REPORT

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Background: In the vast agricultural expanse of rural India, farmers endure the inherent challenges of an unpredictable climate, fluctuating soil conditions, and the ever-looming threat of natural disasters. Agriculture, being the backbone of the rural economy, is intricately woven into the lives of the farmers who heavily depend on their crops for sustenance and livelihood. However, the age-old practices passed down through generations are proving insufficient in mitigating the complexities arising from contemporary environmental issues.

The scenario is particularly poignant as farmers deal with erratic weather, unexpected fires, because they lack the tools and knowledge required to make proactive decisions to safeguard their crops. This situation is exacerbated by the lack of real-time data and remote monitoring capabilities, leaving farmers with limited tools to anticipate, respond to, and mitigate potential threats.

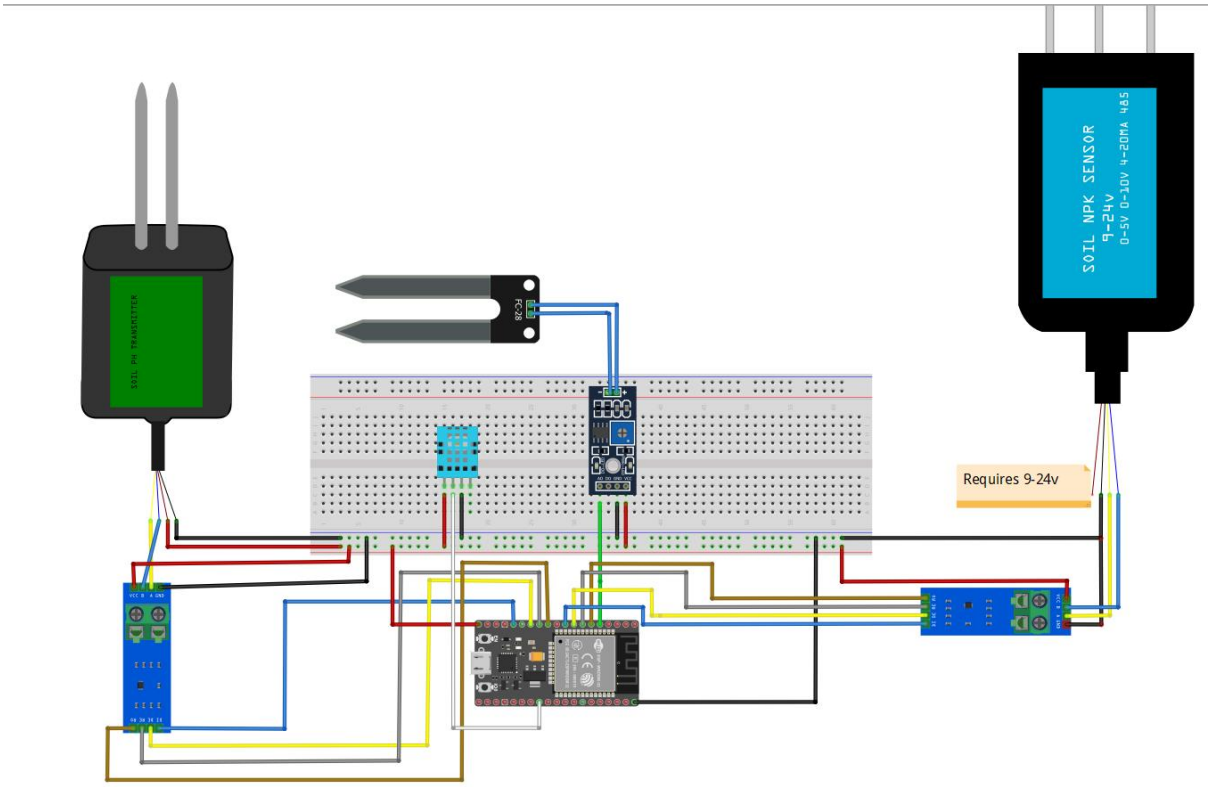
Problem Statement: In the agrarian landscapes of India, farmers face an alarming gap in their ability to effectively manage and protect their crops against the backdrop of rapidly changing environmental conditions. Traditional methods of farming, while rooted in tradition, are falling short in providing the necessary precision and adaptability needed in the face of modern challenges.

The absence of a reliable and real-time monitoring system leaves farmers vulnerable to the adverse impacts of climate change, fires, and soil degradation. The consequences are dire, resulting in reduced yields, economic instability, and an uncertain future for the farming community. The need for an innovative solution becomes apparent as farmers grapple with the urgent requirement for timely and actionable information that can empower them to make informed decisions and adopt sustainable practices.

In this context, our project aims to address the critical gaps in current agricultural practices by providing a comprehensive soil monitoring system. By focusing on key environmental factors like CO2 levels, temperature, humidity, and the potential threat of fires, we aim to equip farmers with the tools they need to navigate the challenges of modern agriculture. This initiative seeks to empower farmers with information that goes beyond tradition, enabling them to proactively manage their fields, enhance productivity, and secure a more sustainable future for Indian agriculture.

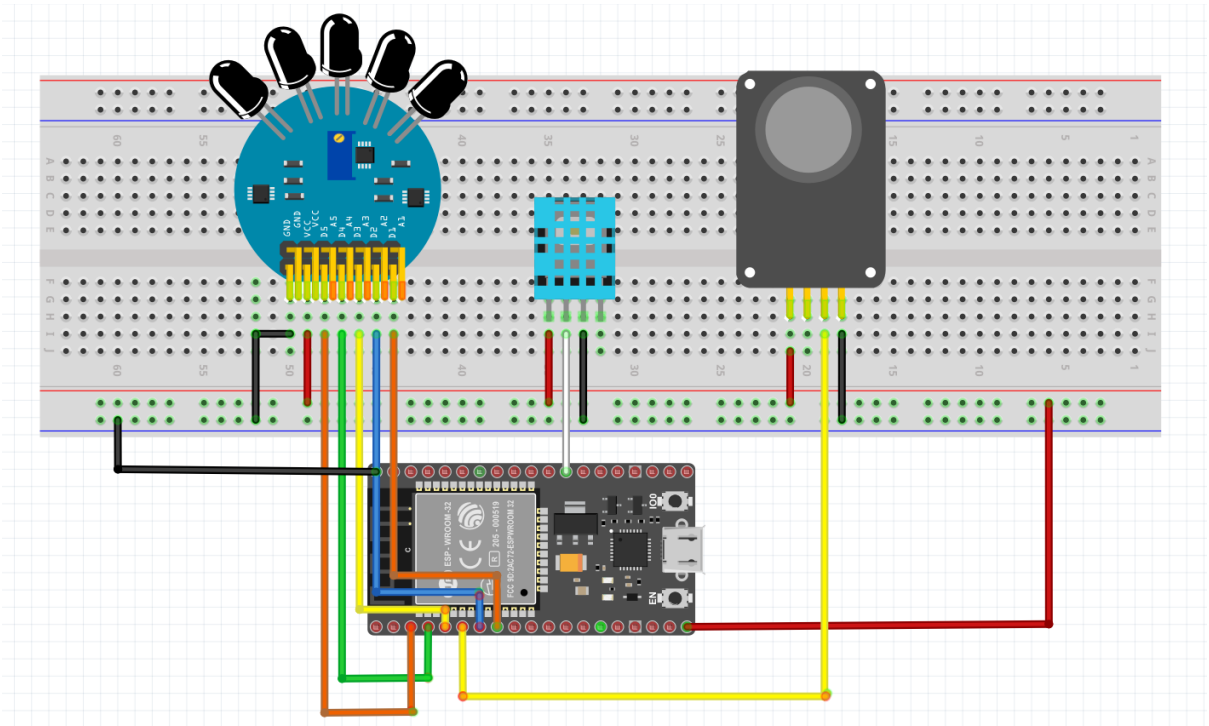
Methodology: Our soil monitoring IoT system consists of 3 modules, the Home module, the Field module and the Storage module.

Field module: The Field module is set up in the field. It is equipped with an ESP32 microcontroller, ESP32 camera module for animal detection and live CAM feed, a DHT11 sensor for monitoring temperature and humidity, moisture sensor for assessing soil moisture levels, NPK sensor and pH sensor.



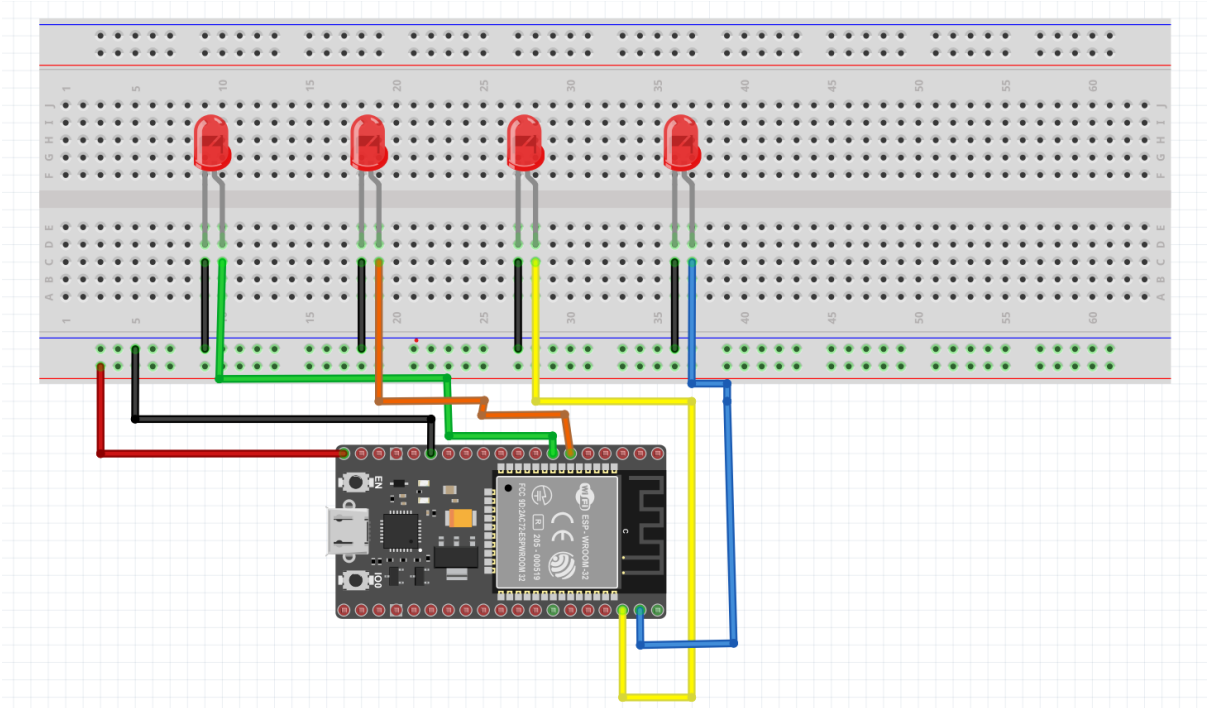
Storage module: The Storage module consists of ESP32 camera module, a DHT 11 sensor, and a 5-channel flame sensor to detect potential fire hazards.

The ESP32 cam module provides a live feed of the storage shed.



Home module: The Home module is made for farmers who may not be proficient with mobile phones. It contains of an ESP32 microcontroller with four LED lights.

Each light illuminates under specific conditions:
1) If flames are detected in storage shed.
2) If animals are detected in field .
3) If the soil is dry and needs irrigation.
4) If the CO_2 concentration goes beyond the threshold limit in storage shed.



Integration with cloud:

All sensor values and images are managed through an API. AWS Lambda functions transfers the data to DynamoDB database tables.
If sensor or image data meets alerting condition, the values are also sent to a “notifications” table. The notifications are received by the farmer through a mobile app and also they are alerted via blinking led in home module.

Results: The successful implementation of the system yielded promising results. The Field Module effectively monitored environmental parameters and animal presence, while the Storage Module ensured the safety of stored crops. The Home Module provided an accessible interface for farmers, enabling quick response to potential issues. Data transmission and notification mechanisms demonstrated reliability, ensuring farmers receive timely alerts, enhancing their ability to make informed decisions.

Current prototype:

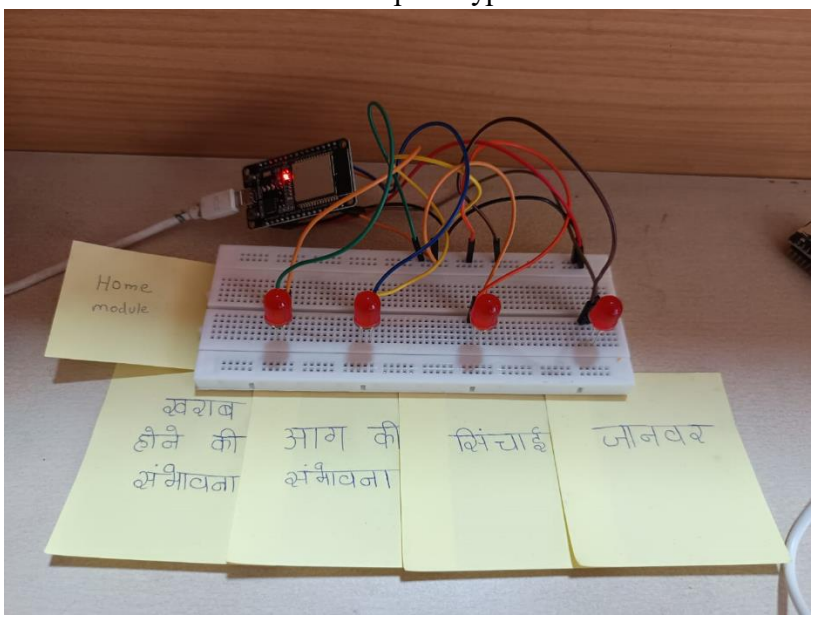


Figure 1: Home module

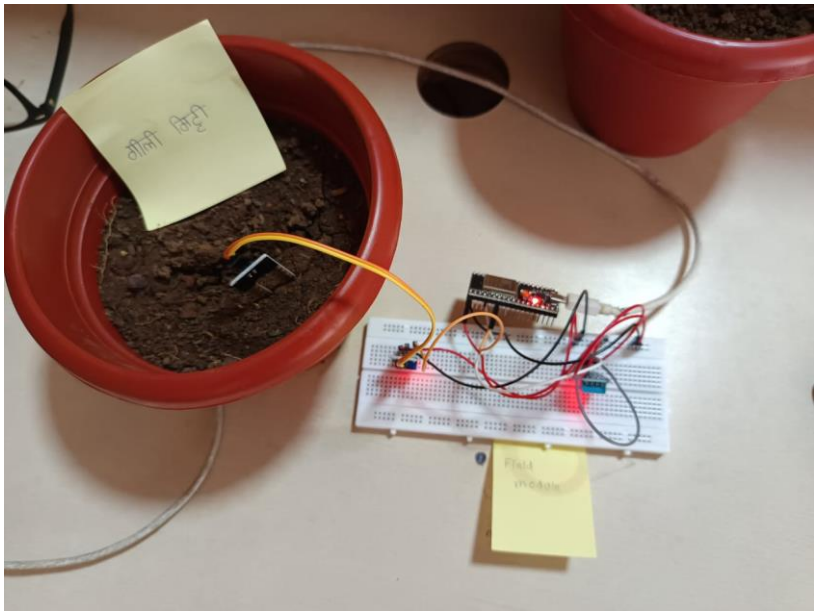


Figure 2: Field module

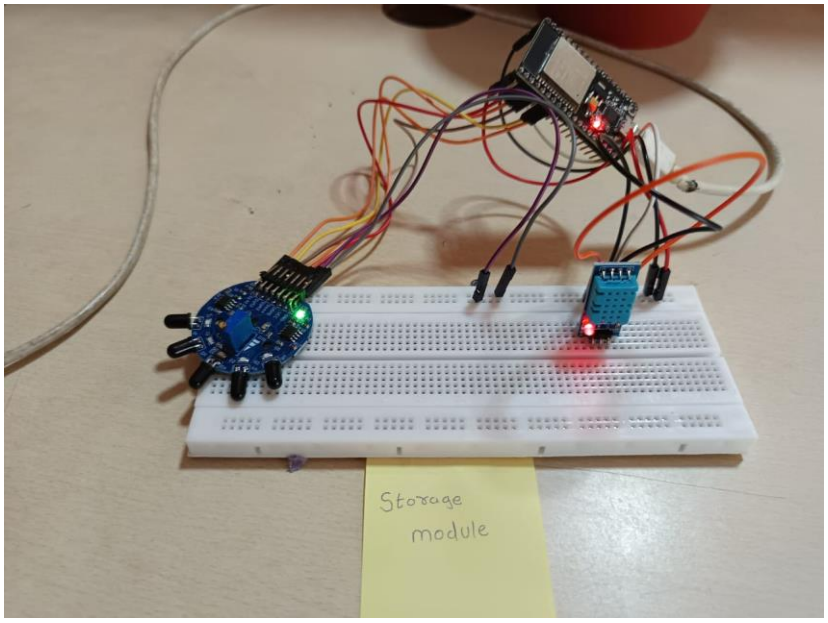


Figure 3: Storage module

Cloud Deployment:

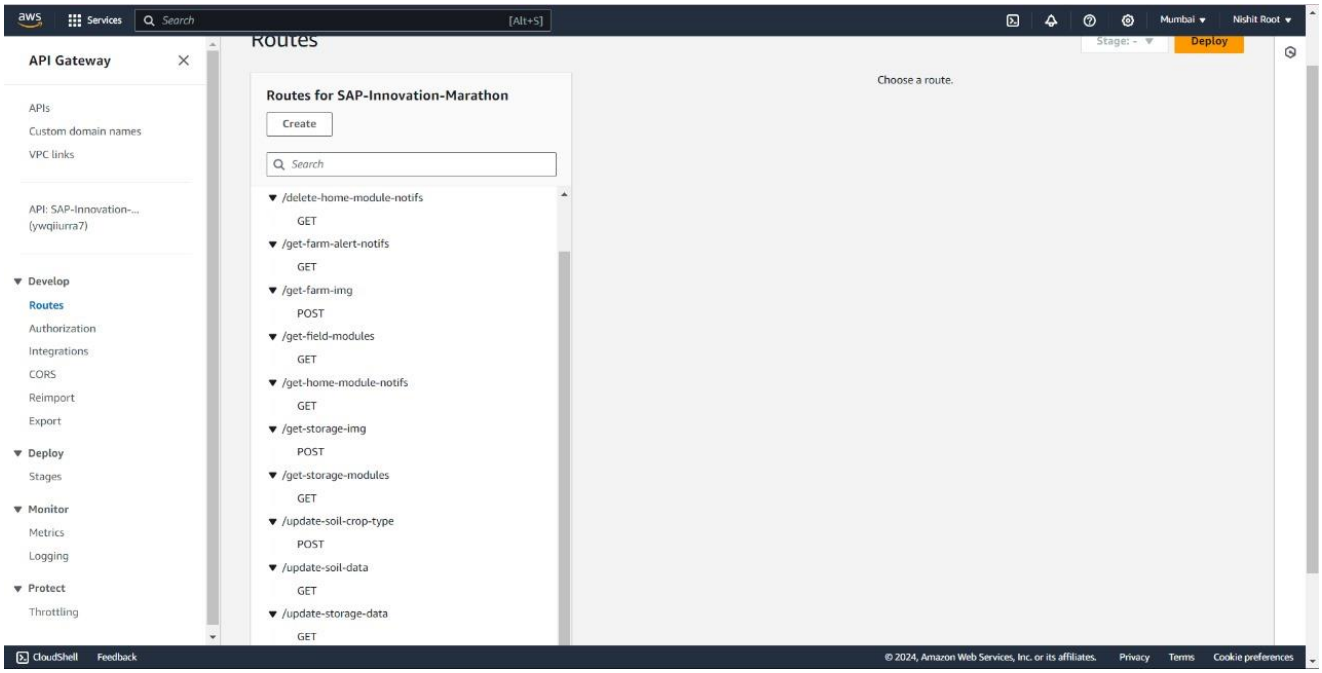


Figure 4: API Gateway

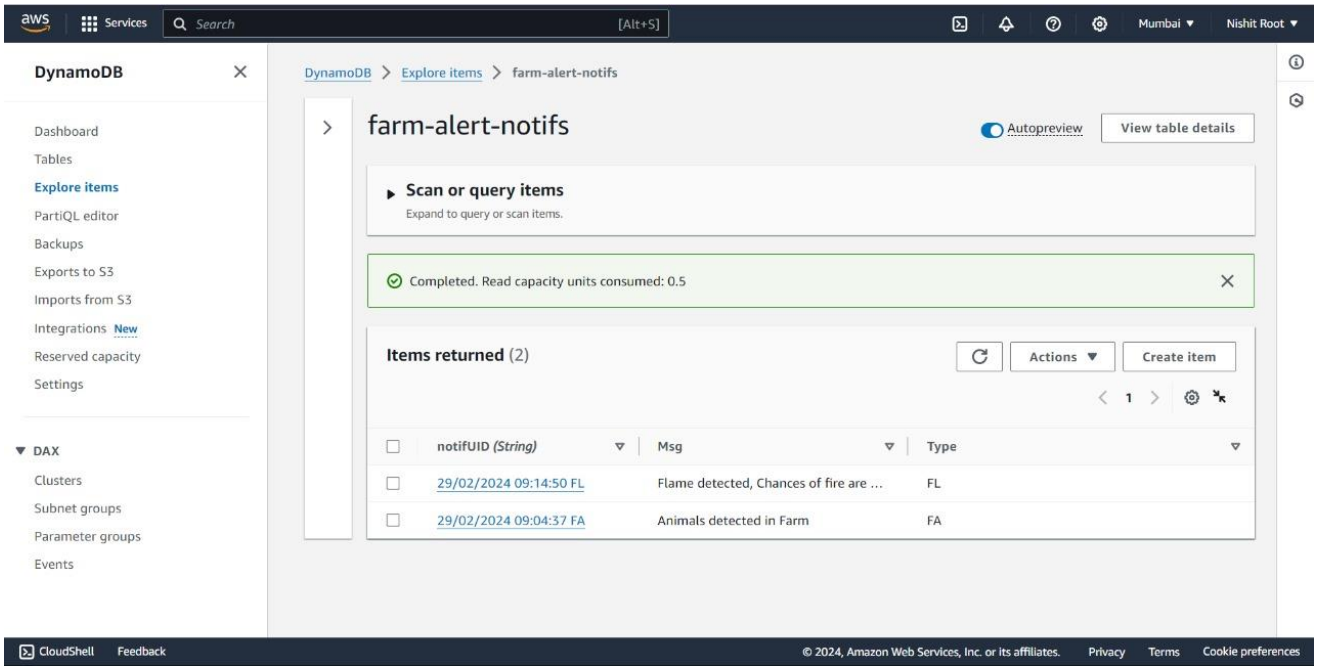


Figure 5: DynamoDB table

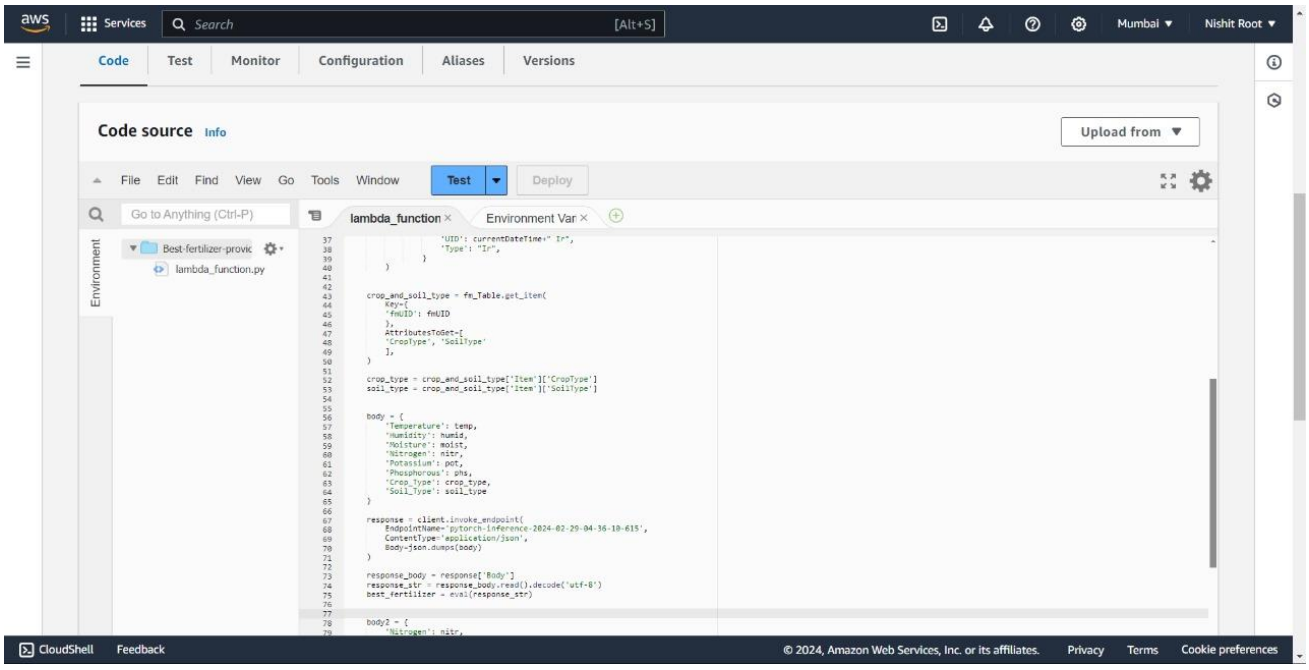


Figure 6: AWS Lamda Function

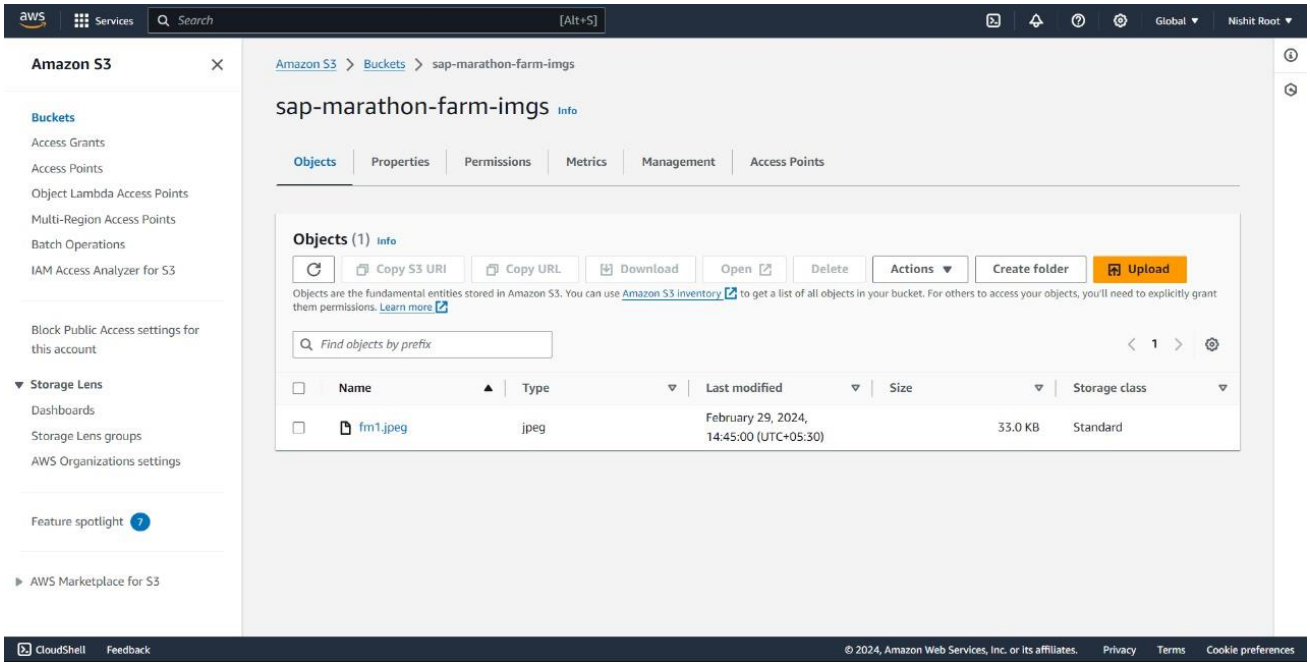
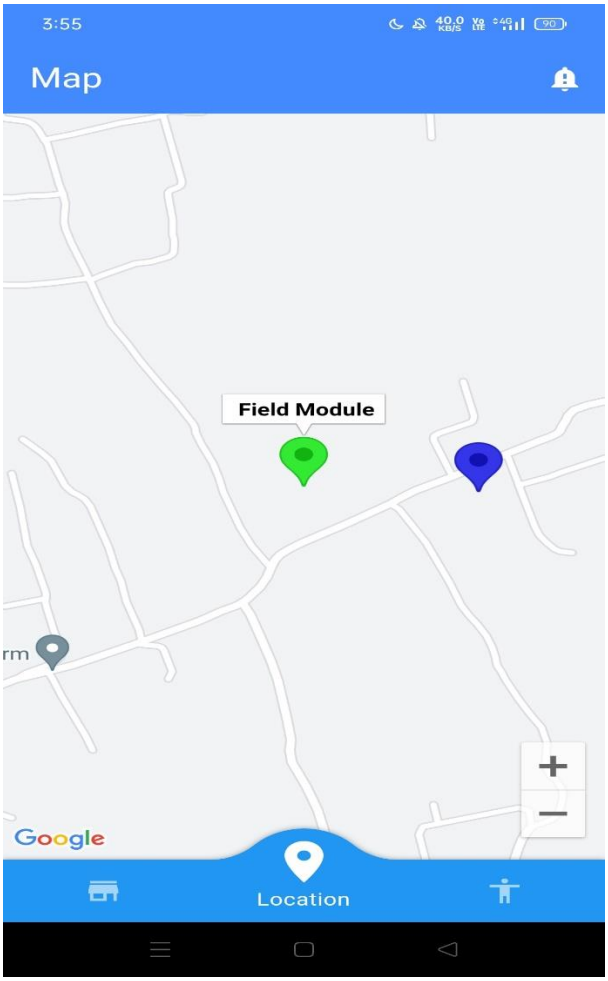
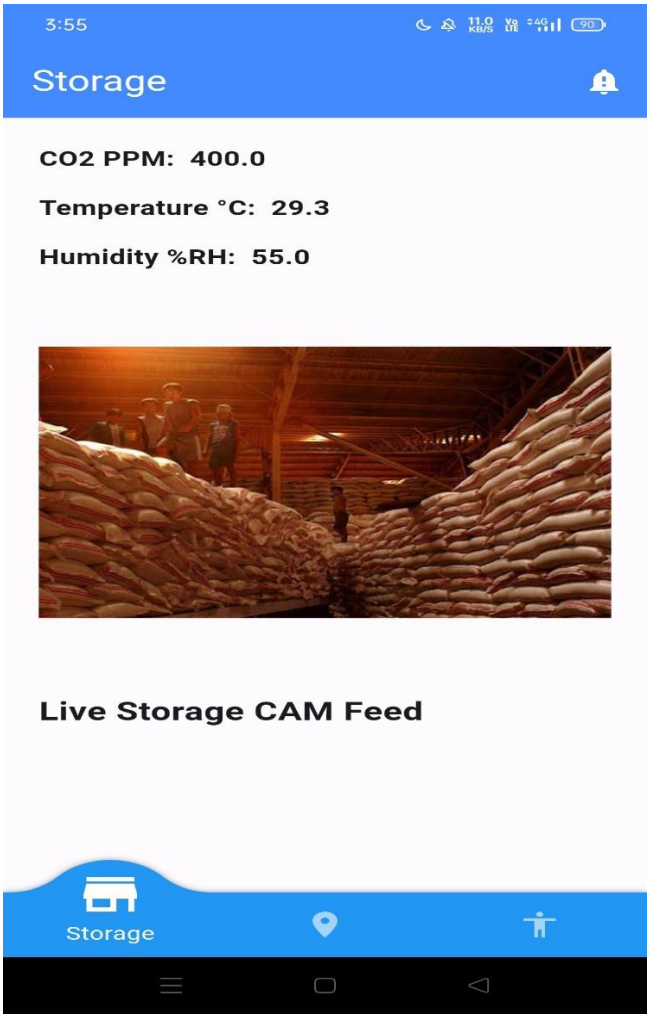
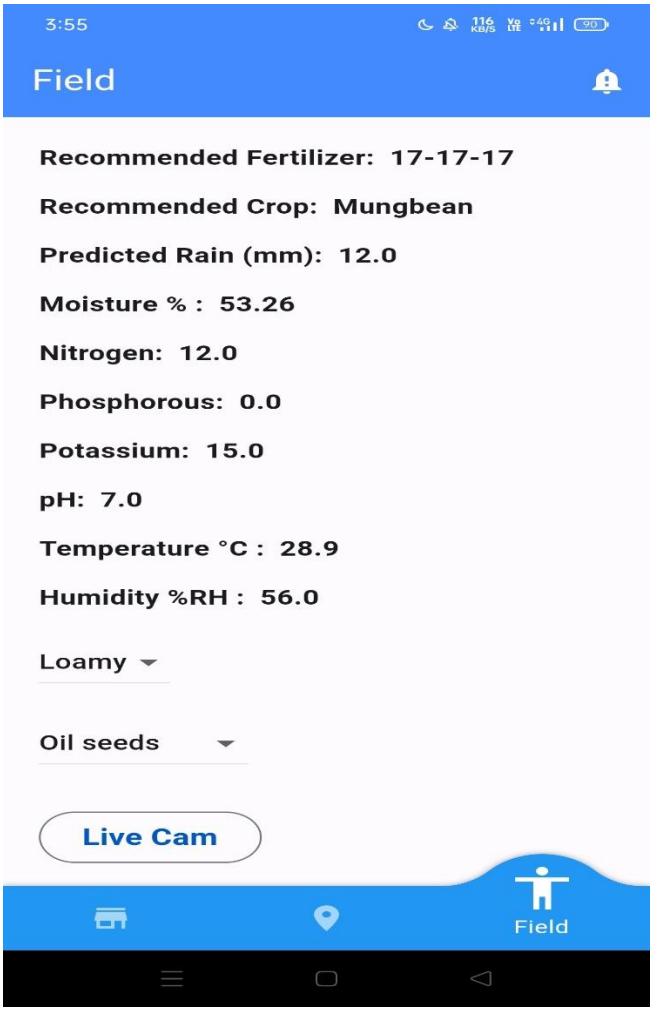


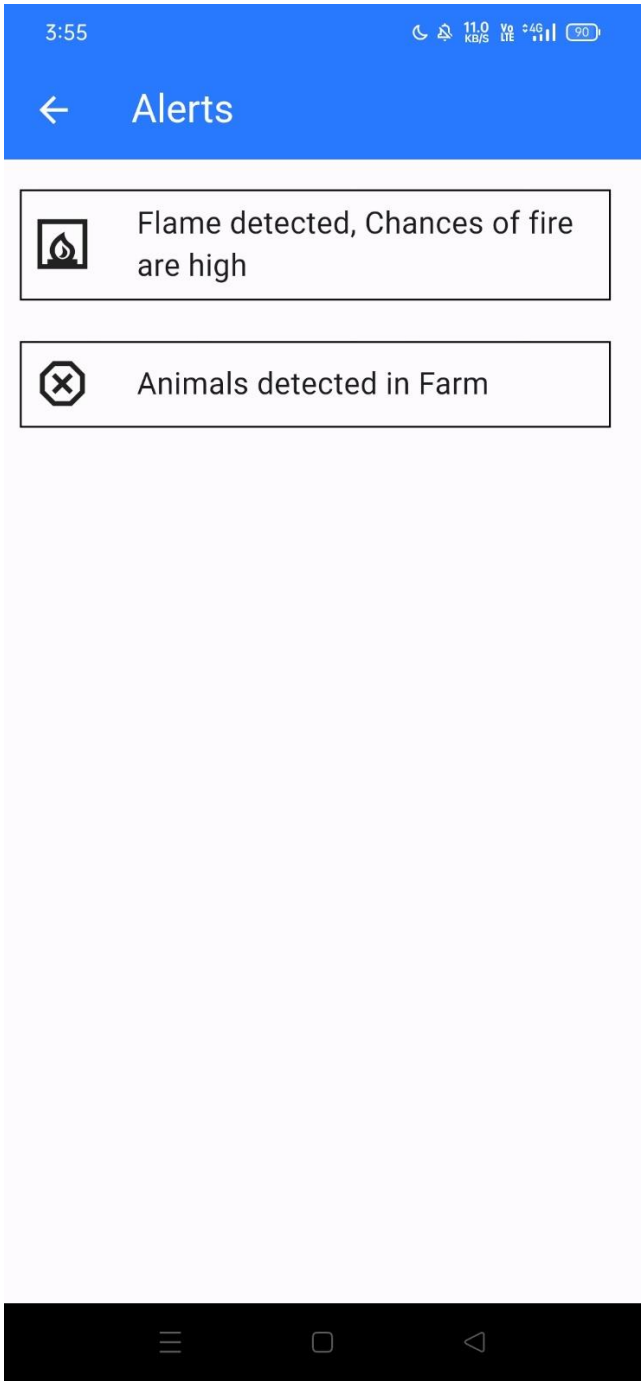
Figure 7: AWS S3 Bucket

Mobile app:


3:55
Map
Field Module
Google
Location


3:55
Storage
CO2 PPM: 400.0
Temperature °C: 29.3
Humidity %RH: 55.0
Live Storage CAM Feed
Storage


3:55
Field
Recommended Fertilizer: 17-17-17
Recommended Crop: Mungbean
Predicted Rain (mm): 12.0
Moisture % : 53.26
Nitrogen: 12.0
Phosphorous: 0.0
Potassium: 15.0
pH: 7.0
Temperature °C : 28.9
Humidity %RH : 56.0
Loamy
Oil seeds
Live Cam
Field



Conclusion: Our System presents a comprehensive solution for Indian farmers, addressing critical challenges in agriculture. The integration of these specialized modules, coupled with cloud connectivity enabling real-time notifications and monitoring, empowers farmers to proactively manage their fields. By combining hardware components, intuitive interfaces, and cloud-based data handling, this system emerges as an asset in promoting sustainable and efficient farming practices.