Smart Pet Guardian

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***Abstract*— The integration of Internet of Things (IoT) technologies into daily life presents unprecedented opportunities for enhancing the quality of living for both humans and pets. The Smart Pet Guardian (SPG) system, leveraging advanced IoT and cloud computing technologies, embodies this by offering real-time pet monitoring and management capabilities. This paper delves into the architecture, implementation, and evaluation of SPG, illustrating its contribution to smart pet management solutions.**

Keywords— Internet of Things (IoT), Amazon Web Services (AWS), Global Positioning System (GPS), Radio Frequency Identification (RFID), Application Programming Interface (API), Smart Pet Guardian (SPG).

I. Introduction

The increasing concern for pet safety and health among pet owners has necessitated innovative solutions. The SPG project seeks to address this need by utilizing IoT to provide real-time monitoring and management of pets. Incorporating sensors for location tracking and activity monitoring, and a user-friendly interface for pet owners, SPG exemplifies the potential of IoT in enhancing pet care.

II. System Architecture and Features

The architecture of the Smart Pet Guardian (SPG) system is designed to integrate various components of Internet of Things (IoT) technologies to provide a comprehensive pet management solution as shown in Figure 1. This architecture encompasses hardware devices for data collection, cloud services for data processing and storage, and a user interface for interaction with the system. Here's a detailed breakdown of the SPG architecture:

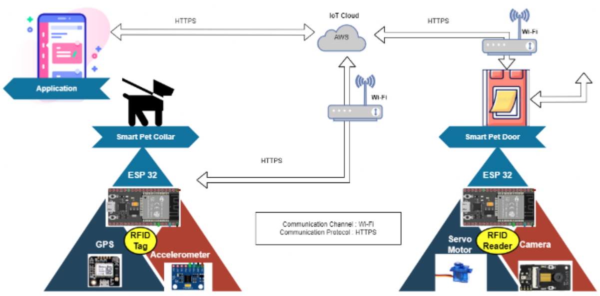

Figure 1: Architecture Diagram

A. Hardware Layer

The core of the hardware layer is the ESP32 microcontroller, selected for its low power consumption, integrated Wi-Fi, and ample processing capabilities. It interfaces with GPS modules for location tracking and RFID tags for pet identification. A servo motor, actuated upon successful RFID authentication, controls a pet door, enhancing the pet's autonomy while ensuring security. Additionally, the ESP-EYE is used to provide the user with a live video stream of the pet door.

B. Connectivity and Communication Layers

Using Wi-Fi, the ESP32 connects to the internet, transmitting data to cloud services for processing. The system employs HTTPS for secure data transmission, ensuring efficient and secure communication between devices and the cloud.

C. Cloud Service Layer

AWS Lambda and API Gateway form the backbone of data processing and API management. Lambda functions respond to events triggered by incoming data, while API

Gateway facilitates communication between the user interface and backend services. Amazon S3 and DynamoDB provide storage solutions for unstructured and structured data, respectively.

D. User Interface Layer

Developed with React, the user interface offers real-time monitoring of pets' locations and health statistics. It features alerts for specific events like geofence breaches and supports door control for managing pet access.

III. DESIGN DECISIONS

The choice of ESP32 and AWS was guided by considerations of power efficiency, memory capacity, connectivity, cost-effectiveness, and integration capabilities with cloud services. These selections were instrumental in achieving a balance between performance and cost, making SPG a scalable and user-friendly solution.

IV. EVALUATION AND FUTURE DIRECTIONS

A. Limitations

The system, while effective, faces limitations such as battery dependency and Wi-Fi range constraints. The current feature set, though extensive, could be expanded to include more sophisticated health and behavioural analysis tools. The project is also limited by the capabilities of the sensors – the GPS module does not provide accurate measurements of speed and the RFID reader is only able to detect tags placed at a very close distance.

B. Improvements

Future improvements might involve incorporating alternative power sources, additional sensors for comprehensive monitoring, and exploring newer IoT communication standards like LoRaWAN or 5G IoT for improved scalability and responsiveness.

V. CONCLUSION

The Smart Pet Guardian project stands as a significant advancement in pet care technology, demonstrating the applicability of IoT in enhancing the well-being of pets. By addressing current limitations and embracing future technological developments, SPG aims to provide even more comprehensive and effective solutions for pet owners worldwide.