Rohan Yadav
Zesshan Khan
Vikas Kumar Verma
Vinit Dubey
2023

Hackathon Project Report

Full Final Report

Smart Crop, Fertilizer and Disease Prediction System

Team Leader : Raj Patil

A report submitted for

National Level Hackathon 2k23

Mentor: Prof. Sarvagya Jain

Oriental Institute of Science and Technology Bhopal

Department of CSE-AIML

OIST Bhopal

Rohan Yadav
Zesshan Khan
Vikas Kumar Verma
Vinit Dubey
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Declaration

This report has been prepared on the basis of my own work. Where other published and unpublished source materials have been used, these have been acknowledged.

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Students Name:

1. Raj Patil
2. Rohan Yadav
3. Vikas Kumar Verma
4. Zesshan Khan
5. Vinit Dubey

Date of Submission: 3rd October 2023

Signature of Mentor with Designation and College/University Seal:

Sarvagya jain

Assistant professor

Deparment of CSE-AIML

Oriental institute of Science and Technology

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1). Executive Summary

Smart Agriculture is a cutting-edge approach to farming that leverages technology to optimize crop production while conserving resources. This project report discusses the development and implementation of a Smart Crop, Fertilizer, and Disease Predictor System. The system employs data analytics and machine learning algorithms to predict crop yields, recommend appropriate fertilizers, and detect and predict diseases in crops. The objective of this project is to enhance agricultural productivity, reduce resource wastage, and provide timely solutions to common farming challenges

2). Introduction

App name-AgroIntel Pro

Agriculture is a major industry in India, employing the majority of the population. As the world's population expands, so do agricultural challenges. It is one of the most important vocations for human survival. We have noted that the environment is always changing, which is damaging crops and driving farmers into debt and suicide. The majority of farmers face the problem of planting the wrong crop for their land based on a traditional or non scientific approach. This is a daunting task for a country like India, where agriculture feeds over 42% of the population. Crop selection mistakes lead to reduced yield and profit. As a result, farmers are relocating to cities for jobs, attempting suicide, giving up farming, leasing land to industrialists, or utilizing it for non-agricultural purposes.

Agriculture plays a pivotal role in sustaining human life, and its efficiency is crucial for food security and economic stability. AgroIntel Pro focuses on using advanced technologies like data analytics, and machine learning to revolutionize farming practices. In this project, we introduce a Smart Crop, Fertilizer, and Disease Predictor System that aids farmers in making informed decisions to optimize their yields and mitigate risks.

3). Objective

The primary objectives of this project are as follows:

I. To predict crop yields based on historical and real-time data.

II. To recommend suitable fertilizers based on soil and crop conditions.

III. To detect and predict crop diseases using image recognition and machine learning.

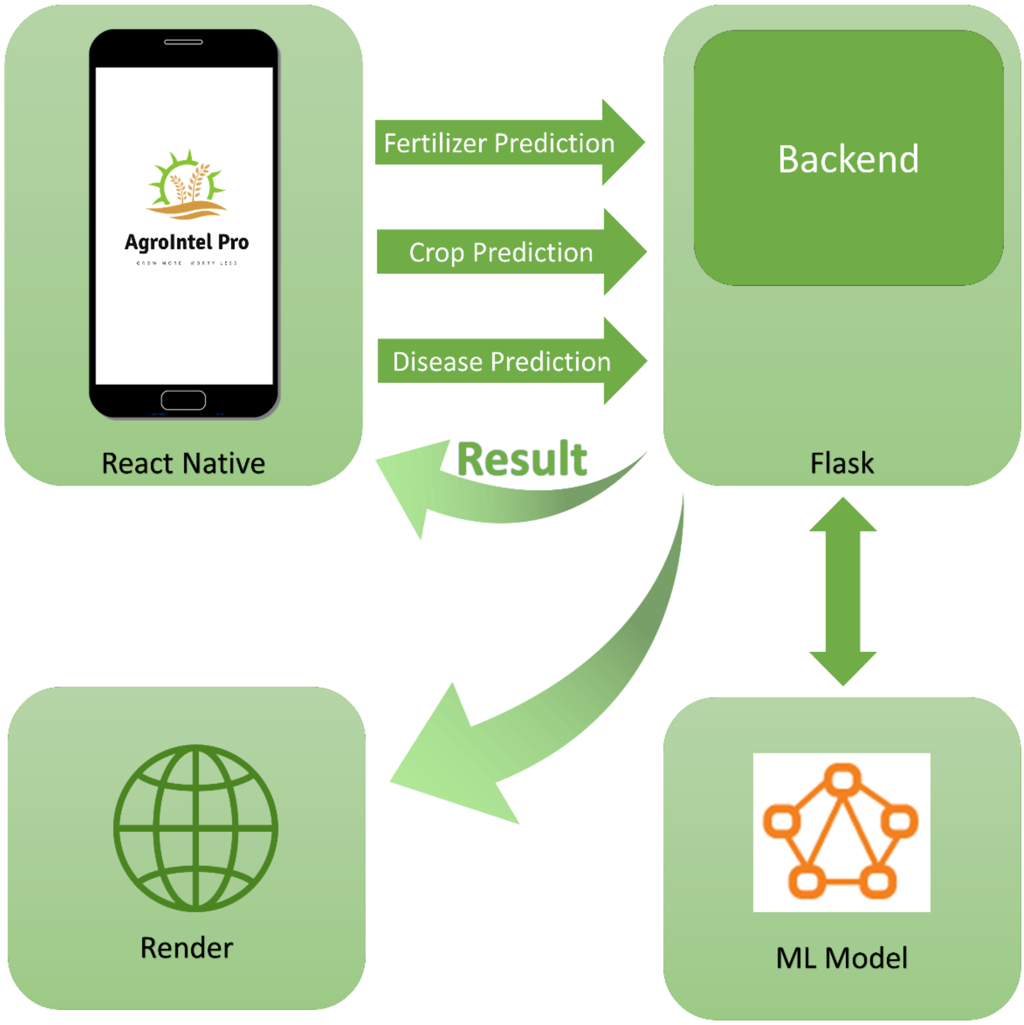
IV. To provide an intuitive user interface for farmers to access and act upon the system's recommendations.

4). Literature Review

This section summarises the conclusions of multiple articles that have been studied and reviewed. This section contains records that were reviewed prior to and during project development. The documents provided an improved understanding of existing solutions, how methods can be optimized, and how algorithms could be selected based on their performance to get a better result while developing the Project.

Title and Authors	Year of publication	Work Done	Techniques Used
Crop recommendation system for precision agriculture	2016	SAD is a crop selection method that improves net yield rate by improving accuracy and classification performance.	Support Vector Machine, Random Forest, Neural Network, REP Tree, Bagging, and Bayes
Crop Recommender System Using Machine Learning Approach	2021	API is used to predict weather parameters.ML algorithms are used to compare the results of models. Random Forest is the algorithm used with an accuracy Of 95%.	ANN, Fuzzy Network, decision tree, KNN, Enet, Lasso and Kernel Ridge, ARMA, SARIMA and ARMAX

5). Methodology



We propose a system with a simple, cost-effective, user friendly User Interface that is also time efficient. Our proposed approach assists farmers and users in achieving their objectives. This method recommends crops and fertilizers while also forecasting plant problems. In this proposed system, we will collect factors such as nitrogen, phosphorus, potassium, and others and recommend crops or fertilizers using methods such as Decision Tree, Random Forest, Naive Bayes, Support Vector Machine, and Logistic Regression, which will aid in accurate prediction. In addition, in this proposed system, we will take a picture of the plant then the algorithm will predict the disease using the ResNet algorithm. As a result, this approach will make farming easier while also increasing customer satisfaction.

Step 1: Loading the dataset, the data which was collected from the study Crop will be used in the system to optimize Crop Production Using Machine Learning Algorithms, which included a crop recommendation dataset. The accuracy of a machine learning model is determined by the quality of the data.

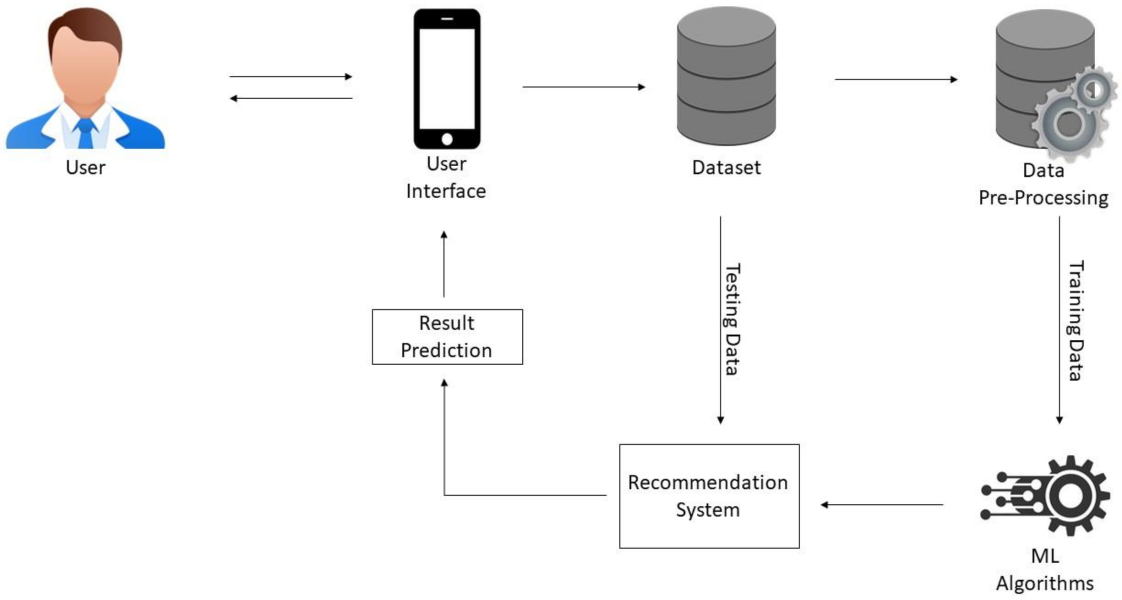
Step 2: Pre-processing of the input dataset, the most essential or time-consuming task in any machine learning project is data pre-processing. During the pre-processing step, missing values are filled using techniques such as mean, mode, and median, scaling or transforming values in a certain range, cleaning the data, encoding categorical data, and checking for variable correlation so that the accuracy can be increased.

Step 3: Analyzing exploratory data, before getting hands dirty with model construction, univariate, bivariate, and multivariate analysis are carried out to uncover hidden patterns in the data and to try to interpret the data. A few examples of the univariate analytic plot arePDF and CDF while multivariate plots are pair plot, box plot, and Heatmaps.

Step 4: Splitting data into training and testing in this step, the preprocessed dataset is divided into training and testing groups based on 80:20 ratios, which indicates that 80% of the data is used for training and 20% for testing on the unseen dataset and cross-validation to discover the best hyper parameter.

Step 5: Creating a classification model based on the training data, the training dataset is delivered to the individual classifier in this stage, and the model is trained on top of it.

6). System Architecture



Architecture Diagram

Data Collection Layer:

Camera Systems: Install cameras to capture images of the crops for visual inspection and disease detection.

Weather Stations: Incorporate weather stations to monitor local weather conditions and forecast changes.

Data Transmission Layer:

Wireless Networks: Use wireless technologies like Wi-Fi, LoRaWAN, or cellular networks to transmit data from the sensors and devices to a central hub.

Edge Computing: Optionally, employ edge computing devices to preprocess data locally, reducing latency and bandwidth requirements.

Data Processing Layer:

Data Storage: Store the collected data in databases or data lakes for historical analysis and real-time processing.

Data Preprocessing: Clean, filter, and aggregate data to prepare it for analysis.

Machine Learning Models: Develop and train machine learning models for crop yield prediction, disease detection, and fertilizer recommendation.

Crop and Disease Prediction:

Crop Monitoring: Analyze data from cameras to monitor the growth and health of crops.

Disease Detection: Utilize image analysis and machine learning to identify signs of diseases in crops from images and environmental data.

Crop Yield Prediction: Predict crop yields based on historical data, weather forecasts, and other relevant factors.

Fertilizer Recommendation:

Soil Analysis: Conduct soil testing to determine its nutrient composition.

Fertilizer Recommendation Engine: Develop an algorithm that considers soil data, crop type, and growth stage to recommend the appropriate type and amount of fertilizer.

Fertilizer Dispensing: Implement mechanisms for precise fertilizer application, such as automated fertilizer spreaders.

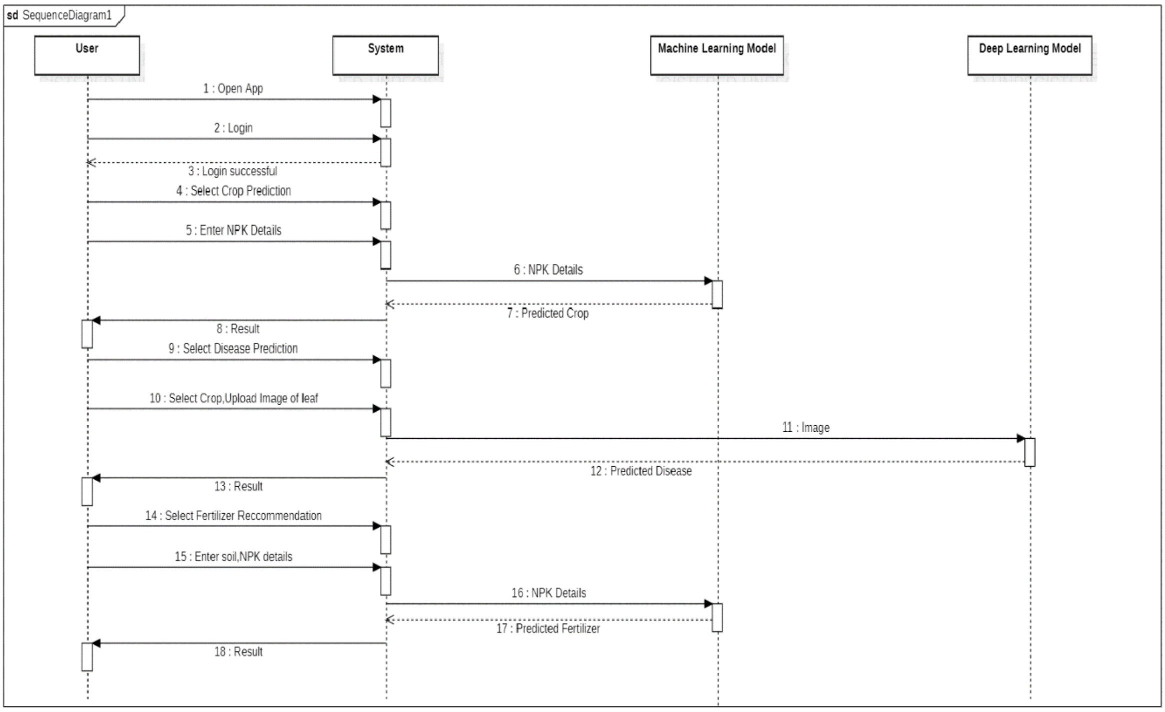
Scalability and Integration:

Design the system to be scalable, allowing for the addition of more sensors and devices as the farm grows. Integrate with existing farm management software and equipment for seamless operation.

Maintenance and Support:

Provide ongoing maintenance and support to ensure the system's reliability and accuracy. Update machine learning models and algorithms to adapt to changing conditions and improve prediction accuracy.

Data flow Diagram, Sequence Diagram



7). Data Collection and Analysis

Data Collection:

a. Environmental Data:

- Weather Data: Collect historical and real-time weather data, including temperature, precipitation, humidity, wind speed, and solar radiation. Weather stations or online APIs can provide this information.
- Soil Data: Perform soil testing to measure soil composition, nutrient levels, pH, and moisture content. Soil sensors or manual sampling can be used.
- Geospatial Data: Obtain geographical data, such as topography, elevation, and land use, which can impact crop growth.

b. Crop Data:

- Crop Type: Identify the specific crop varieties being cultivated in each field.
- Planting Date: Record the date when crops were planted.
- Harvest Date: Record the date when crops were harvested.
- https://www.kaggle.com/datasets/atharvaingle/crop-recommendation-dataset

c. Management Practices:

- Fertilizer and Irrigation: Collect data on fertilizer application and irrigation practices, including types, amounts, and frequencies.
- Pesticide Usage: Record information about pesticide application and pest control practices.

8. Requirements

Software

• Jupyter Notebook: Jupyter Notebook is an open-source software program this is an interactive computational environment, wherein you could integrate code execution, wealthy text, mathematics, plots, and wealthy media, it's far used for modifying and walking the application, additionally it turned into first-rate appropriate for us to broaden our challenge, we're the usage of Jupiter Notebook for appearing a diverse set of rules on the information we take a look at the accuracy of every set of rules.

• VS Code: Visual Studio Code is a code editor that may be used with a whole lot of programming languages, it's far a code editor made with the aid of using Microsoft for Windows, Linux, and macOS. Features encompass guide for debugging, syntax highlighting, sensible code completion, snippets, code refactoring, and embedded Git. In VS Code we're developing an internet site with the usage of HTML, CSS and Java script, and Flask.

• Spyder: Spyder is an open-source cross-platform integrated development environment (IDE) for programming withinside the Python language Frontend:

• HTML: HTML stands for Hyper Text Markup Language HTML is the same old markup language for developing Web pages HTML describes the shape of a Web page HTML includes a sequence of factors HTML is used as a skeleton on this challenge

• CSS: CSS stands for Cascading Style Sheets CSS describes how HTML factors are to be displayed on the screen, paper, or indifferent media CSS saves loads of work.

• JAVASCRIPT: JavaScript is a high-stage programming language; It turned into at the beginning designed as a scripting language for web sites however have become extensively followed as a general-motive programming language, and is presently the maximum famous programming language in use JavaScript consists of out maximum of the functions.

Backend

• Flask: Flask is a framework written in Python. The backend of this challenge is programmed with the assistance of Flask Flask is an API of Python that lets us accumulate internet applications. It evolved with the aid of using Armin Ronacher. Flask's framework is greater expressed than Django's framework and is likewise less complicated to research as it has much less base code to put into effect an easy internet-Application.

Deep Learning:

• Python: Python is an interpreted general-motive programming language Python is dynamically typed and garbage-collected. It helps a couple of programming paradigms, such as structured (particularly, procedural), object-orientated and useful programming. Python is the language used on this challenge to application and educates diff models

For more details refer to:
https://drive.google.com/file/d/1JcsQhxLFMZCAFc5bGd6r7YhKK9M2ym34/view?usp=drive_link

9. Source Code

The source code is divided into Two parts:

1.Android App

2.Backend and model Training and building

A) Flask backend

B) Model Training

All Two folders are attached with the file.

Refer to requirements to run the code

Link to code:

https://drive.google.com/drive/folders/1LP-ZrnzAEqdZX7hRUrNGaseAH5-zsdz3?usp=sharing

For Direct install of apk-

From above link search for AgroIntel Pro.apk in folder

10. Contribution to Society

The AgroIntel Pro app, designed for smart agriculture, offers several significant contributions to society:

1. Enhanced Agricultural Productivity:
    - One of the primary contributions is the improvement of agricultural productivity. By accurately predicting crop yields, recommending suitable fertilizers, and detecting diseases early, the app empowers farmers to make informed decisions. This leads to increased crop yields and reduced losses, contributing to food security and economic stability.
2. Resource Optimization:
    - The app promotes efficient resource utilization. By recommending the appropriate amount and type of fertilizers based on soil conditions and crop requirements, it helps reduce fertilizer overuse. This not only saves farmers money but also mitigates environmental issues associated with excessive fertilizer application, such as water pollution.
3. Risk Mitigation:
    - Farmers face various risks, including weather-related uncertainties and crop diseases. The app assists in risk mitigation by providing timely information and recommendations. For example, early disease detection can prevent the spread of diseases, minimizing crop damage.
4. Sustainability:
    - The app encourages sustainable farming practices. By promoting soil health, minimizing chemical inputs, and optimizing resource usage, it contributes to sustainable agriculture, reducing the environmental impact of farming.
5. Empowerment of Small-Scale Farmers:
    - Small-scale and subsistence farmers often lack access to advanced agricultural technology. The app levels the playing field by providing them with valuable insights and

recommendations that were previously available mainly to large-scale commercial farmers.

6. Knowledge Sharing and Collaboration:

    - The app can facilitate knowledge sharing and collaboration among farmers. By connecting users and allowing them to share their experiences and best practices, it fosters a sense of community and mutual support among farmers.

7. Data-Driven Agriculture Policy:

    - The data collected by the app can be aggregated and anonymized to provide valuable insights to agricultural policymakers. This information can inform policy decisions aimed at improving farming practices, addressing food security challenges, and promoting sustainable agriculture.

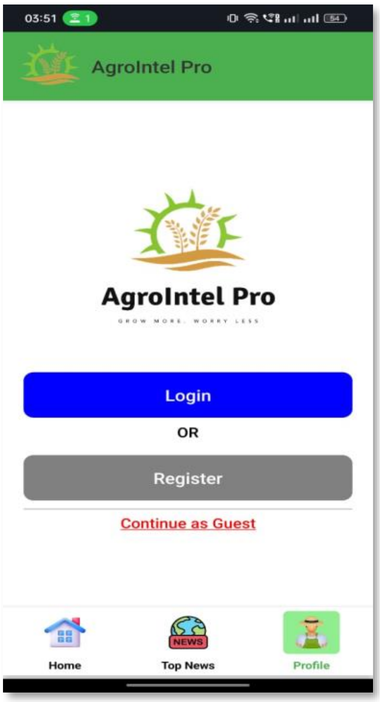
8. Reduction in Chemical Usage:

    - By recommending precise fertilizer applications and pest control measures, the app contributes to reducing the use of chemical inputs in agriculture. This has positive implications for both the environment and human health.

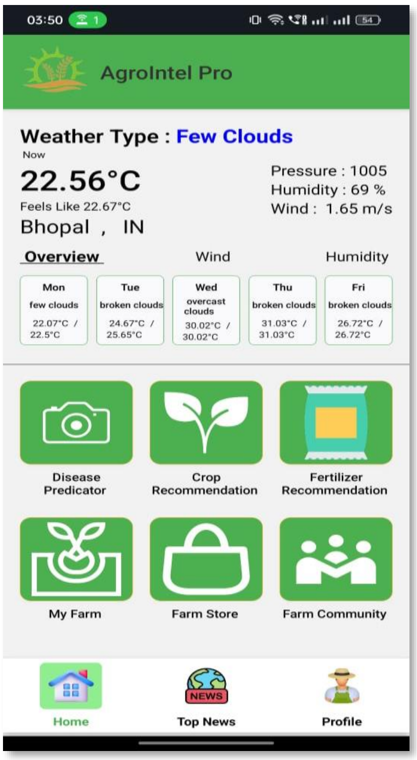
9. Time and Cost Savings:

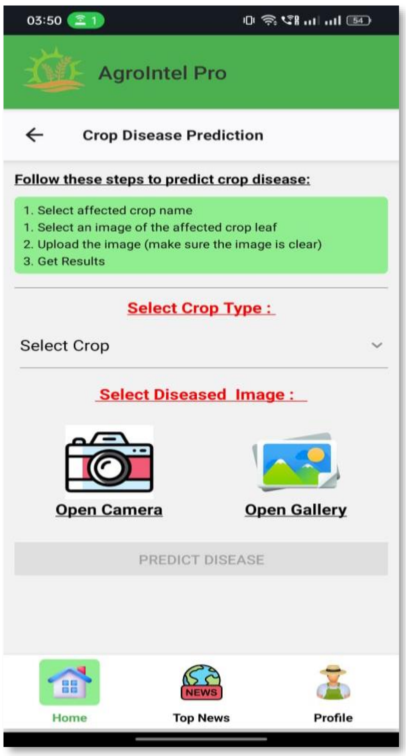
    - The app saves farmers time and money by automating the process of data analysis and prediction. This allows farmers to focus on other essential aspects of their work, such as crop management and marketing.

11.User Interface

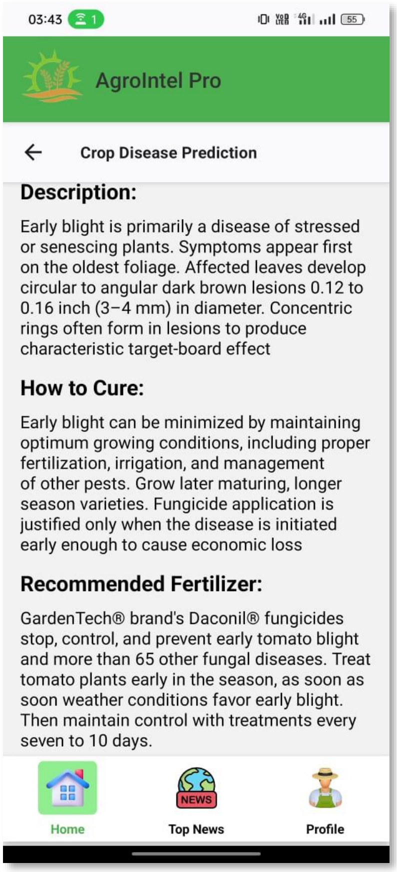


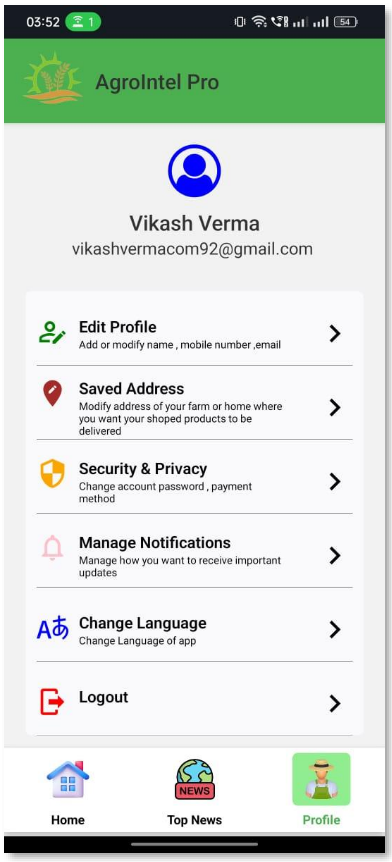
Login Screen





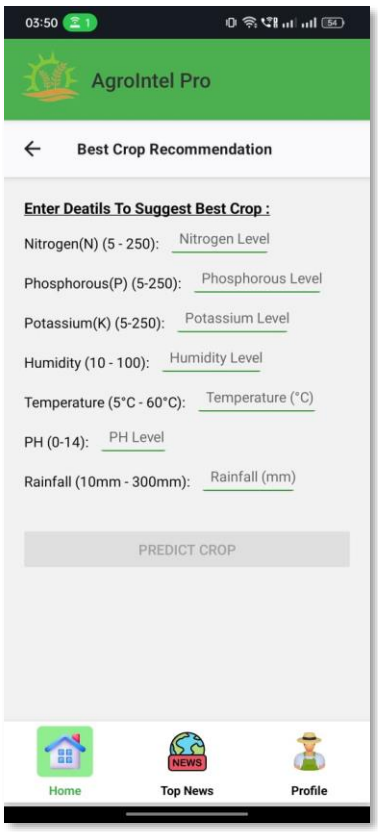
Home Screen Disease prediction

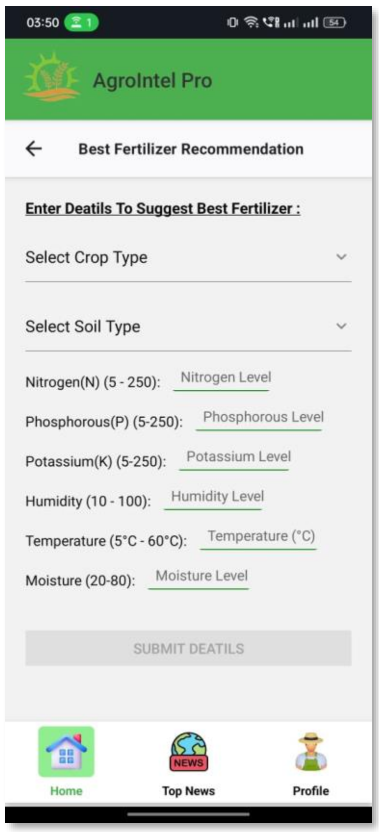




Prediction

Profile





12). Results

This system developed with machine learning known as AgroIntel Pro will assist in recommending the best crop to grow inland, as well as which fertilizer to use, and provide plant disease detection based on images, which will be easily available and used by users in order to make a decision on which crop to grow based on the soil nutritional values and climate in that region. The model proposed in the research can be expanded in the future to include crop and fertilizer recommendations as well as plant disease detection in a mobile app. Consequently, our app will assist farmers in sowing the appropriate seed based on soil requirements and increasing their crop yields in order to boost production and profit in their operations from such techniques.

13. Conclusion

The prediction of crop based on soil data and proper implementation of algorithms have proved that a higher crop yield can be achieved. From the above work, we conclude that for soil classification Random Forest is a suitable algorithm with an accuracy of 99.09% compare to Gaussian Naive Bayes. The work can be extended further to add the following functionality. Building a app can be built to help farmers by uploading an image of farms. Crop diseases detection uses image processing in which users get pesticides based on disease images and Fertilizer prediction based on soil condition.

14). Future Enhancements

1. Crop Diversification Recommendations:
    - Extend the system to recommend crop diversification strategies based on market demand and soil health. This can help farmers reduce risks associated with mono-cropping and adapt to changing market dynamics.
2. Climate Change Adaptation:
    - Incorporate climate change modeling to provide farmers with insights into long-term climate trends. This can assist in making adaptive decisions, such as shifting planting dates or selecting more climate-resilient crop varieties.
3. Crop Quality Assessment:
    - Include features to assess not only crop quantity but also crop quality. Quality assessments can help farmers meet specific market standards and fetch better prices for their produce.
4. AI-driven Pest Control:
    - Extend the disease prediction module to include recommendations for pest control. Utilize AI algorithms to identify common pests and suggest appropriate control measures, reducing the need for chemical pesticides.
5. Farmers' Community Integration:
    - Create a platform for farmers to connect with each other and share their experiences and best practices. This community integration can foster knowledge sharing and collaboration among farmers.
6. Data Security and Privacy:
    - Strengthen data security and privacy measures to protect sensitive information about farms and farmers. Consider implementing blockchain or other secure data management technologies.

7. Remote Monitoring and Control:

    - Integrate remote monitoring and control features, allowing farmers to remotely control irrigation systems, adjust fertilizer application, and receive alerts about adverse conditions.

8. Customization and Scalability:

    - Make the system highly customizable so that it can cater to the unique needs of individual farms. Ensure that it is scalable to accommodate large agricultural operations.

9. Partnerships with Agricultural Agencies:

    - Collaborate with government agricultural agencies to provide valuable data and insights for policy-making and agricultural development programs.

10. Machine Learning Model Continual Training:

    - Implement mechanisms for continual training of machine learning models to adapt to changing environmental conditions and data patterns.

11. Environmental Impact Assessment:

    - Include features to assess the environmental impact of farming practices and suggest sustainable alternatives to reduce carbon footprint and resource consumption.

12. Integration with Supply Chain Management:

    - Connect the system to supply chain management platforms to enable farmers to track their produce from the field to market, improving transparency and traceability.

13. Localized Language Support:

    - Offer support for local languages and dialects to ensure that the system is accessible to a wide range of farmers, including those in non-English speaking regions.

These future enhancements will not only improve the functionality and effectiveness of the Smart Crop, Fertilizer, and Disease Predictor System but also contribute to the sustainability and efficiency of modern agriculture practices.

15).Bibliography

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