance system designed to ensure the well- being of pets through automated feeding, health monitoring, and remote supervision. The proposed system integrates sensors, microcontroller-based hardware, and cloud computing to collect and analyze real time data related to pet activity, food consumption, and environmental conditions. The system allows pet owners to monitor and control feeding schedules through a mobile or web interface, ensuring timely and adequate nutrition. In addition, the cloud platform stores historical data and applies intelligent analysis to provide insights and alerts regarding pet health and behavior. The implementation of this system improves convenience, reduces manual effort, and enhances the quality of pet care. The results demonstrate that the proposed system is reliable, scalable, and suitable for modern smart home environments.

KEYWORDS: IoT, Smart Pet Feeder, NodeMCU, ESP32-CAM, GSM Module, Blynk

I. INTRODUCTION

The rapid advancement of Internet of Things (IoT) technology has enabled the development of smart automation systems in various domains, including healthcare, agriculture, smart homes, and pet care. Among these, pet care systems are gaining significant attention due to the increasing number of pet owners who require reliable and automated solutions for feeding and monitoring their pets. Traditional pet feeding methods depend entirely on manual intervention, which often leads to irregular feeding schedules, overfeeding, or missed feeding times. This can negatively affect the health and wellbeing of pets. To overcome these limitations, an automated and intelligent system is required that can ensure timely feeding and provide real-time monitoring. The proposed IoTbased Smart Pet Feeding System integrates Node MCU (ESP8266) for controlling the feeding mechanism, along with the Blynk mobile application for remote access and scheduling. An ESP32-CAM module is used to enable live video streaming, allowing pet owners to visually monitor their pets from anywhere. Additionally, a GSM module is incorporated to send alerts and enable communication during emergency situations. This system aims to improve convenience, reliability, and efficiency in pet care by reducing human dependency and enabling remote management. By combining automation, monitoring, and communication technologies, the proposed system provides a comprehensive solution for modern pet care requirements.

II. LITERATURE REVIEW

IOT Based Smart Pet Feeding System Using ESP 32; Objective: To create an automated IoT-based pet feeder using ESP32 for scheduled feeding and remote monitoring. Methodology: Used ESP32 with a load cell and servo motor; feeding data is sent to the cloud, and alerts notify the owner when food is low or dispensed. Conclusion: The system ensures timely feeding, remote access, and alerts, improving pet safety and reliability.

An Internet of things-enabled smart feeding system for pets powered by deep learning Objective: To build an IoTbased pet feeder using deep learning to detect pets and automate feeding. Methodology: Used a camera with deep learning for pet detection, IoT sensors for control, and an app for alerts and monitoring. Conclusion: Ensures accurate, automated feeding with real-time monitoring, improving pet care and reliability.

Design and Implementation of a Mobile-Controlled IoT Smart Pet Feeder for Busy Pet Owners; Objective: To build a simple mobile-controlled IoT pet feeder for busy pet owners. Methodology: Used ESP8266, sensors, and a mobile app to schedule feeding and monitor food levels effectively. Conclusion: Ensures reliable remote feeding and timely meals, improving convenience for pet owners.

Design and Development of a Smart Pet Feeder with IoT and Deep Learning. Objective: To create a smart IoT pet feeder that uses deep learning to detect pets and control feeding automatically. Methodology: Integrated a camera with deep learning models for pet recognition, IoT sensors for feeder control, and a cloud interface for alerts and monitoring. Conclusion: The system provides accurate, automated feeding with intelligent detection, improving efficiency and pet care convenience.

Enhancing Milk Quality Detection with Machine
Learning: A Comparative Analysis of KNN and DistanceWeighted KNN Algorithms; Objective: To improve milk quality detection by comparing the performance of KNN and Distance-Weighted KNN algorithms. Methodology: Collected milk quality parameters, preprocessed the dataset, and trained both KNN and Distance-Weighted KNN models to evaluate accuracy and reliability. Conclusion: Distance-Weighted KNN showed better classification accuracy, offering a more effective method for detecting milk quality.

Design and Implementation of a Solar-Based Automatic Pet feeder And Water Dispenser; Objective: To develop a solar-powered automatic pet feeder and water dispenser that works efficiently without external electricity. Methodology: Used solar panels, battery storage, sensors, and a control unit to automate food and water dispensing with consistent power supply. Conclusion: Provides energy-efficient, reliable feeding and hydration for pets, ensuring continuous operation even in power outages.

Autonomous Pet Feeding System with Battery Backup and Solar Power; Objective: To develop an eco-friendly autonomous pet feeder with power backup. Methodology: Combined solar panels, battery storage, NodeMCU, and automated dispensing. System operates independently of grid power. Conclusion: Demonstrated sustainable operation suitable for remote locations and also more effective method.

Pet Feeding System with Voice Recognition and IoT Integration Using ESP32; Objective: To incorporate voice recognition for pet feeding commands within an IoT framework. Methodology: Employed ESP32 with microphone array, voice recognition algorithms, and automatic dispensing. Connected via Wi-Fi for remote access. Conclusion: Enhanced user interaction through voice control, improving usability and accessibility.

IoT-Enabled Pet Feeding System with Cloud Data Storage and Notification System; Objective: To implement a pet feeding system with cloud data logging and notification services. Methodology: Used NodeMCU with Wi-Fi module, cloud platform for data storage, and push notifications for feeding status. Conclusion: Enabled remote monitoring and data analysis, improving system transparency and maintenance.

III. RESEARCH METHODOLOGY

The present invention discloses an automated and intelligent animal pet feeding system that leverages embedded control, Internet of Things (IoT), and cloud technologies to ensure timely feeding, remote monitoring, and improved pet care management. The system is designed to automatically dispense food to pets at predefined schedules, thereby reducing the need for continuous human intervention and minimizing the risk of missed or irregular feeding. In accordance with one embodiment of the invention, the system comprises a microcontroller-based control unit operatively connected to a feeding mechanism, a monitoring module, a communication module, and a power supply. The control unit regulates feeding operations based on scheduled parameters configured through a cloud-connected user interface. Feeding status and system information are transmitted through a network to enable remote supervision and control. The invention further provides real-time visual monitoring of the pet environment through an integrated camera module, allowing a pet owner to observe pet behavior and feeding activity remotely. Additionally, a wireless communication module enables voice-based interaction between the pet owner and the feeding environment,

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enhancing safety, responsiveness, and user engagement. By integrating automated feeding, real-time monitoring, and remote communication within a unified IoT-enabled framework, the present invention offers a reliable, scalable, and user-friendly solution that enhances animal well-being while providing convenience and peace of mind to pet owners.

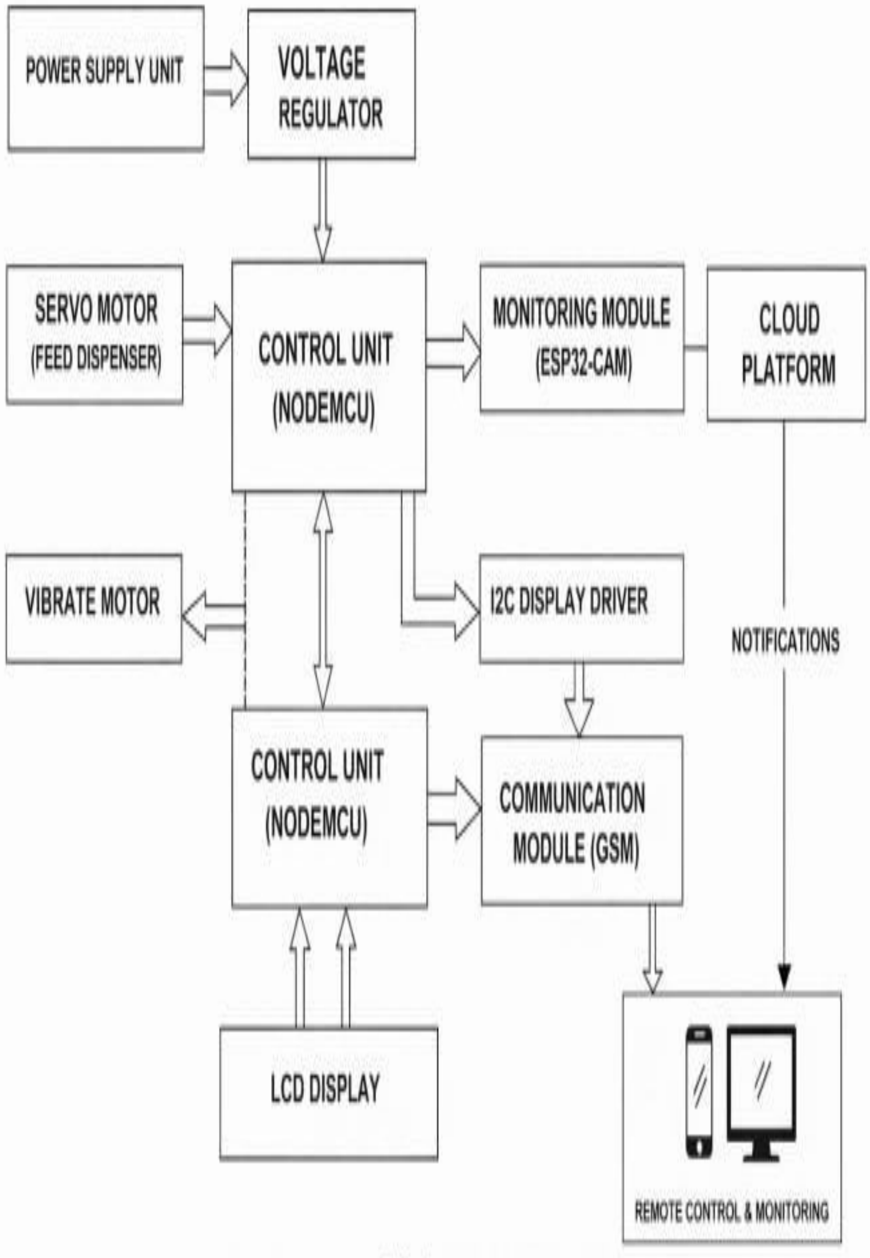

FIG. 1

FIG. 1 illustrates a block diagram of the cloud enhanced intelligence pet sustenance system in accordance with an embodiment of the present invention.

Referring to FIG. 1, the cloud enhanced intelligence pet sustenance system comprises a power supply unit, a control unit, one or more actuation modules, a monitoring module, a display unit, and a communication module. The power

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supply unit includes an adaptor and a voltage regulation circuit configured to provide regulated electrical power to all system components.

The control unit receives the regulated power and functions as the central processing element of the system. The control unit is configured to control a servo motor for dispensing food and a vibration motor for assisting the delivery of food from the storage compartment. The monitoring module captures visual information of the feeding area during operation. The communication module enables transmission of feeding status, monitoring data, and system information to a cloud platform for remote access and supervision.

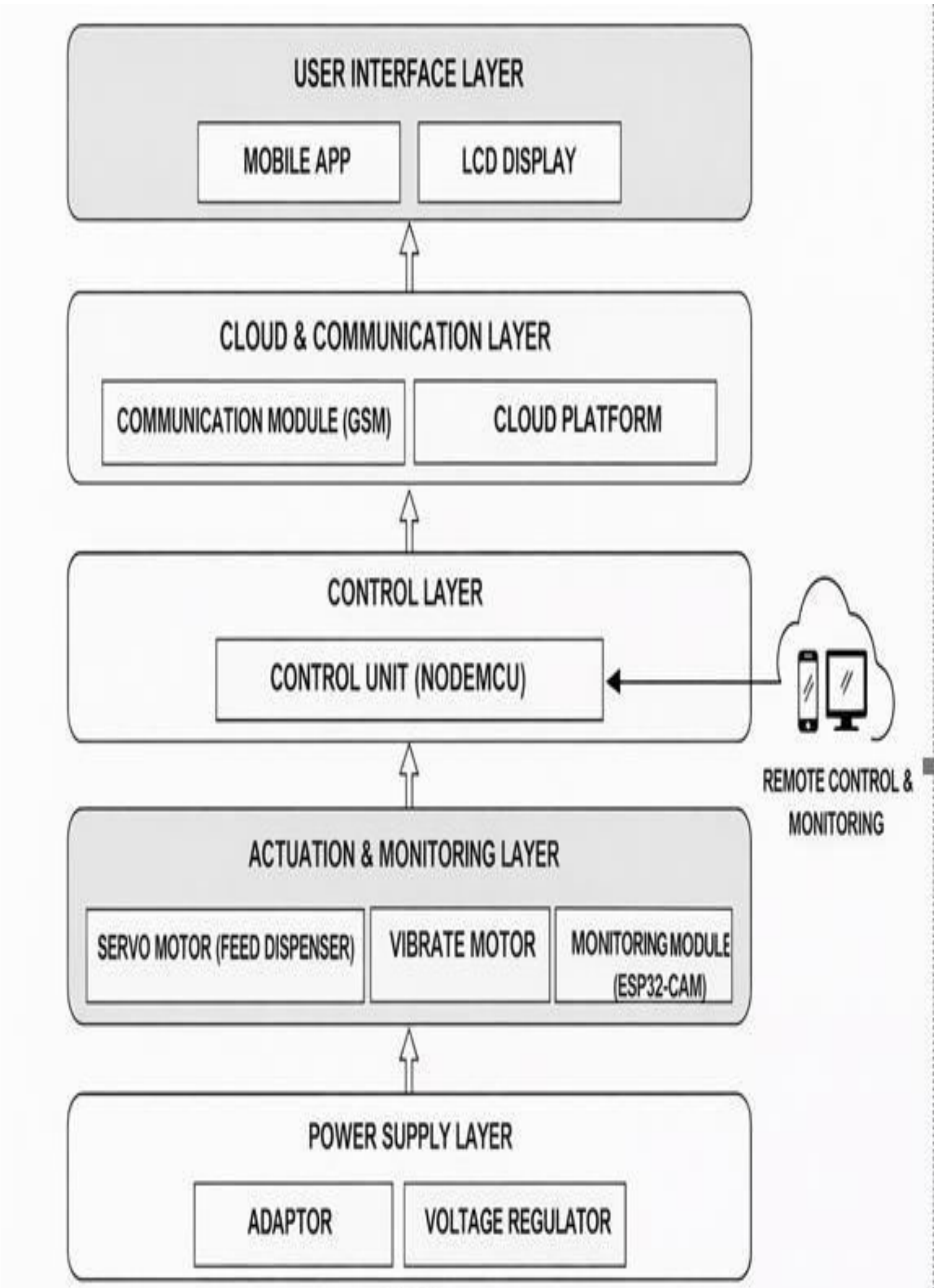

FIG. 2

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Referring to FIG. 2, the functional architecture of the system is organized into multiple logical layers, including a power supply layer, an actuation and monitoring layer, a control layer, a cloud and communication layer, and a user interface layer.

The control layer processes feeding schedules, operational parameters, and monitoring data. The cloud and communication layer facilitates data storage, synchronization, and remote accessibility. The user interface layer allows a user to configure feeding schedules, receive notifications, and monitor system status through a connected application or interface.

FLOWCHART OF OPERATION

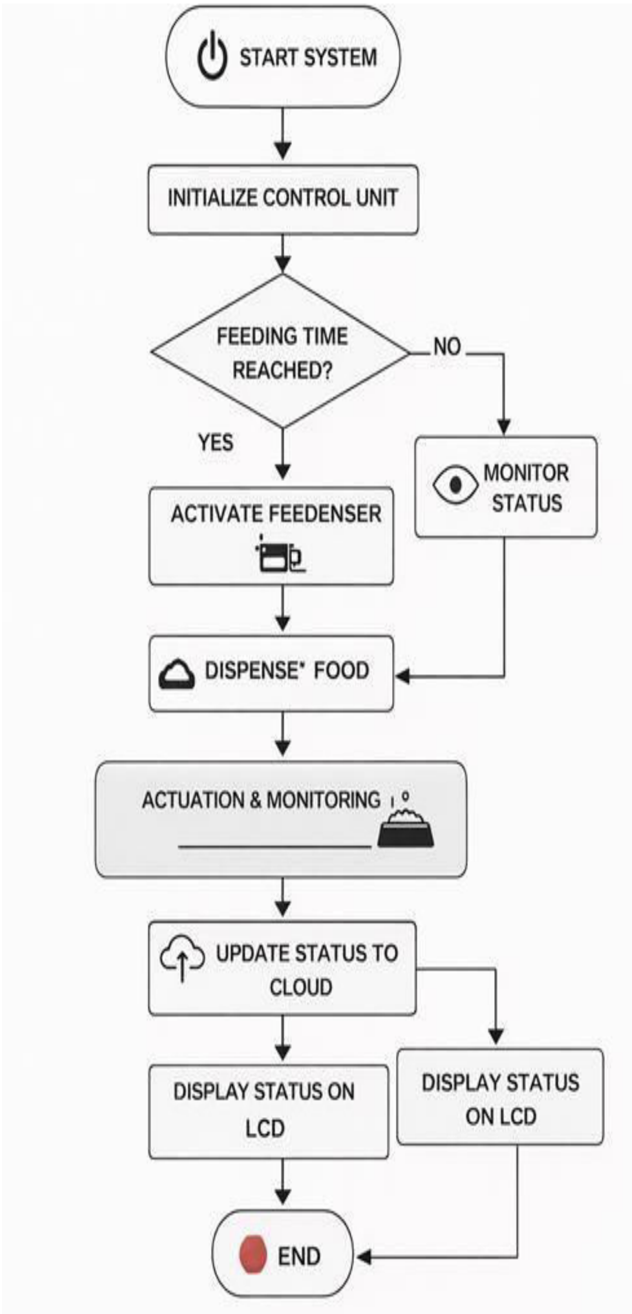

FIG. 3

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Referring to FIG. 3, the operational flow of the system begins with system initialization, during which the control unit activates and verifies operational readiness. The control unit continuously checks whether a predefined feeding time has been reached. Upon satisfaction of the feeding condition, the control unit actuates the feeder mechanism to dispense food. During feeding, the monitoring module observes feeding activity, and relevant status information is collected. The collected data is transmitted to the cloud platform through the communication module. The feeding status is simultaneously displayed on the local display unit. The process then terminates or repeats based on the programmed feeding schedule.

The proposed animal pet feeding system integrates multiple advanced technologies to ensure efficient and convenient pet care. It utilizes a NodeMCU microcontroller to automate the feeding process, allowing users to control feeding schedules remotely via the Blynk app. The system features an automatic time setting mechanism that ensures pets are fed at programmed intervals without manual intervention. For realtime monitoring, an ESP32-CAM module is incorporated to provide live video streaming, enabling pet owners to observe their pets anytime remotely.

COMMUNICATION AND DATA FLOW

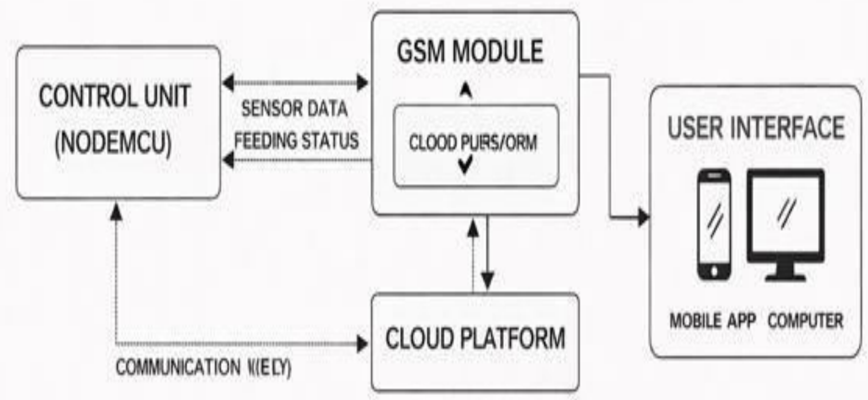

FIG. 4

FIG. 4 illustrates the communication and data flow between the control unit, cloud platform, and user interface in the pet sustenance system.

Referring to FIG. 4, the control unit exchanges data with the cloud platform via the communication module. Feeding status information and monitoring data are uploaded to the cloud platform for storage and remote access. User commands, configuration updates, and feeding schedules are transmitted from the user interface to the control unit through the cloud infrastructure, enabling bidirectional communication.

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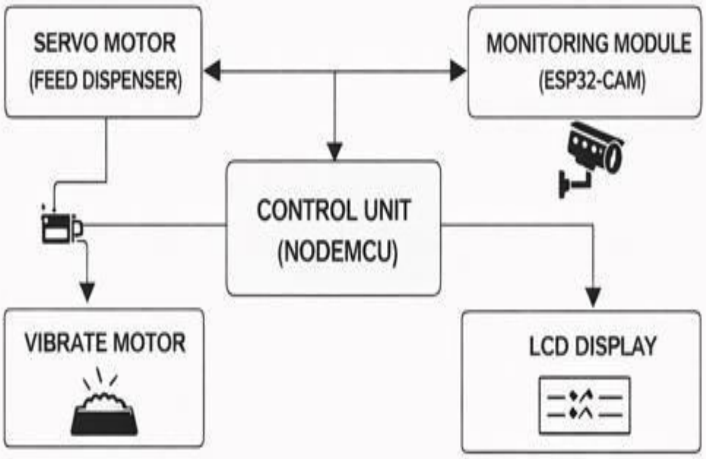

FIG. 5

FIG. 5 illustrates a feeding and monitoring subsystem of the cloud enhanced intelligence pet sustenance system controlled by the control unit.

Referring to FIG. 5 The subsystem includes a servo motor configured as a feed he feeding and monitoring dispenser, a vibration motor to assist food movement, a monitoring module for observing feeding activity, and a display unit for providing local system status information. All subsystem components are operatively connected to and controlled by the control unit to ensure synchronized operation

IV. SOFTWARE ENVIRONMENT

Arduino Software (IDE)

Arduino is an open-source electronics platform based on easy-to-use hardware and software. Arduino boards are able to read inputs - light on a sensor, a finger on a button, or a Twitter message - and turn it into an output - activating a Motor, turning on an LED, publishing something online. You can tell your board what to do by sending a set of instructions to the microcontroller on the board. To do so you use the Arduino programming language (based on Wiring), and the Arduino Software (IDE), based on Processing. Arduino has been the brain of thousands of projects, from everyday objects to complex scientific instruments. A worldwide community of makers - students, hobbyists, artists, programmers, and professionals - has gathered around this open-source platform, their contributions have added up to an incredible amount of accessible knowledge that can be of great help to novices and experts alike. Arduino was born at the Ivrea Interaction Design Institute as an easy tool for fast prototyping, aimed at students without a background in electronics and programming. As soon as it reached a wider community, the Arduino board started changing to adapt to new needs and challenges, differentiating its offer from simple 8-bit boards to products for IoT applications, wearable, 3D printing, and embedded environments. All Arduino boards are completely open-source, empowering users to build them independently and eventually adapt them to their particular needs. The software, too, is open-source, and it is growing through the contributions of users worldwide.

Arduino also simplifies the process of working with microcontrollers, but it offers some advantage for teachers, students, and interested amateurs over other systems. The Arduino Software (IDE) is easy-to use for beginners, yet flexible enough for advanced users to take advantage of as well. For teachers, it's conveniently based on the Processing programming environment, so students learning to program in that environment will be familiar with how the Arduino IDE works.

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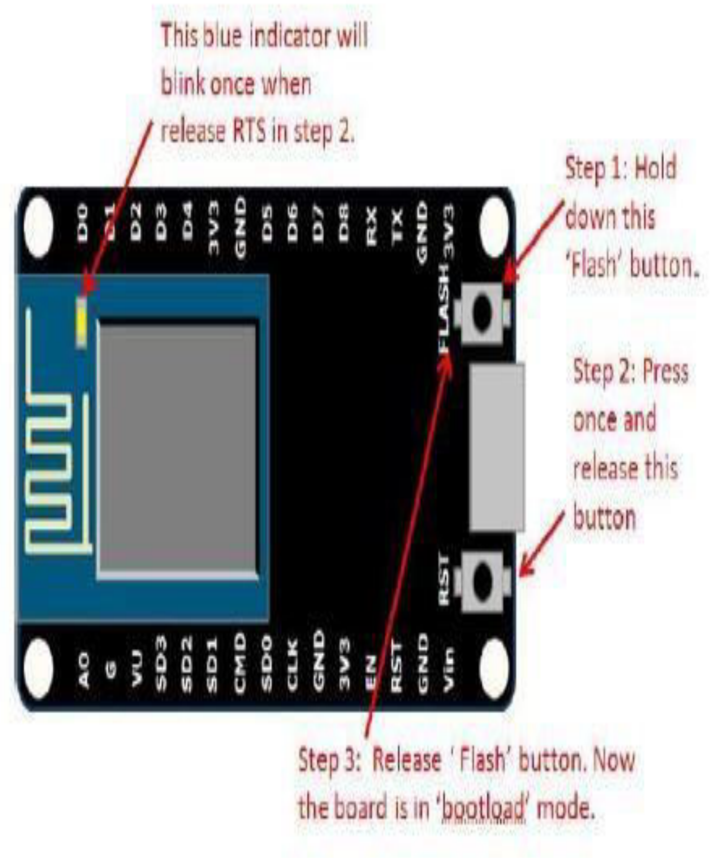
Open source and extensible hardware - The plans of the Arduino boards are published under a Creative Commons license, so experienced circuit designers can make their own version of the module, extending it and improving it. Even relatively inexperienced users can build the breadboard version of the module in order to understand how it works and save money.

Embedded C is a set of language extensions for the C programming language by the C Standards Committee to address commonality issues that exist between C extensions for different embedded systems. Embedded C programming typically requires nonstandard extensions to the C language in order to support enhanced microprocessor features such as fixed- point arithmetic, multiple distinct memory banks, and basic I/O operations. In 2008, the C Standards Committee extended the C language to address such capabilities by providing a common standard for all implementations to adhere to. It includes a number of features not available in normal C, such as fixed-point arithmetic, named address spaces and basic I/O hardware addressing.

V. HARDWARE ENVIRONMENT

NODEMCU V3

NodeMCU V3 is an open-source firmware and development kit that plays a vital role in designing an IoT product using a few script lines. Multiple GPIO pins on the board allow us to connect the board with other peripherals and are capable of generating PWM, I2C, SPI, and UART serial communications. The interface of the module is mainly divided into two parts including both Firmware and Hardware where former runs on the ESP8266 Wi-Fi SoC and later is based on the ESP-12 module. The firmware is based on Lua – A scripting language that is easy to learn, giving a simple programming environment layered with a fast-scripting language that connects you with a well-known developer community.



USB to UART converter is added on the module that helps in converting USB data to UART data which mainly understands the language of serial communication. Instead of the regular USB port, MicroUSB port is included in the module that connects it with the computer for dual purposes: programming and powering up the board.The board

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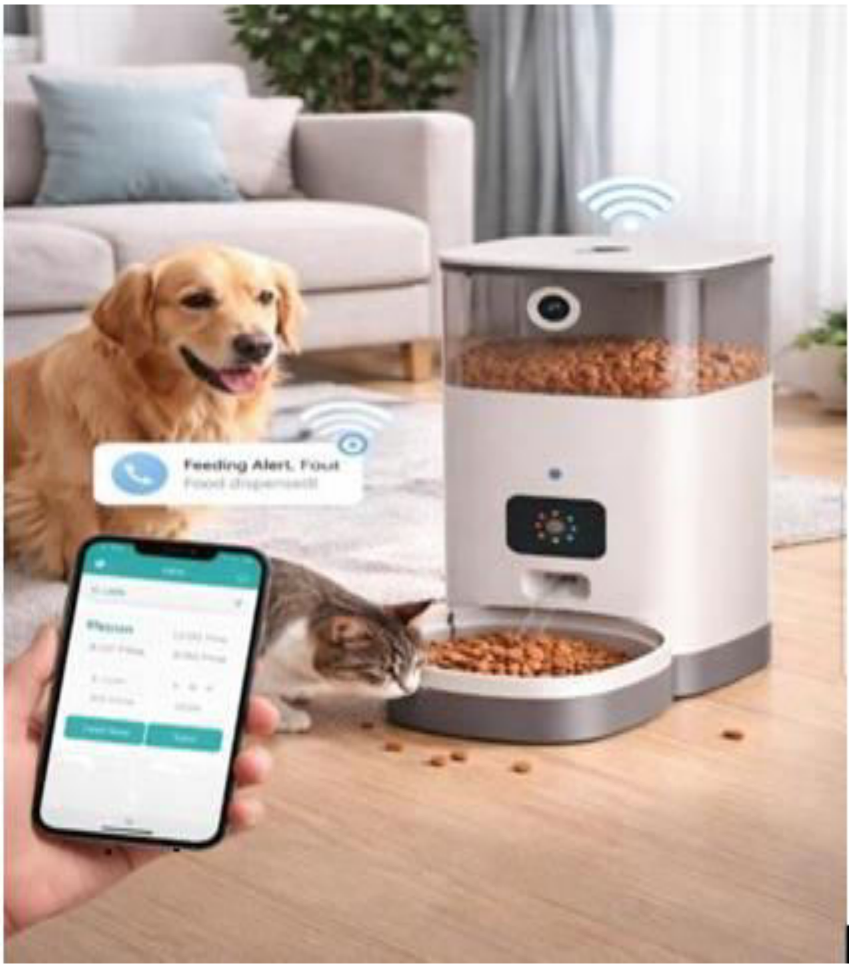
incorporates status LED that blinks and turns off immediately, giving you the current status of the module if it is running properly when connected with the computer.The ability of module to establish a flawless WiFi connection between two channels makes it an ideal choice for incorporating it with other embedded devices like Raspberry Pi.

LCD Display

A liquid crystal display (LCD) is a flat panel display, electronic visual display, or video display that uses the light modulating properties of liquid crystals. Liquid crystals do not emit light directly. LCDs are available to display arbitrary images (as in a general-purpose computer display) or fixed images which can be displayed or hidden, such as preset words, digits, and 7-segment displays as in a digital clock. They use the same basic technology, except that arbitrary images are made up of a large number of small pixels, while other displays have larger elements.

VI. RESULTS AND DISCUSSION



Automated and Consistent Feeding: The system ensures pets receive food at the correct time through a programmable automatic feeding schedule. Using the Blynk app, the owner can set precise feeding times, eliminate missed or irregular feeding and promoting the pet's health.

Real-Time Video Monitoring: The integration of the ESP32CAM module provides live video feed to the owner via the mobile application. This allows real-time monitoring of the pet, the feeding area, and the food dispenser. Owners can instantly check the pet's behaviour and ensure feeding is occurring properly.

Remote Control and User Convenience With the NodeMCU and Blynk app, the feeding system can be fully operated from anywhere. The owner can: Trigger manual feeding, modify schedules and view live camera feed GSM Alerts and Emergency Notifications: The GSM 800 module sends call alerts to the owner's phone during emergencies such as:
Feeder malfunction,Food container empty and Motor jam

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Centralized IoT Integration: All components—Node MCU, ESP32 CAM, GSM module, and Blynk app—work together to provide a unified smart pet care ecosystem. The system supports remote updates, easy maintenance, and expansion of features (e.g., weight sensor, temperature sensor, AI-based pet detection).
Improved Safety and Reliability: Automation reduces manual errors and ensures consistent operation. Low-power IoT hardware ensures stable performance and continuous reliability, even during long-term use.

Automated and scheduled pet feeding without continuous human intervention.

- Cloud-based remote monitoring and control of feeding operations.
- Reduction of manual effort and feeding errors.
- Improved reliability and convenience in pet care management.
- Scalability and adaptability to different pet feeding requirements.

VII. CONCLUSION

In conclusion, the integrated animal pet feeding system utilizing Blynk app control, NodeMCU microcontroller, ESP32-CAM for real-time video monitoring, and GSM module for calling functionality offers a comprehensive and efficient solution for pet care. The automation of feeding schedules through automatic time settings ensures pets are fed consistently, reducing the need for manual intervention. Realtime video streaming enhances user engagement and provides peace of mind, while the GSM calling feature enables direct communication during emergencies. This system not only improves the convenience for pet owners but also promotes better health and safety for pets through reliable automation and monitoring.

VIII. FUTURE WORK

The future scope of this system includes the incorporation of advanced features such as AI-based pet behavior analysis for personalized feeding and health monitoring. Integration with cloud-based data storage can facilitate long-term tracking of pet health metrics and feeding patterns. Additionally, expanding the system to include environmental sensors (temperature, humidity) can optimize the pet's living conditions. Developing a mobile app with multi-user access and notifications can further enhance user convenience. Moreover, incorporating solar power options could make the system more energy-efficient and sustainable, paving the way for smarter and more autonomous pet care solutions.

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