SUP'COM
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Forest Fire Detection System

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Academic year : **2023-2024**

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1. Introduction:

Forest fires are a devastating threat to the environment, causing widespread damage to ecosystems, wildlife habitats, and human communities. Early detection and suppression of forest fires are crucial to minimize their impact. Traditional methods of forest fire detection, such as human observation and aerial surveillance, are often time-consuming, resource-intensive, and ineffective, especially in remote or inaccessible areas.

In this context, we have decided to create a forest fire detection system that must address the following use cases:

1. Smoke and Flame Detection: this task requires a high-resolution camera.

2. Upon detecting smoke or flames, the system will promptly activate an alert notification on the Progressive Web Application (PWA). This notification will clearly communicate the nature of the detected hazard (smoke or flame), including its location, the nearest water source and the nearest fire station.

2. Conception:

2.1. Use case diagram:

A Use Case Diagram is a visual representation of the interactions between actors and the system they interact with. It helps to define the scope of a system and the functionalities it provides.

The client enjoys a range of vital functionalities within the Forest Fire Detection system through a mobile application. They gain real-time access to visual data captured by fire detection cameras spread across the forest, enabling them to monitor potential fire outbreaks. Additionally, the client receives immediate alerts upon fire detection, ensuring timely response and action. Crucially, the application equips users with directions to the nearest water source in case of fire, offering not just alerts but also practical guidance to safety. This comprehensive tool empowers users to visualize, respond, and navigate effectively in critical situations, contributing significantly to forest fire prevention and safety measures.
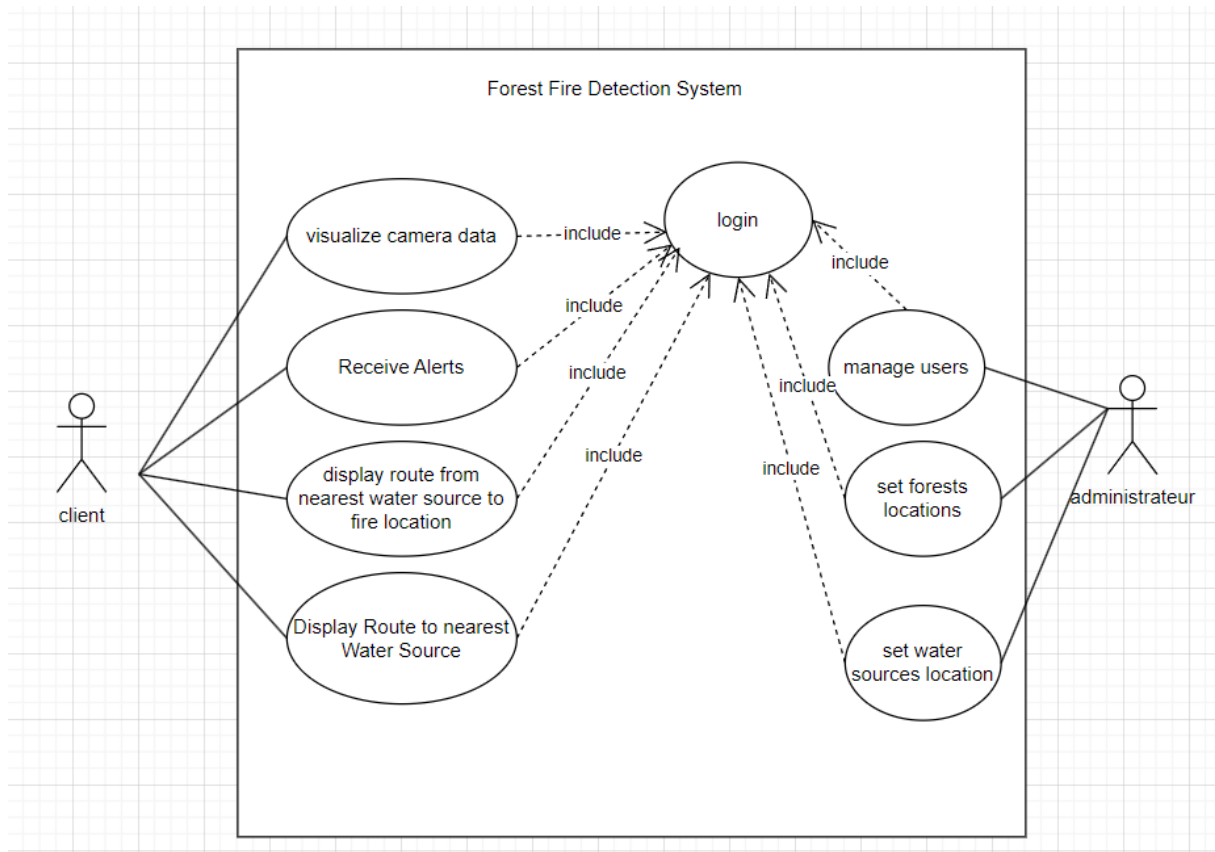
Figure 1: Use case diagram

2.2.   Sequential diagram:

The sequential diagram comprises four interconnected components: the IoT system, Mosquitto, Node-RED, and the client interface. At the core of this system, the IoT setup serves as the sensor and data hub, responsible for publishing updates regarding the forest state. Specifically, it publishes updates to the "forest_state" topic. In the event of fire or smoke detection, triggered by the IoT system, an alert message bearing the status "on" is published to the "alert" topic. Mosquitto, acting as the MQTT broker, efficiently manages and routes these messages. Node-RED, the flow-based development tool, acts as the mediator, intercepting messages from Mosquitto, processing the data, and orchestrating subsequent actions based on the received alerts or forest state updates. Finally, the client interface interacts with Node-RED to receive and display these alerts in real-time, providing crucial information and timely notifications to users, ensuring prompt responses in case of fire emergencies. This sequential interaction among the components forms a robust system enabling swift communication, data processing, and user interface updates for effective forest fire detection and response.
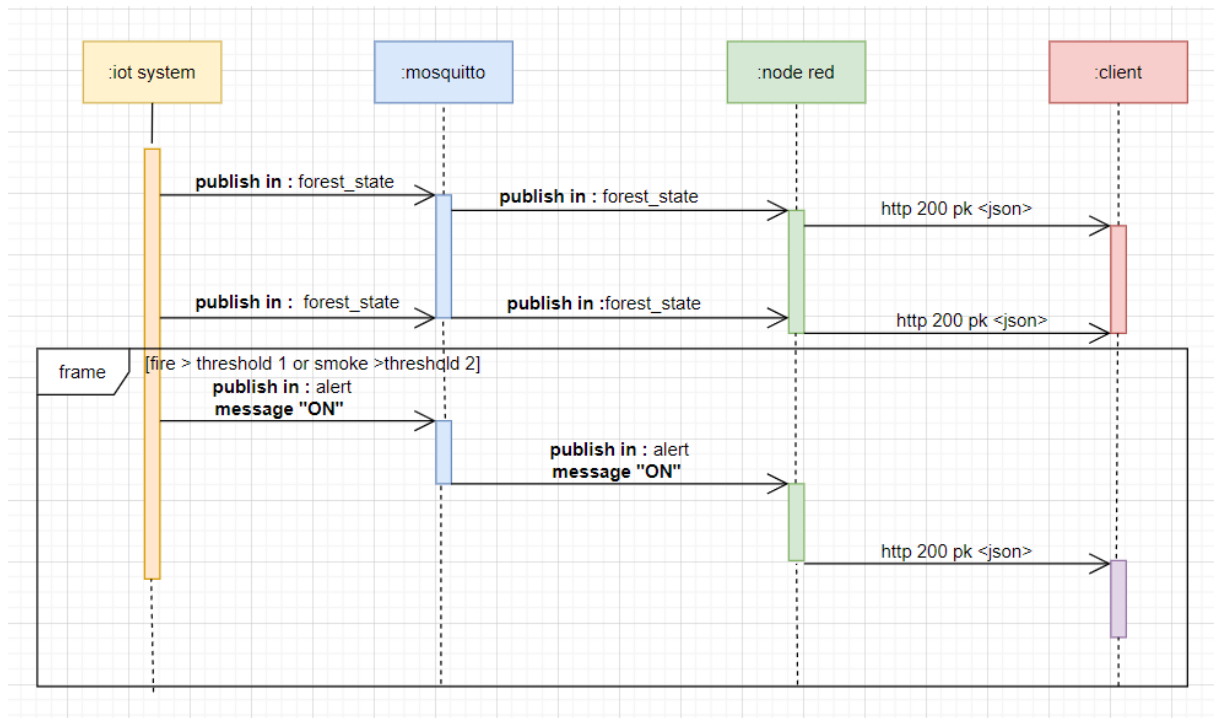
Figure 2: sequential diagram

2.3. Class diagram

A class diagram describes the structure of a software system by showing the system's classes, their attributes, operations, and the relationships between objects. The iot system is composed of a high-resolution camera. The other part of the project is the mobile application side. The users of the application are in contact with the application through user interface. The mobile application gives the user the following access:

- Create an account.
- Subscribe to the application services.
- Check on the status of the sensors in real-time.
- Receive alerts in case of fire or smoke detection.
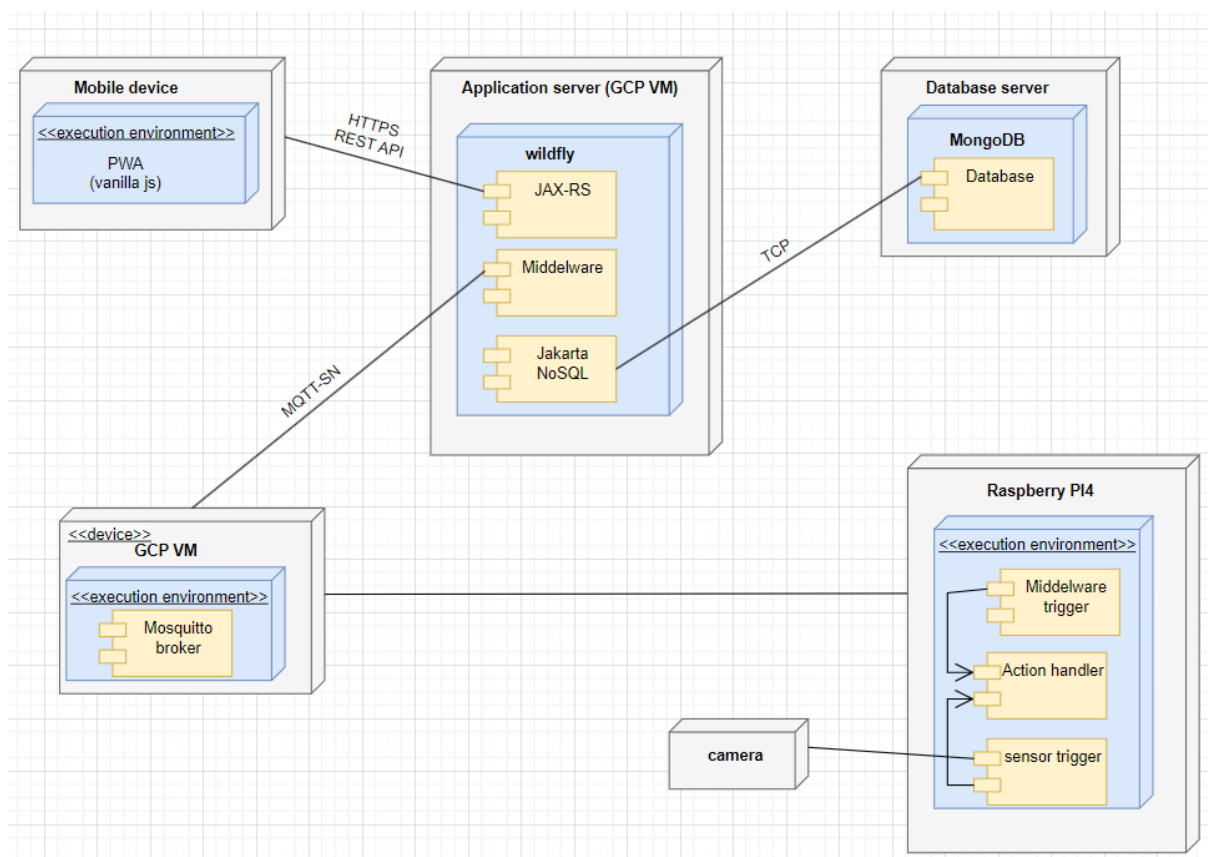- Visualize route to nearest fire station and water source in case of fire or smoke detection.
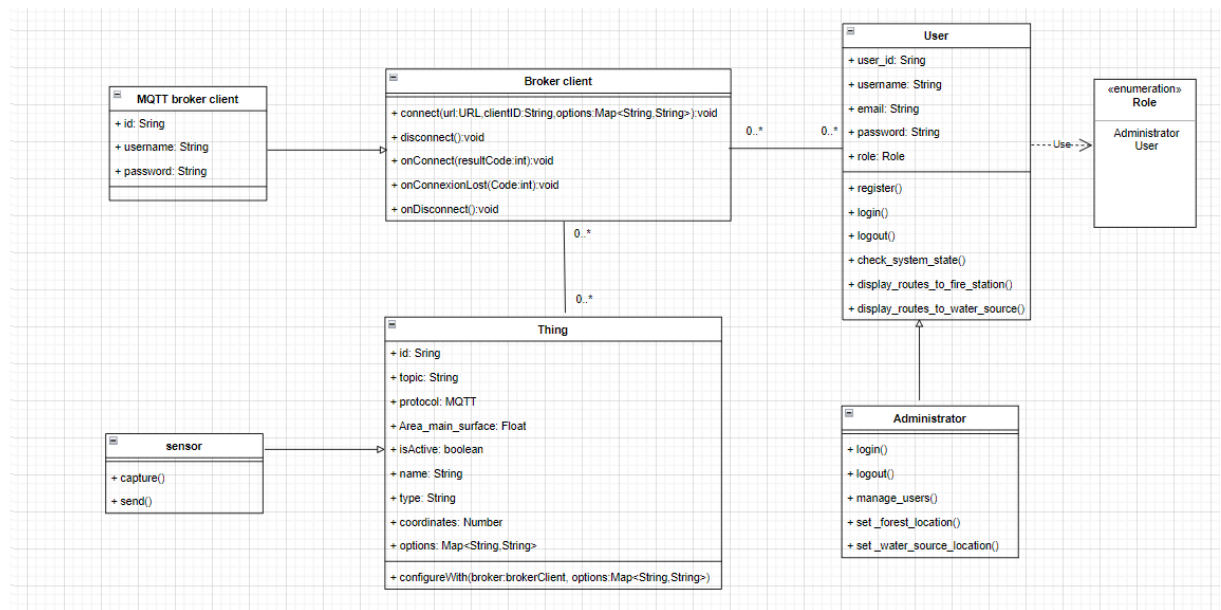
2.4. Deployment diagram

Figure 3: Deployment diagram