St. Joseph's College of Engineering & Technology, Palai

TECHSOW

INTEGRATED CROP AND SOIL HEALTH MONITORING SYSTEM

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Problem Statement

Inappropriate fertilizer application methods, common plant diseases, and inadequate soil health procedures present farmers with significant hurdles in maximizing agricultural yields while controlling expenses. The environmental sustainability of conventional farming practices is reduced and expenses rise as a result of the wasteful use of fertilizers. Crop yields are lowered by inaccurate application, which also wastes resources.

ABSTRACT

TechSow - a Crop and Soil Monitoring System, is an innovative agricultural system that uses a smart robot to improve farming. This robot has arms to check soil moisture and nutrient levels. It moves around your farm on its own, guided by a handy app. The app helps you manage your farm, from monitoring soil health to spotting plant diseases with AI. The application also uses weather data to make better decisions and figures out the right amount of fertilizer your crops need. This system helps farmers grow more while using fewer resources, making farming eco-friendly and efficient.

LITERATURE SURVEY

S.NO	Title	Inference
1	EARLY DETECTION OF MAJOR DISEASES IN TURMERIC PLANT USING IMPROVED DEEP LEARNING ALGORITHM	Improved YOLOV3-Tiny simplifies turmeric disease detection, eliminating steps for precision. Efficient deep learning offers accurate diagnosis of plant diseases.
2	PACKAGE OF PRACTICES RECOMMENDATION : CROPS 2016	Accurately determined the specific NPK and nutrient requirements for diverse crops. Obtained comprehensive data on fertilizer quantities and related details.
3	NAVIGATION SYSTEM OF THE AUTONOMOUS AGRICULTURAL ROBOT (JOURNAL)	Utilizes a Simultaneous Localization and Mapping (SLAM) model for autonomous rover driving, integrating a Lidar module to enable obstacle detection and navigation.
4	DETECTION OF NITROGEN, PHOSPHORUS, AND POTASSIUM (NPK) NUTRIENTS OF SOIL USING OPTICAL TRANSDUCER	The optical sensor, comprising LEDs and a photodiode, tailored to nutrient absorption bands, effectively measures soil NPK levels. Integrated with an Arduino microcontroller, it provides digital readings, enabling precise evaluation of soil content.

Objectives

- Disease Detection
- Soil NPK Content Analysis
- Micronutrients Analysis
- Soil PH analysis
- Fertilizer Recommendation System

REQUIREMENT ANALYSIS

Functional Requirements

Image Processing for Disease Detection:

- The app should be able to capture and process images
- Implement machine learning models to analyze plant images and detect diseases accurately.

Fertilizer Calculator:

- Provide a user interface to select a specific crop.
- Retrieve NPK values for the selected crop from a database.
- Calculate the amount of fertilizer required based on the selected crop and its area.

Functional Requirements

Rover Control:

- Enable remote control of the rover's movement through the app.
- Receive data from rover sensors (pH and NPK) in real-time.

Soil Micronutrient Measurement:

- Analyze pH and NPK values received from the rover sensors.
- Determine soil micronutrient levels based on the collected data.

Fertilizer Recommendation:

- Provide recommendations for fertilizers based on the analyzed NPK values.
- Suggest specific fertilizers and quantities needed to balance nutrient deficiencies.

Non-Functional Requirements

Performance:

- The app should process and analyze plant images quickly to provide instant disease detection feedback.
- Rover control commands should have minimal latency

Reliability:

- The disease detection model should have a high accuracy rate.
- Rover sensors should provide reliable and accurate pH and NPK values.

Scalability:

- The app should handle an increasing number of users and connected rovers without significant performance degradation.

Non-Functional Requirements

Usability:

- The user interface should be intuitive and user-friendly.
- The app should provide clear and understandable recommendations.

Compatibility:

- The app should be compatible with various devices and screen sizes.

Maintainability:

- Design the app with modular and well-documented code for easy maintenance.
- Mechanisms for updating the disease detection model and fertilizer database.

Integration:

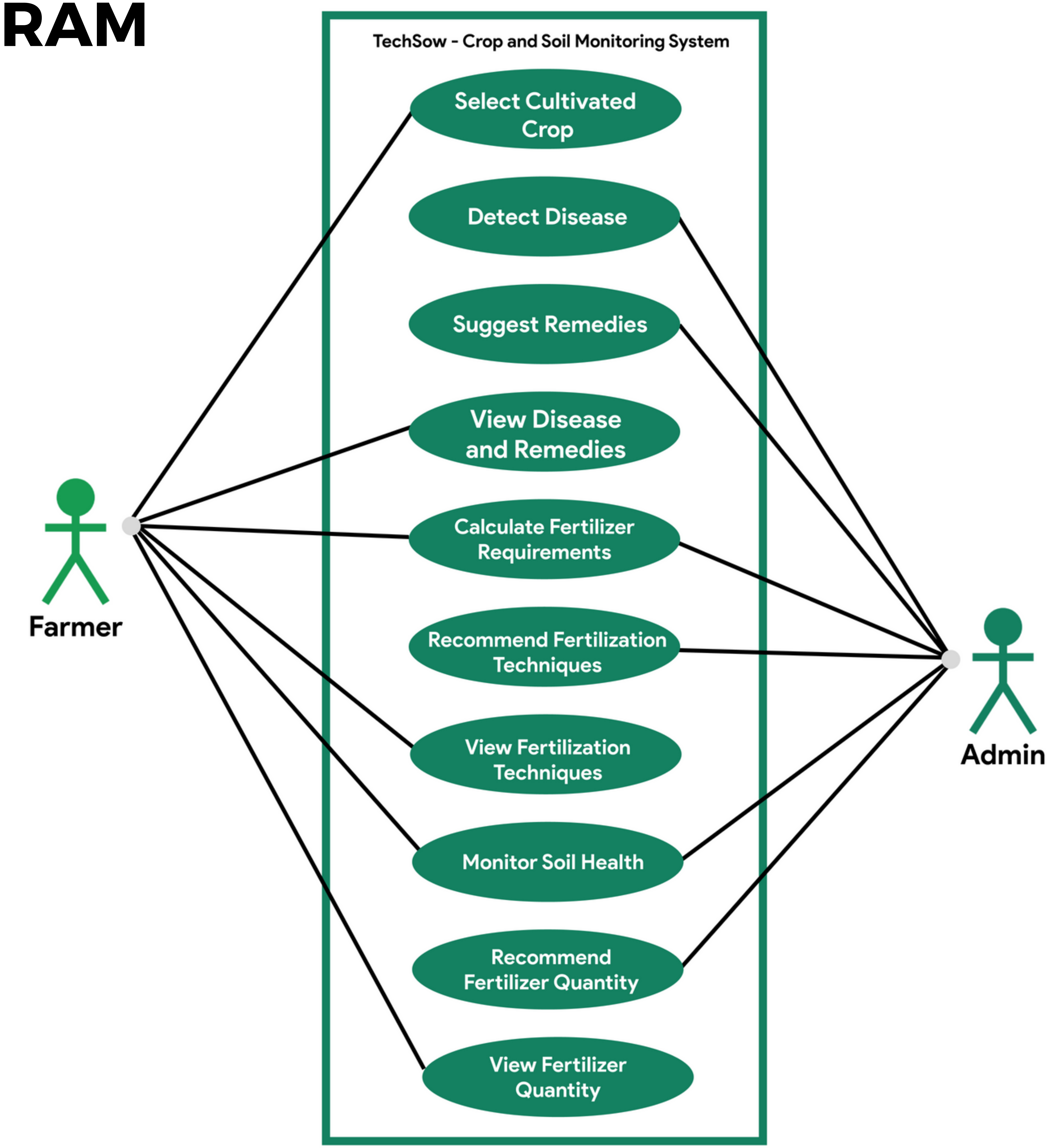
- Ensure seamless integration between varoius features
- Integrate with external databases

Technology Stack

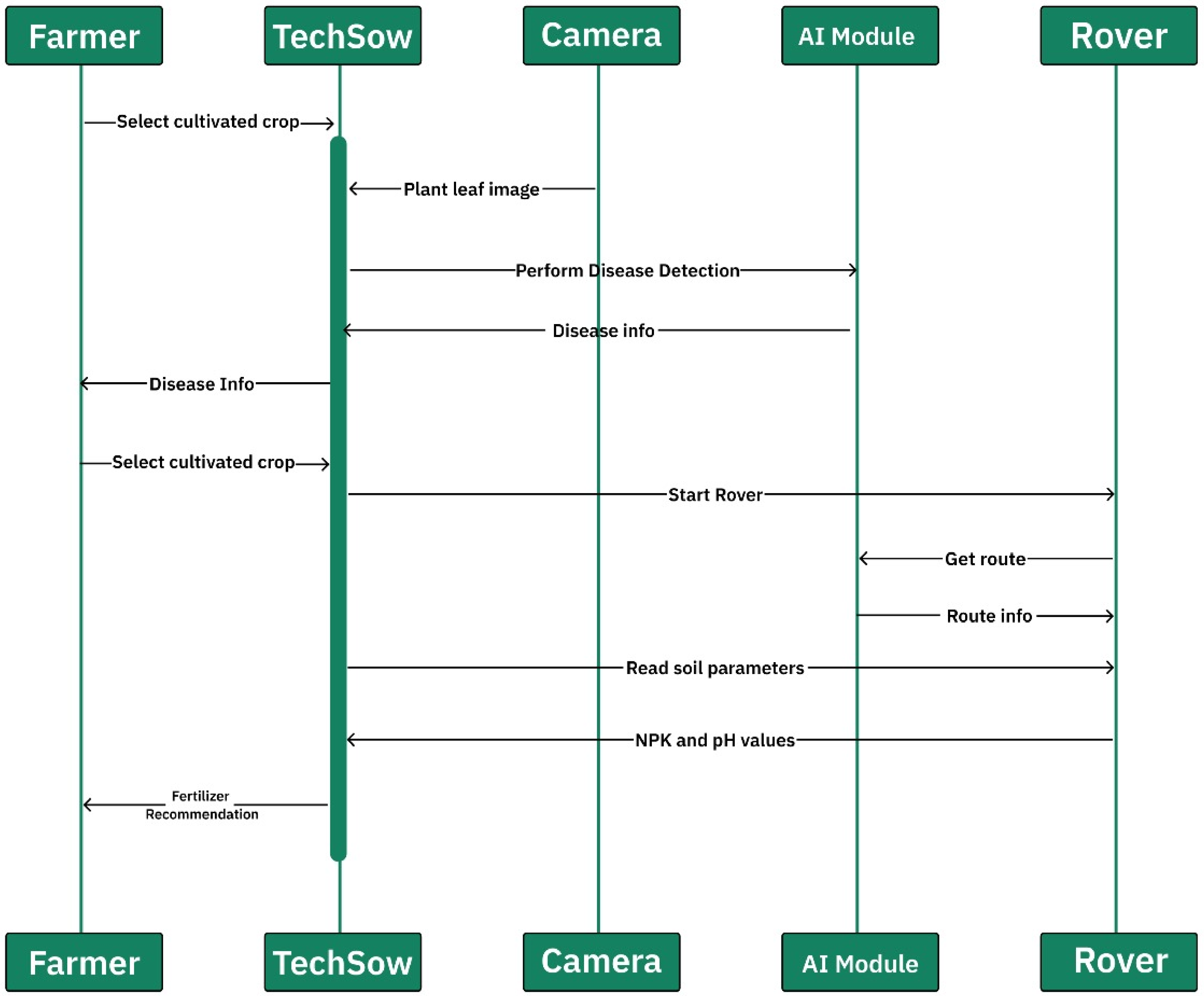
- Codebase : Flutter
- Backend : Firebase
- TensorFlow
- Dataset : Kaggle
- Yolo V3 Tiny : Model for disease detection
- microcontroller : ESP 32

DESIGN

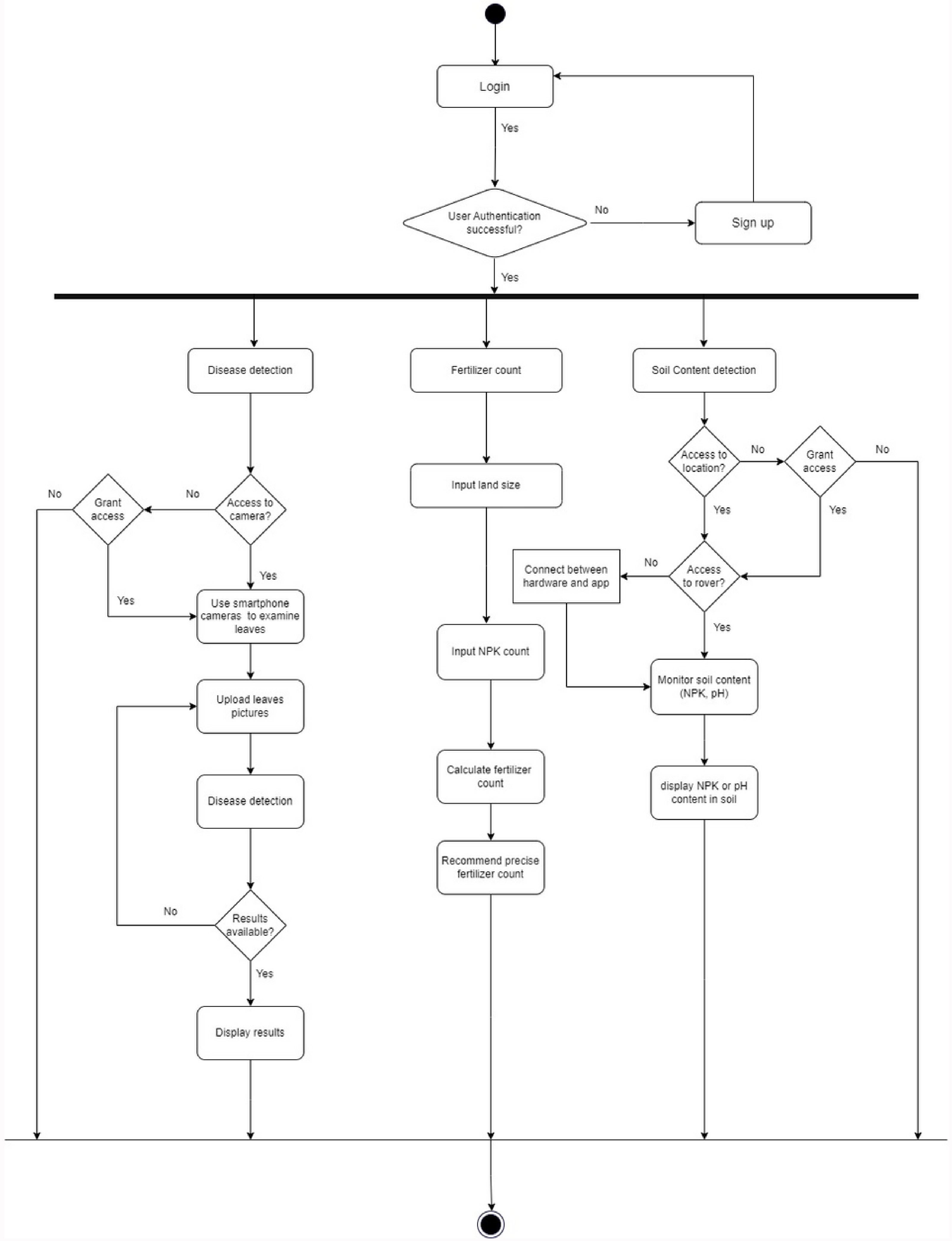
USE CASE DIAGRAM



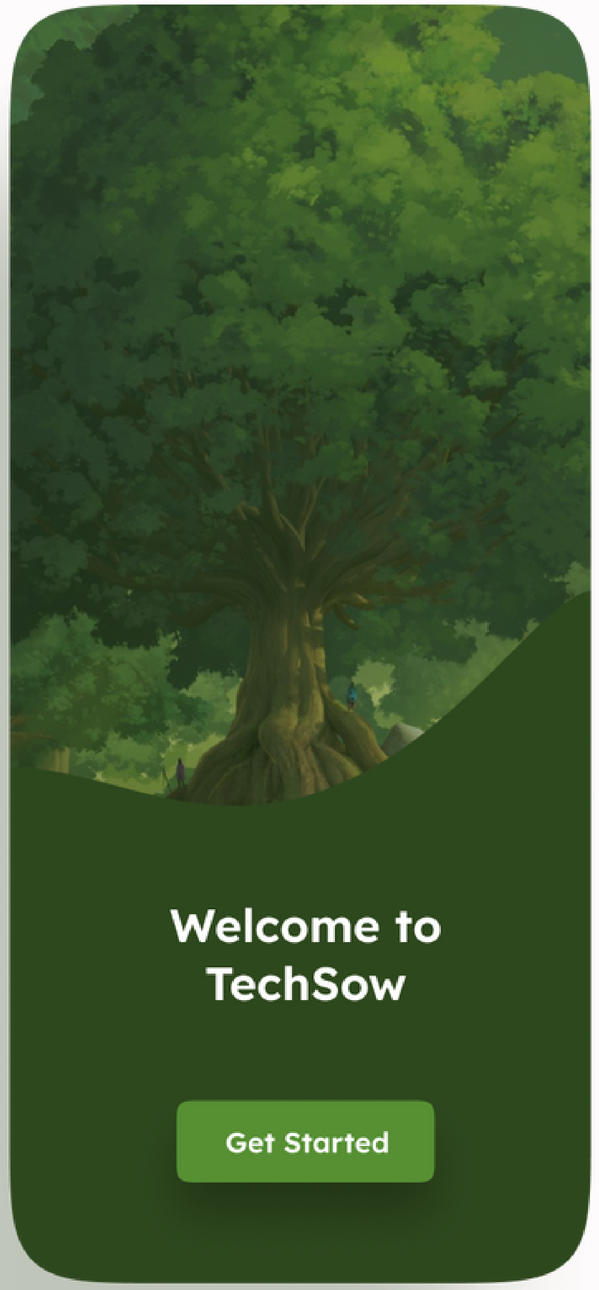
SEQUENCE DIAGRAM

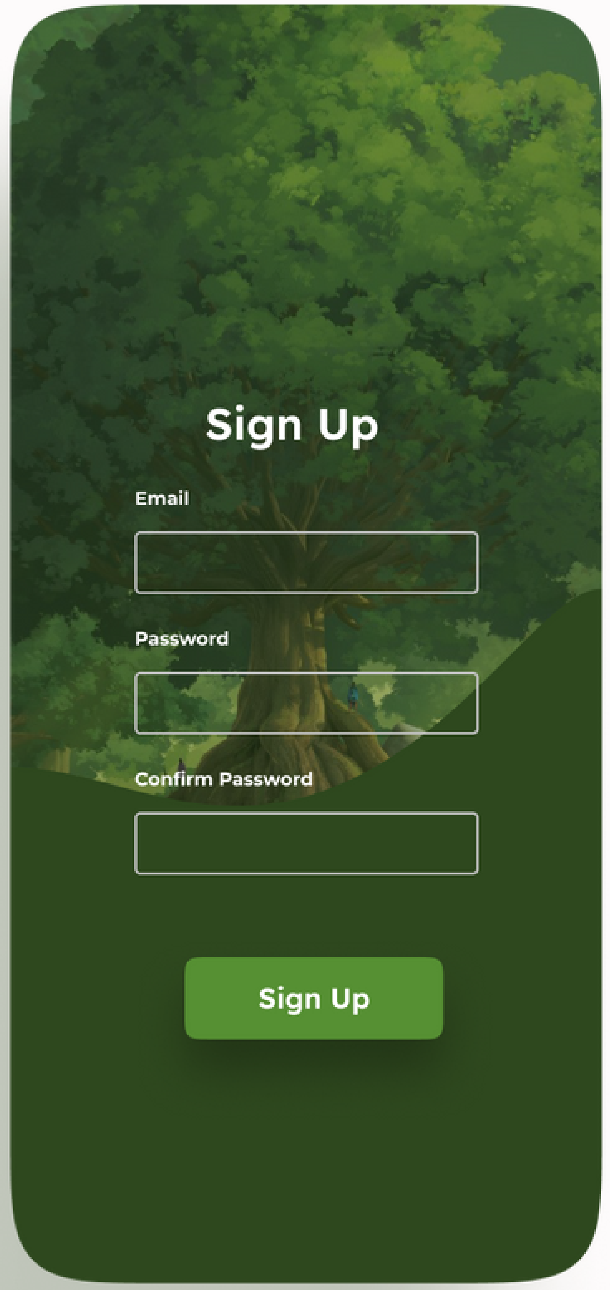


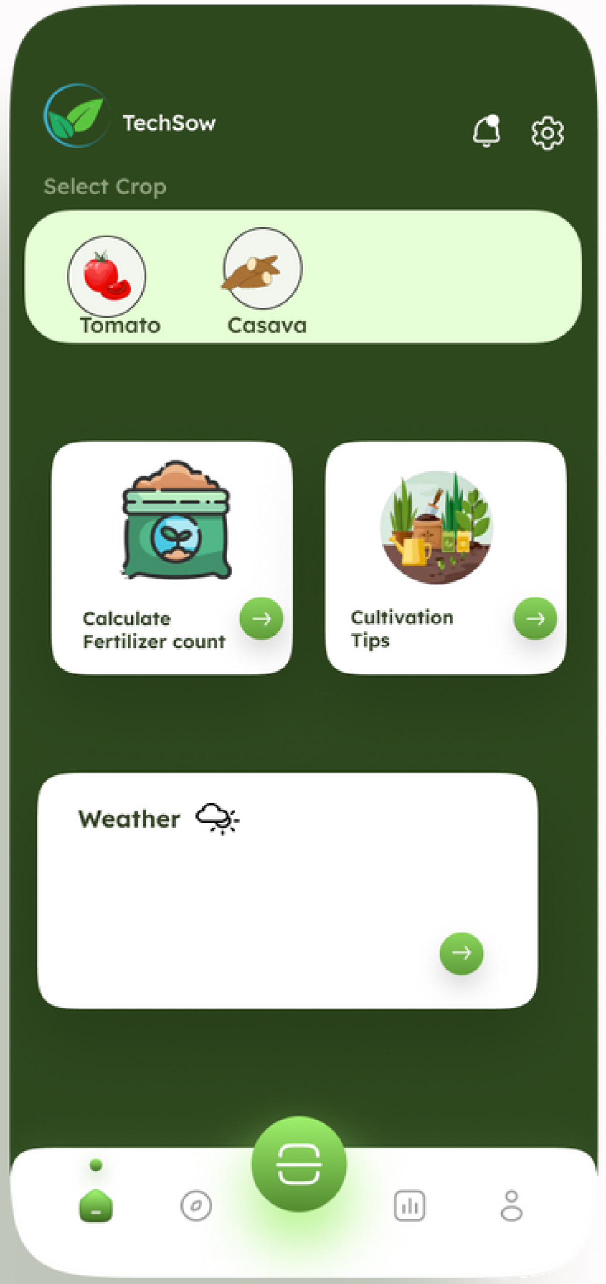
ACTIVITY DIAGRAM

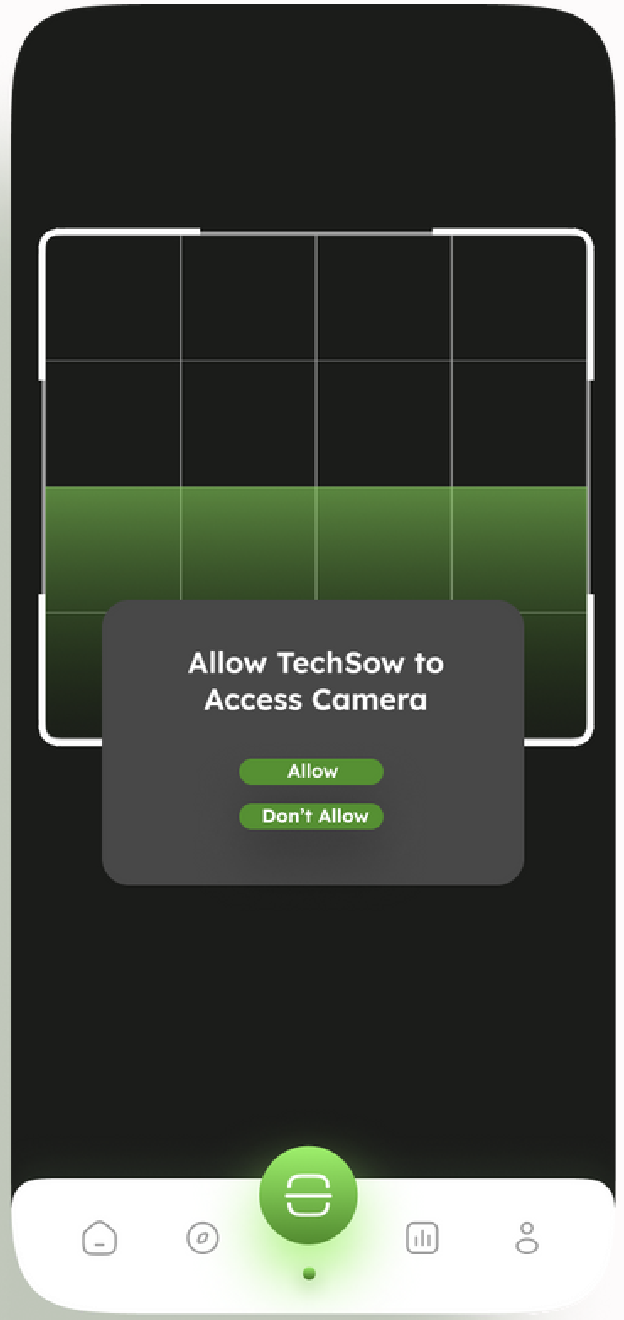


UI DIAGRAM


Welcome to TechSow
Get Started

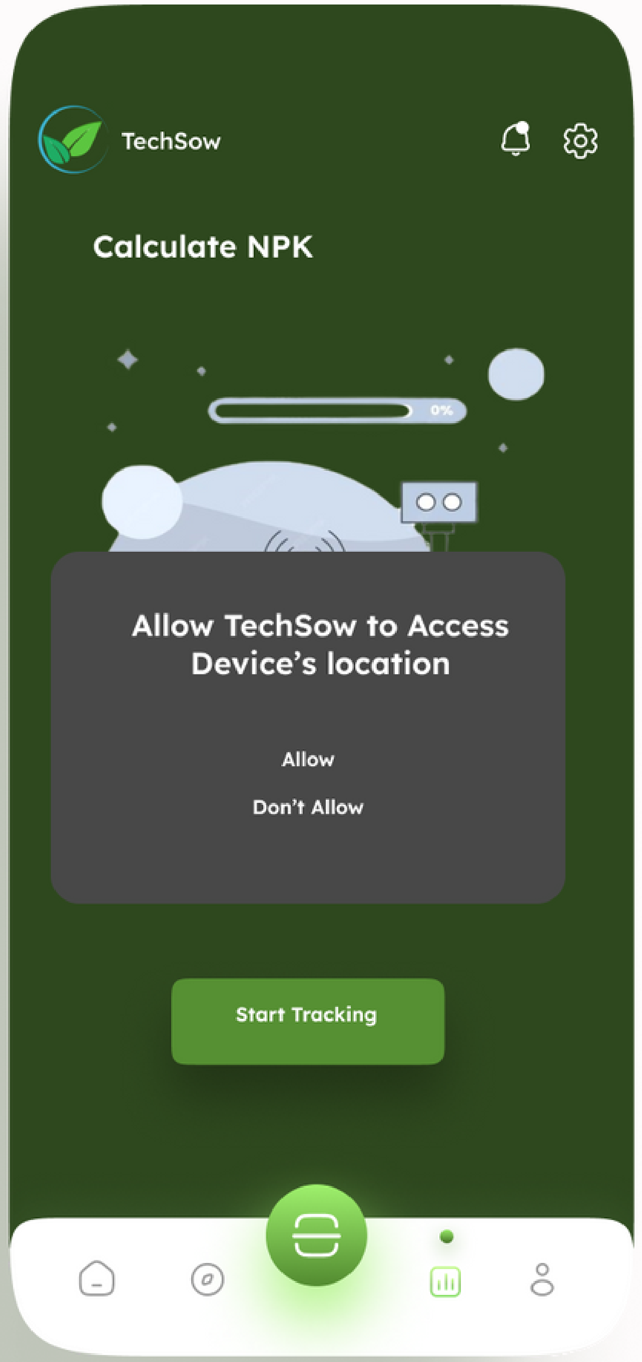

Sign Up
Email
Password
Confirm Password
Sign Up

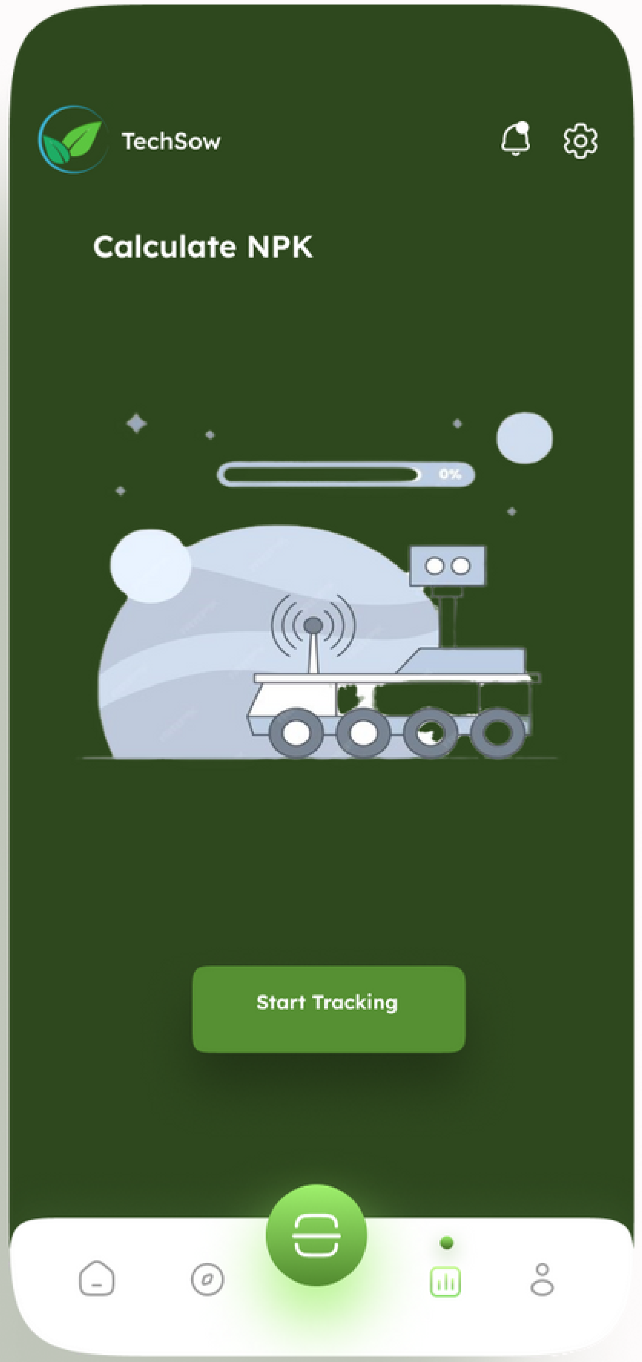

TechSow
Select Crop
Tomato
Casava
Calculate Fertilizer count
Cultivation Tips
Weather

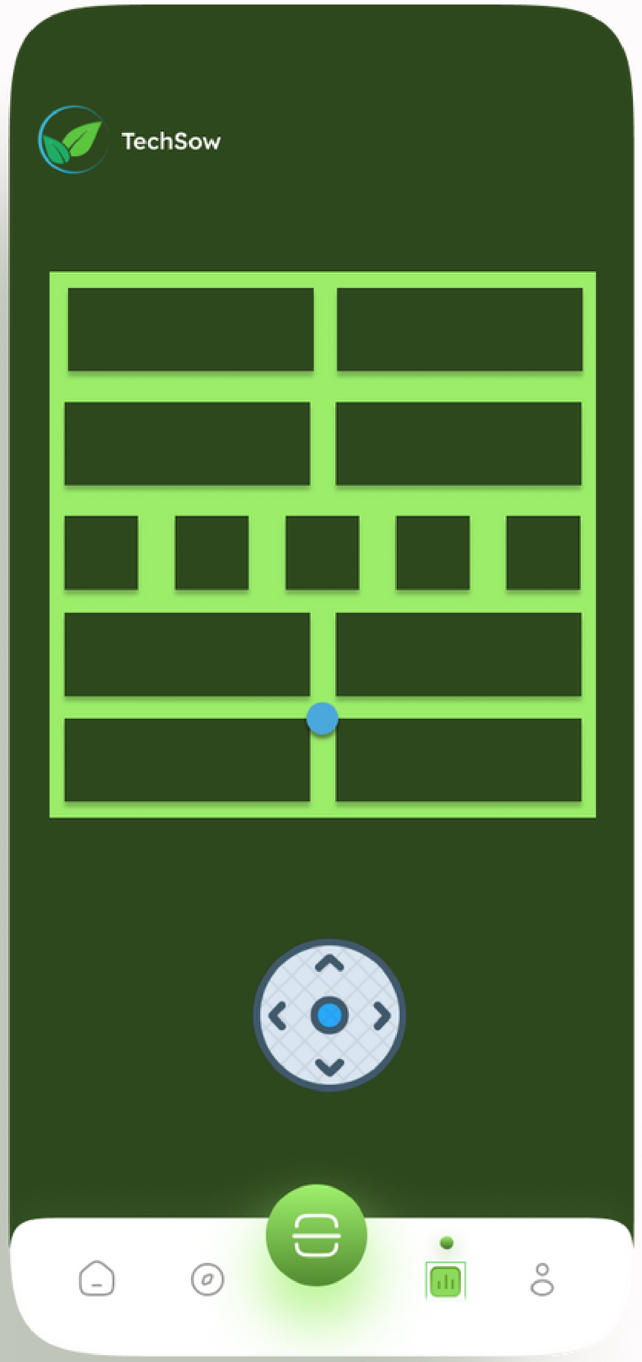

Allow TechSow to Access Camera
Allow
Don't Allow

UI DIAGRAM

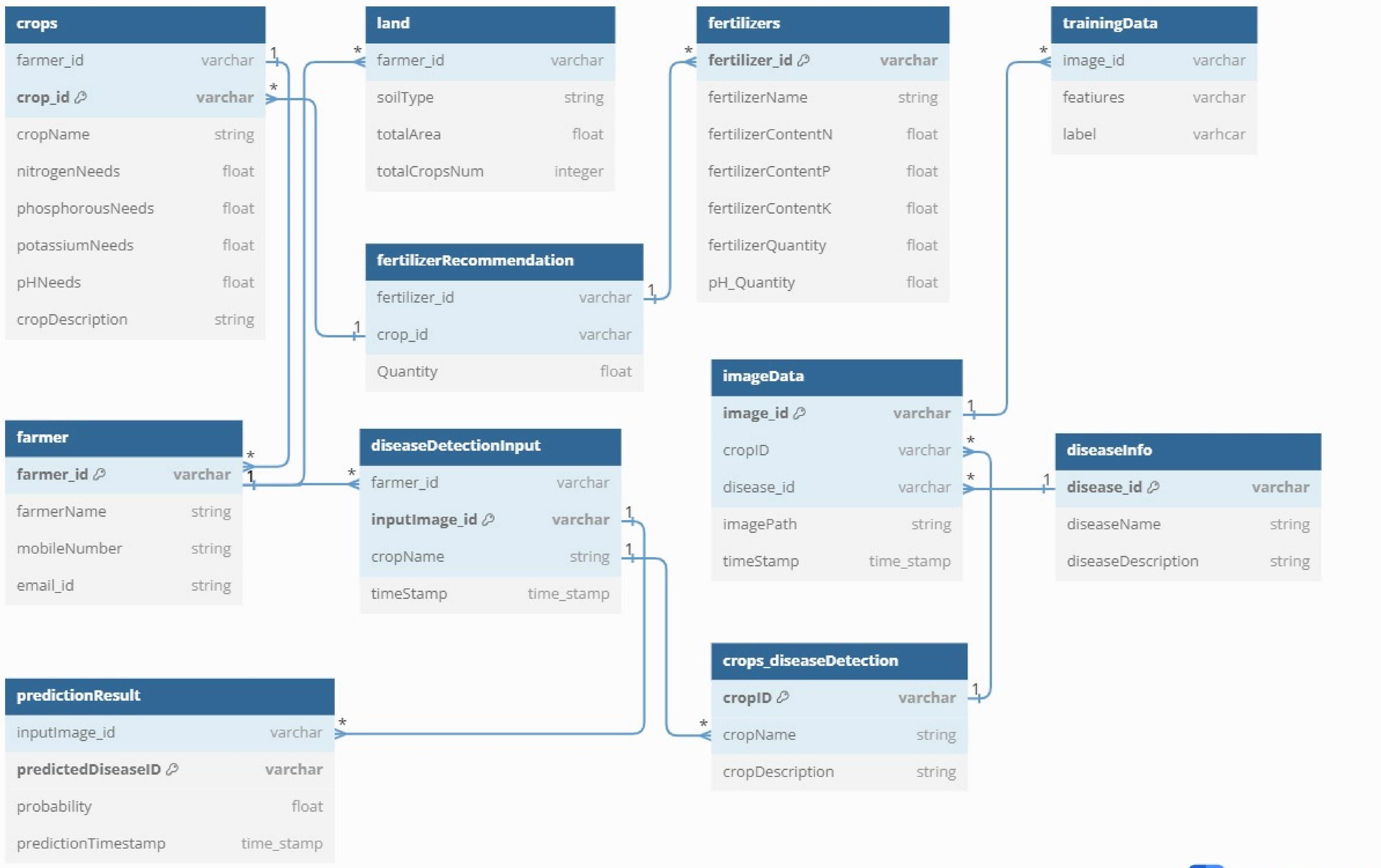

Tomato Plant
Disease Name : Alternaria Canker
details


TechSow
Calculate NPK
Allow TechSow to Access Device's location
Allow
Don't Allow
Start Tracking

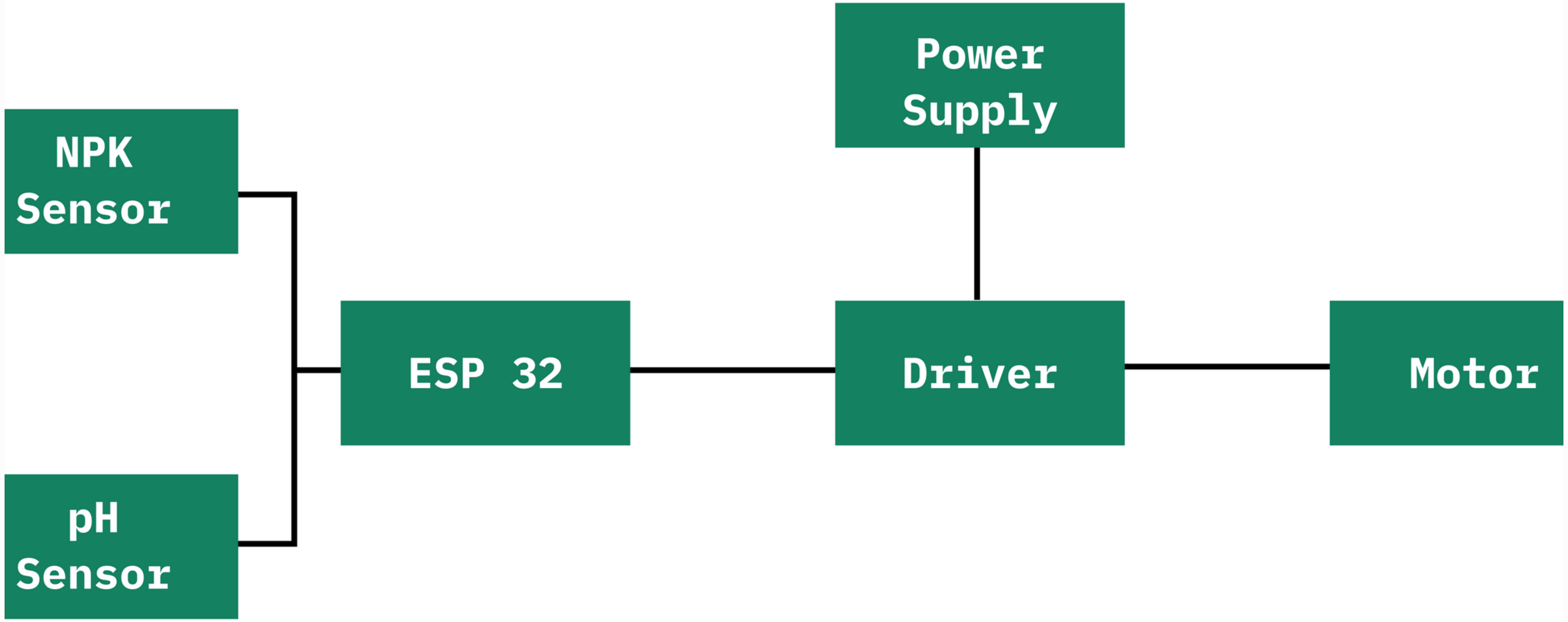

TechSow
Calculate NPK
Start Tracking

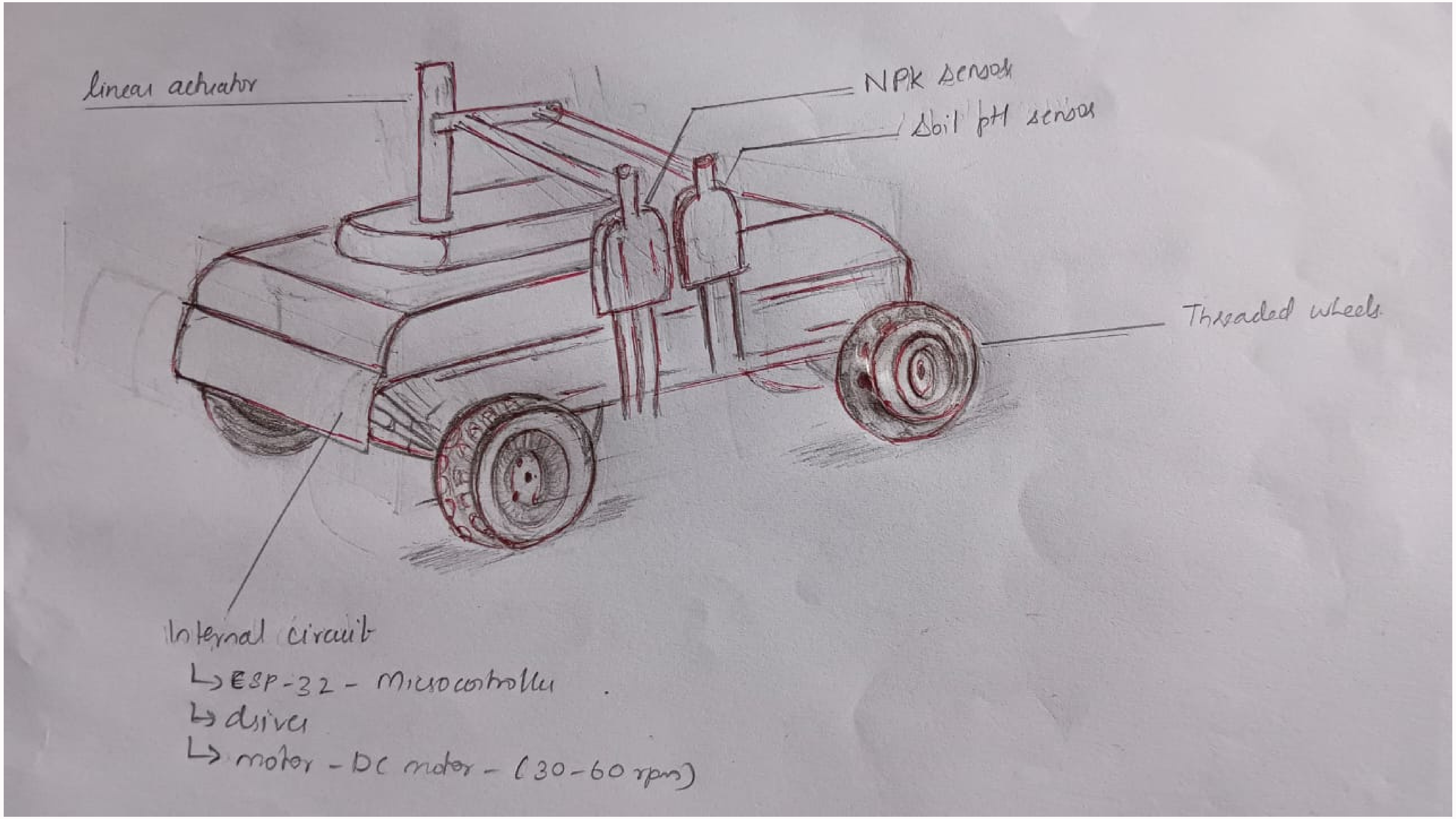

TechSow

SCHEMA DIAGRAM



BLOCK DIAGRAM




linear actuator
NPK sensor
Soil pH sensor
Threaded wheels
Internal circuit
↳ ESP-32 - Microcontroller
↳ driver
↳ motor - DC motor - (30-60 rpm)

COST ESTIMATION

Components	Cost (INR)
ESP 32	800
DC MOTOR	500
NPK SENSOR	9,500 - 12,500
PH SENSOR	600 - 700
ROVER & BASIC STRUCTURE	3000
TOTAL COST	14,400 - 17,500

CONCLUSION

In conclusion, addressing the challenges faced by farmers in soil nutrient content detection and disease identification is imperative for sustainable agriculture. Innovative solutions leveraging technology can revolutionize farming practices and enhance crop yield while conserving resources. Empowering farmers with accurate information is key to ensuring a resilient and productive agricultural future.

THANK YOU