1 Name of Use Case

Name of the Use Case	**Smart IoT platform for plant care**
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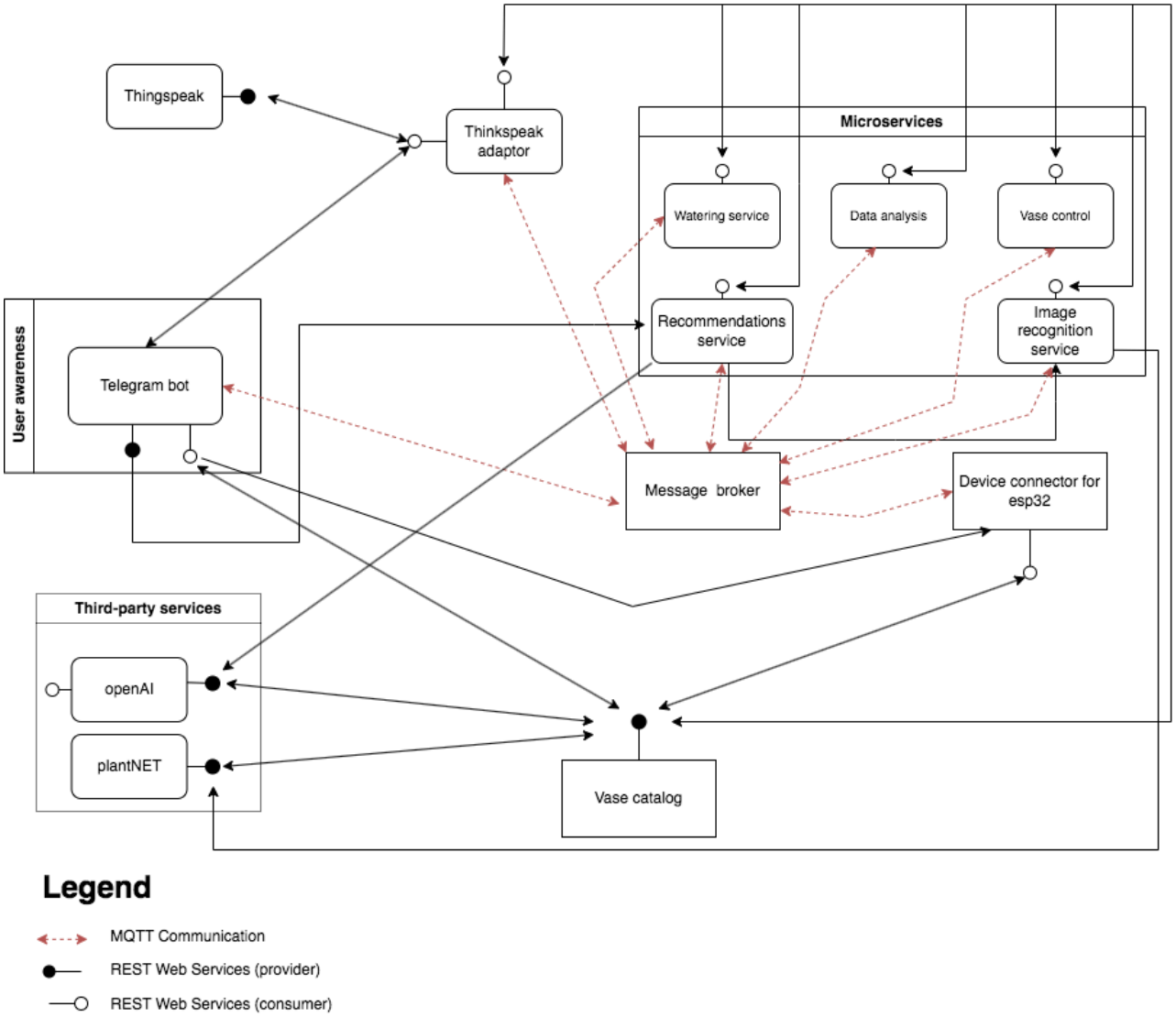
2 Scope and Objectives of Function

Scope and Objectives of Use Case	
Scope	This project integrates image recognition, ESP32-equipped vases with humidity, temperature and light level sensors, a Raspberry Pi, and a Telegram bot for personalized plant care. It includes an automated watering system with a pump, ensuring precise irrigation based on soil moisture levels with smart vases.
Objective(s)	The objective of this project is to develop a platform to manage an intelligent IoT smart vase system that utilizes image recognition for plant identification, an openAI API to get plant specification and integrates ESP32-equipped vases with soil sensor, a Raspberry Pi decision-making system, and a Telegram bot for personalized plant care recommendations. Based on the plant identity the project aims to implement an automated watering system control with a water pump, ensuring precise irrigation based on real-time soil moisture levels, a light control system based on light photoreceptor sensor, and a temperature monitor. User will be notified about plant status and advised to set the best environment, based on AI specifications. Also the user will be alerted when the battery is over or the water is missing.
Domain(s)	Smart plant care – Image recognition – Smart monitoring and watering system.
Stakeholder(s)	Plant owners – Plant and flower shops - Plants
Short description	This interdisciplinary project merges IoT, image recognition, and home automation to create a smart vase system. It employs ESP32-equipped vases with soil sensors, a Raspberry Pi decision-making system, and a Telegram bot. The system not only identifies plant species through image recognition but also optimizes plant care by automating watering through a pump, adjusting environmental conditions, and providing personalized recommendations, all facilitated by efficient communication using REST and MQTT protocols. The intuitive user interface ensures seamless interaction, making it a comprehensive solution for smart and efficient plant management.

3 Diagram of Use Case



4 Complete description of the system

The IoT smart vase system is designed with a modular microservices approach, employing MQTT for real-time communication and RESTful Web Services for efficient interactions. It incorporates image recognition, recommendation, device connection, data analysis, watering, light, Telegram bot, ThingSpeak, Message Broker, Vase Control, and Vase Catalog components.

Image recognition service
In the image recognition process, users submit plant images to the Telegram bot, which utilizes a Pl@ntNet-300K model for identification. The recognized plant names are stored in the Vase Catalog for future retrieval.

Recommendation service
The recommendation service fetches plant names from either image recognition or the Vase Catalog. It then provides tailored suggestions via the Telegram bot using OpenAI's API. Additionally, the service imparts care tips, and all relevant data is stored in the Vase Catalog.

Device connector
The device connector, an ESP32, interfaces with connected light, soil moisture, and temperature sensors in each smart vase for real-time environmental data. Using MQTT, it publishes data to the broker, sended to the Thingspeak adaptor and subscribes for pump and light instructions.

Data analysis service
The data analysis service processes data of past measurement from various sensors retrieved from the Thingspeak adaptor through REST api. Then the data processed are sent to telegram bot with REST api where they can be shown as statistical graphs which graphically summarize the status of the plant during the time.

Watering system
The watering system subscribes to receive MQTT commands from the vase control, ensuring plants receive the right amount of water for optimal growth. It sends an alert through MQTT whenever the water level of the tank is too low.

Telegram bot
The Telegram bot acts as a user-friendly interface, facilitating image recognition and recommendations. It sends real-time MQTT notifications to device connectors for environmental changes and allows users to query sensor values through REST from ThingSpeak and past processed data through REST from the data analysis service.

Thinkspeak adaptor
Thingspeak adaptor allows other services to connect through REST and MQTT protocol with ThingSpeak which serves as a cloud-based platform for storing real-time sensor data received through MQTT.

Message broker
The message broker enables asynchronous communication through MQTT, enhancing scalability and responsiveness.

Vase control
The Vase Control implements a control which, based on ideal conditions obtained from vase catalog(REST) , manages the level of water and light using MQTT. It continuously receive(subscribe) sensor measurement from device connector and if needed send(publish) calculated actuation command to watering system and device connector(light)

Vase catalog
The Vase Catalog functions as a centralized repository for device and service details, providing critical information for seamless integration and optimal functionality.

PlantNet
PlantNet offers an image recognition dataset with pretrained models for use in the image recognition service.

OpenAI
OpenAI's APIs contribute personalized plant care recommendations and facts within the recommendation service, maintaining a connection through RESTful communication.

5 Desired Hardware components (only among those we can provide)

1.

Device Name	Quantity	Needed for…