Head of the Department

ABSTARCT

The IoT-based automatic pet feeding system integrates smart technology to enhance pet care by automating the feeding process, ensuring timely and consistent meals for pets, even when owners are not at home. The system employs an ESP8266 microcontroller to manage the feeding process and send real-time alert messages to the Arduino IoT Cloud remote app, allowing users to monitor and control the system remotely through a seamless connection between the hardware and cloud interface.

Pet owners can schedule meals, adjust portion sizes, and monitor feeding habits in real time using a smartphone application. The system is equipped with sensors, such as an ultrasonic sensor, to detect when the pet has finished eating, and sends notifications when food levels are low, ensuring the feeder is never empty. This reduces the risk of missed meals due to human oversight and promotes consistent feeding schedules, which is vital for pets with dietary restrictions or controlled portions.

By providing remote control and real-time monitoring, the IoT-based pet feeder offers convenience and peace of mind for pet owners. The system is designed to ensure pets' well-being by delivering timely, consistent meals, promoting healthier eating habits, and enabling owners to stay connected to their pets' routines from anywhere. The integration of the ESP8266 enhances the system's connectivity, making it a scalable and practical solution for modern pet care.

Chapter-1 Introduction

Introduction

In today's fast-paced world, the role of smart technology in everyday life has become increasingly significant, providing automation and convenience in various aspects of daily tasks. One area where smart solutions are gaining prominence is in pet care. Ensuring pets are fed on time and in the right amounts can be challenging for pet owners, especially for those who are frequently away from home. To address this, IoT (Internet of Things) technology offers a practical solution by enabling remote monitoring and control of feeding schedules. This paper presents the design and development of an "IoT-based Smart Pet Feeding System" that automates the feeding process while allowing pet owners to manage feeding remotely via an intuitive interface.

The system utilizes an 'ESP8266 microcontroller, which connects the feeder to the "Arduino IoT Cloud' platform, enabling real-time monitoring and control through a smartphone application. Key components include a 'servo motor' to dispense food, an 'ultrasonic sensor' to monitor the pet's food consumption, and a 'GSM module' for alert notifications when internet connectivity is unavailable. By using the Arduino IoT Cloud, users can create a seamless interaction between the hardware and software components, allowing them to set feeding schedules, receive low food alerts, and monitor their pet's feeding activity in real time.

The project not only addresses the need for automation in pet care but also enhances the pet's well-being by ensuring consistent meal times, which is crucial for pets with specific dietary needs. This system can be particularly beneficial for busy pet owners, ensuring that their pets are well-fed even in their absence. Furthermore, the use of cost-effective and widely available components such as the ESP8266 makes the system scalable and accessible for a broader audience, ensuring that such smart solutions can be easily integrated into households.

Chapter -2 SYSTEM MODEL AND LITERATURE SURVEY

2.1 System Model

2.1.1 System components:

ESP8266 Microcontroller: Manages the system's operations and connects to the Arduino IoT Cloud via its integrated Wi-Fi module, allowing real-time remote control and monitoring.

Servo Motor: Controls the dispensing of food by rotating to release specific portions based on the schedule set by the user.

Ultrasonic Sensor: Detects when the pet has finished eating by measuring the distance between the food level and the feeder.

Wi-Fi Module: Integrated into the ESP8266, it facilitates data transmission over Wi-Fi for cloud-based control and notifications.

Arduino IoT Cloud: Provides remote access to control feeding schedules, monitor the system, and receive real-time alerts via a user-friendly dashboard.

Display Device: Shows weather conditions to help owners adjust feeding schedules based on environmental factors.

Mobile Device: Displays alert messages and allows users to monitor and control the feeder remotely, ensuring the system's performance is easily managed.

2.1.2 System Operation:

Pet Presence Detection: The ultrasonic sensor detects when the pet approaches or finishes eating by measuring the distance between the pet and the feeder.

Signal Processing: The ESP8266 processes the data from the ultrasonic sensor and determines whether the pet has finished eating or if food needs to be dispensed.

Food Dispensing: Upon confirming the pet's presence or at a scheduled time, the ESP8266 activates the 360-degree servo motor to dispense food.

Wi-Fi Communication: The ESP8266 uses its integrated Wi-Fi module to send data and alert messages to the Arduino IoT Cloud.

Cloud Integration: The Arduino IoT Cloud receives the information and updates the system’s status, displaying it on the user’s mobile device via the Arduino IoT Remote App.

Real-Time Notification: The user receives alert messages on their mobile app, such as when the pet finishes eating or when the food supply is running low.

Remote Monitoring and Control: The user can monitor the system’s status, control feeding schedules, and activate or deactivate the feeder remotely through the app

2.2 Literature Survey

2.2.1 Ultrasonic Sensing Technologies:

There are various technologies for detecting proximity and distance, including infrared, ultrasonic, and optical sensors. Ultrasonic sensors, like the HC-SR04 used in this project, are well-suited for detecting the presence of objects or liquids, making them ideal for monitoring whether the pet has finished eating. Each sensor type offers trade-offs in terms of accuracy, range, and cost. Ultrasonic sensors are particularly favored for their precision and reliability in different environmental conditions.

2.2.2 Cloud-Based Communication and API Integration:

The integration of IoT platforms, such as Arduino IoT Cloud, facilitates seamless communication between the smart feeder and the mobile application. Various IoT platforms (AWS, ThingSpeak, Blynk, etc.) provide varying levels of customization, but Arduino IoT Cloud is ideal for this project due to its user-friendly interface, allowing for remote control and real-time monitoring of the pet feeder. This enables users to schedule feeding times and receive notifications through the Arduino IoT Remote App.

2.2.3 Microcontroller Programming:

The ESP8266 microcontroller is a popular choice for IoT projects because of its built-in Wi-Fi capabilities and compatibility with the Arduino IDE. Programming the ESP8266 involves using libraries to handle sensor inputs (e.g., ultrasonic sensors), servo motor control, Wi-Fi communication, and cloud integration. The availability of sample codes for interfacing the sensors and communicating with the cloud simplifies the development process, making it more straightforward to implement scheduled feeding times and monitor the pet's feeding behavior.

2.2.4 IoT Platforms:

Various IoT platforms can be used to monitor and control the smart pet feeder remotely. In this project, Arduino IoT Cloud is chosen for its ease of use and efficient real-time communication features. Other platforms like AWS IoT, Blynk, and ThingSpeak offer similar functionalities, but Arduino IoT Cloud is ideal for its built-in tools that simplify the development of real-time alerts and remote control features tailored to pet care.

2.2.5 Safety Considerations:

The project involves securely sending data over the internet through the ESP8266's Wi-Fi module. Data privacy and protection are essential, as the system handles sensitive information such as feeding schedules and pet activity. Communication with the cloud platform is secured using standard protocols to ensure that the data and control commands are protected from unauthorized access.

2.2.6 User Interface and Remote Control:

Arduino IoT Cloud provides an intuitive user interface through its mobile app. The app allows users to schedule feeding times, receive real-time notifications, and monitor their pet's eating habits remotely. Users can also control the servo motor that dispenses food, and the system alerts them if the pet has finished eating or if there are any anomalies. This flexibility ensures the smart pet feeder is easy to use and adapt to the pet's needs.

2.2.7 Cost Analysis and Market Research:

The system is designed to be cost-effective, with the primary components being the ESP8266 microcontroller, ultrasonic sensor, and servo motor. A market survey shows increasing demand for smart pet care solutions, with consumers looking for affordable, reliable, and easy-to-install automated pet feeders. The scalability and affordability of the Smart Pet Feeder project make it suitable for commercial applications, especially for pet owners seeking convenience and real-time control of their pets' feeding routines.

2.3 Block Diagram

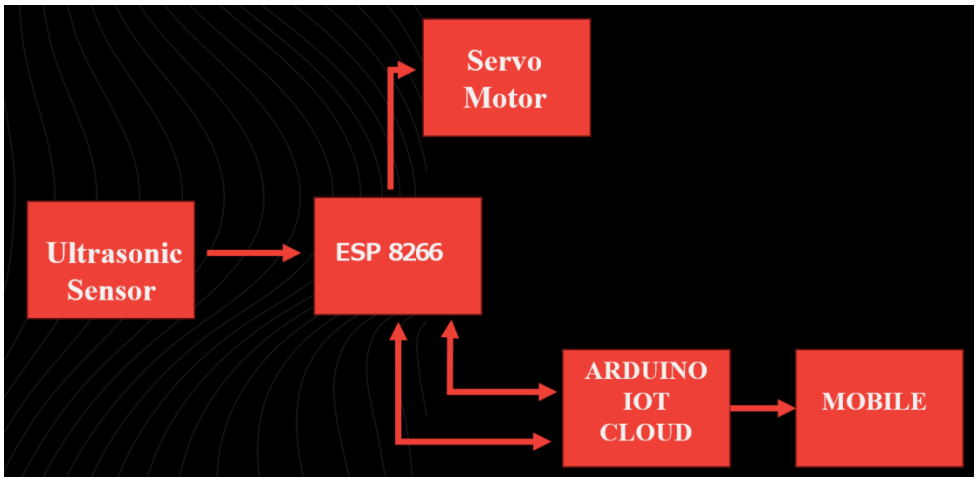

Fig 1: BLOCK DIAGRAM OF SMART PET FEEDING

Ultrasonic Sensor Block:

- Input block for detecting the pet's presence or measuring the food level.
- Sends a distance signal to the ESP8266 for processing.

ESP8266 Microcontroller Block:

- Central block that processes the sensor data and controls the feeding process.
- Communicates with the Wi-Fi module for cloud data transfer.
- Activates the servo motor for food dispensing and sends alert messages.

Servo Motor Block:

- Output block that controls the dispensing of food.
- Rotates based on signals from the ESP8266 to release food portions.

Wi-Fi Module Block:

- Facilitates communication between the ESP8266 and the Arduino IoT Cloud.
- Allows data transfer for remote monitoring and control.

Arduino IoT Cloud Block:

- Receives data from the ESP8266 via Wi-Fi.
- Sends notifications to the user's mobile device and stores data for remote access.

Mobile Device (Arduino IoT Cloud App) Block:

- Displays real-time alerts and notifications.
- Allows remote monitoring, control of feeding schedules, and system status through the app.

Chapter-3 HARDWARE DESCRIPTION

3.1.1 ESP8266:

The ESP8266 microcontroller, developed by Espressif Systems, is widely known for its cost-effectiveness and integrated Wi-Fi capabilities. It features a single-core Tensilica L106 processor, running at 80 MHz or 160 MHz, making it suitable for various IoT applications. The module supports Wi-Fi standards (802.11 b/g/n), enabling reliable wireless communication for data transmission in IoT environments. The ESP8266 offers multiple peripheral interfaces, including GPIO, UART, SPI, and I2C, making it easy to connect with various sensors, actuators, and external modules. It supports both Station and Access Point modes, allowing it to either connect to an existing Wi-Fi network or create its own. This flexibility makes it ideal for projects like smart home automation, remote monitoring, and wireless data logging.

Additionally, the ESP8266 operates at 3.3V and supports deep sleep mode, which helps reduce power consumption in energy-constrained applications. The module comes with a built-in TCP/IP stack, facilitating easy web-based communication. The combination of low cost, compact size, and versatile features has made the ESP8266 a go-to choice for DIY projects, home automation, and industrial applications.

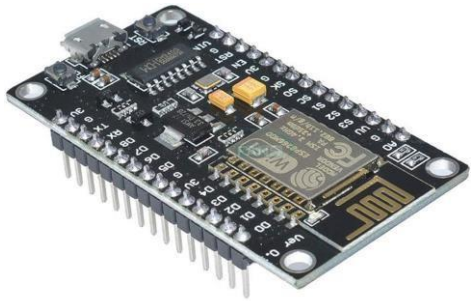

Fig 2: ESP8266

3.1.2 Ultrasonic Sensor:

The Ultrasonic Sensor (HC-SR04) is a widely used sensor for distance measurement. It operates on the principle of ultrasonic waves, emitting a high-frequency sound wave and measuring the time it takes for the echo to return. This sensor is critical in the Smart Pet Feeding System for detecting the presence of pets and measuring food levels in the feeder. It consists of two main components: the transmitter, which emits the ultrasonic pulse, and the receiver, which captures the echo.

When the ultrasonic pulse is emitted, it travels through the air until it encounters an object (the pet or food level) and reflects back to the sensor. The HC-SR04 calculates the distance based on the time taken for the echo to return. This information is processed by the ESP8266 microcontroller to determine when food should be dispensed. The sensor's accurate and quick response time makes it ideal for real-time monitoring in automated systems.

Fig 3: Ultrasonic Sensor

3.1.3 Servo Motor:

The 360-degree servo motor is a type of motor that provides continuous rotation, making it suitable for applications like food dispensing in the Smart Pet Feeding System. Unlike standard servos that operate within a limited range, the 360-degree servo can rotate continuously in either direction. This feature is essential for controlling the dispensing mechanism, as it allows for precise control over how much food is released.

Fig 4: Servo Motor

The servo motor is controlled by the ESP8266, which sends PWM (Pulse Width Modulation) signals to adjust the rotation speed and direction. When activated, the servo motor rotates to dispense food and then returns to its original position. This motor's reliable performance and ease of integration with the ESP8266 make it an ideal choice for the automated pet feeding application.

3.2 Breadboard and Jumper Wires:

A **Breadboard** is a construction base for prototyping electronics. It allows developers to build and test circuits without soldering, making it a reusable and versatile tool for experimentation. The breadboard consists of rows and columns of electrically connected terminals where components can be inserted. These terminal

strips are usually made of metal and are connected in a grid pattern under the plastic surface of the board. The breadboard has two main types of connections: the power rails, which run along the sides of the board, and the terminal strips, where most components are connected.

Jumper wires are essential accessories when working with breadboards. These wires are used to connect various components to the breadboard or between different points on the breadboard. Jumper wires come in three types: male-to-male, male-to-female, and female-to-female, allowing for flexible connections based on the project's needs. They are available in different lengths and colors, making it easy to organize and manage connections. Jumper wires ensure a solid electrical connection between components and help transfer signals and power. In this project, jumper wires are used to connect the ESP8266 to the ultrasonic sensor, servo motor, and the power supply, as well as to link other essential parts of the circuit.

Fig 4: Breadboard and Jumper Wires

SOFTWARE DESCRIPTION

3.1.1 Arduino IOT Cloud:

Fig 5: ARDUINO IOT CLOUD

The Arduino IoT Cloud is a robust and user-friendly platform designed to simplify the creation, deployment, and management of Internet of Things (IoT) devices, making it ideal for the Smart Pet Feeding System. It enables developers to build IoT applications by connecting and controlling devices like the ESP8266 over the internet.

With Arduino IoT Cloud, users can monitor data from sensors, such as the ultrasonic sensor that detects pet presence and food levels, and control actuators, like the servo motor that dispenses food, remotely through a web-based dashboard or a mobile app.

A standout feature of the platform is its drag-and-drop interface, allowing users to create interactive dashboards with minimal coding. It supports various widgets, such as switches for controlling the feeding mechanism and gauges for displaying system status, which can be linked to variables in the IoT devices for real-time monitoring and control. This makes it easy for pet owners to visualize data from the ultrasonic sensor and manage the feeding process remotely.

Arduino IoT Cloud integrates seamlessly with the Arduino IDE, providing a streamlined coding and debugging experience for IoT projects. It supports both C++ programming and automated code generation, helping beginners get started quickly while allowing more advanced users to customize the code to extend the system's capabilities.

Additionally, the platform provides cloud storage for data, enabling users to store and analyze historical feeding habits and sensor readings. It also supports over-the-air (OTA) updates, allowing firmware to be updated remotely, which simplifies maintenance and upgrades. With its versatile capabilities, the Arduino IoT Cloud enhances the Smart Pet Feeding System, ensuring convenience and peace of mind for pet owners managing their pets' feeding schedules from anywhere.

3.2 CIRCUIT DIAGRAM:

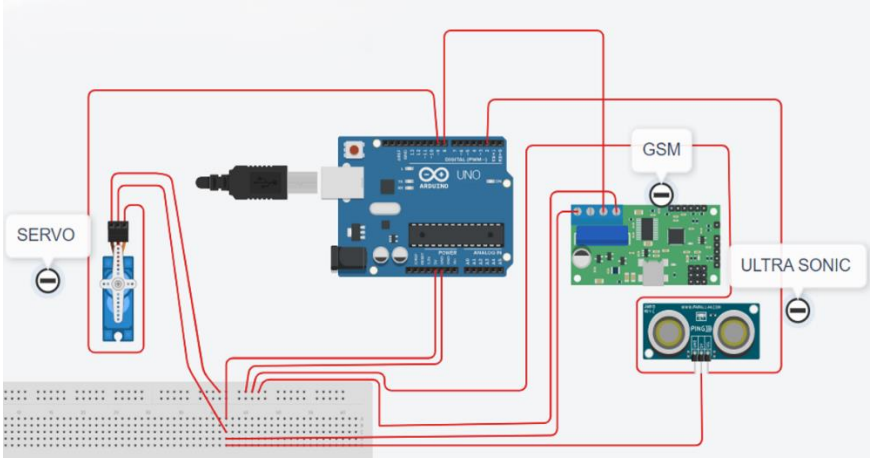

Fig 6: CIRCUIT DIAGRAM OF SMART PET FEEDING

The above fig 6 shows the circuit diagram of Smart Pet Feeding System.

3.3: CODE IMPLEMENTATION:

code controls a smart pet feeder using an ultrasonic sensor (HC-SR04) to detect the presence of a pet and a servo motor to dispense food. The ultrasonic sensor measures the distance to the pet, and if the pet is detected within a 10 cm range (set by distanceThreshold), the servo rotates to dispense food. The servo rotates back and forth between 0 and 180 degrees for nine cycles, simulating food dispensing. The system waits until the pet moves away, then resets, ready for the next detection. Serial communication is used to log when the pet is detected, when it eats, and when it moves away.

https://app.arduino.cc/things/c1b753dd-f3f7-4481-bdb7-1bdcb4575e7b/sketch

Chapter -4 IMPLEMENTATION

4.1 Object Detection:

The Object Detection sensor is used to detect the objects. For this we are using the ultrasonic sensor to detect the pet when it comes near

4.2 Signal Processing:

Ultrasonic signal processing involves triggering the sensor to emit a sound pulse, which reflects off an object and returns to the sensor. The time taken for the echo to return is measured and converted into a distance using the speed of sound in air.

4.3 Decision Making:

The microcontroller evaluates the pressure input, and if an intrusion is detected, it triggers the alarm and sends an alert to the Arduino IoT Cloud for remote monitoring.

4.4 Wi-Fi Connectivity:

The ESP8266 uses its built-in Wi-Fi module to transmit data to the Arduino IoT Cloud, enabling real-time monitoring and remote control through the IoT Cloud app.

4.5 IOT Cloud Platforms:

The Arduino IOT Cloud platform allows users to monitor the system, receive alerts, and control it remotely via a dashboard with a messenger and switch widget.

4.6 Alarm Activation:

If an intrusion is confirmed, the ESP8266 activates the servo motor to feed the via the Arduino IoT Cloud app.

Chapter-5 CONCLUSION AND FUTURE SCOPE

5.1 Conclusion: In conclusion, the IoT-based automatic pet feeding system represents a significant advancement in pet care, utilizing smart technology to automate the feeding process. By integrating the ESP8266 microcontroller, the system facilitates real-time monitoring and control through the Arduino IoT Cloud, enabling pet owners to manage their pets' feeding schedules effectively, even when they are away from home. This innovative solution not only allows for the scheduling of meals and adjustment of portion sizes but also enhances pet health by ensuring consistent and timely feeding. The incorporation of sensors, such as ultrasonic sensors, further optimizes the feeding process by detecting when pets have finished eating and sending notifications when food levels are low. This proactive approach minimizes the risk of missed meals and ensures that pets with dietary restrictions receive the proper care they need. Overall, the project exemplifies the transformative potential of IoT technology in improving the quality of life for pets and their owners alike**.**

5.2 Future Scope: The future scope of the IoT-based automatic pet feeding system is expansive, with numerous opportunities for enhancements and integrations. Key areas for future development include:

5.2.1 Enhanced Sensor Integration:

Incorporating additional sensors, such as temperature and humidity sensors, could improve the monitoring of pet environments, ensuring optimal conditions for food storage and pet well-being.

5.2.2 AI and Machine Learning Algorithms:

Implementing AI-driven analytics could personalize feeding schedules based on pets' behaviors and preferences, enhancing the system's adaptability to individual pet needs.

5.2.3 Advanced Mobile Application Features:

Developing a more robust mobile application could provide features such as video monitoring, remote feeding control, and the ability to receive health insights based on feeding patterns, creating a comprehensive pet care solution.

5.2.4 Integration with Smart Home Systems:

The system could be integrated with other smart home devices, such as cameras or alarms, allowing for a seamless experience in monitoring and managing pet care alongside home security.

5.2.5 Data Analytics for Health Monitoring:
Utilizing the data collected from feeding habits, the system could offer insights into pets' health trends and notify owners of any concerning changes, promoting proactive veterinary care**.**

5.2.6 User Community Engagement:
Establishing a platform for users to share experiences and suggestions could foster community-driven enhancements, enabling ongoing refinement of the system and exploring new use cases.

5.3 Applications: The IoT-based automatic pet feeding system has a broad spectrum of applications across various sectors, primarily in pet care and smart home automation. Here are some key applications:

- **Home Pet Care:**
  This system is ideal for pet owners, ensuring their pets receive timely meals, especially during busy schedules or travel.
- **Veterinary Clinics:**
  Veterinarians can use the system to provide tailored feeding plans for pets with specific dietary needs, enhancing care for their patients.
- **Pet Boarding Facilities:**
  These facilities can deploy the system to manage feeding schedules for multiple pets, ensuring consistency and monitoring their health while owners are away.
- **Pet Shelters and Rescue Organizations:**
  Shelters can utilize the system to maintain consistent feeding schedules for rescued animals, promoting their health and well-being during rehabilitation.
- **Smart Homes:**
  The system can be integrated into smart home setups, enhancing the automation of pet care alongside other home management tasks, creating a cohesive living environment.

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  https://arduino-esp8266.readthedocs.io/en/latest/