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CROPSECURE: A Smart Platform for Crop Disease Detection

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ABSTRACT :

With agriculture being a key contributor to the Indian economy, ensuring crop health has never been more critical. Traditional crop disease diagnosis methods are slow and often inaccurate, especially in rural settings. Cropsecure addresses this issue with a mobile-first solution that uses Convolutional Neural Networks (CNN) to detect crop diseases from leaf images. The app allows farmers to capture and upload images via an intuitive interface. A TensorFlow Lite-optimized model processes these images directly on the device, ensuring fast, offline predictions. Beyond disease detection, Cropsecure provides actionable insights, including the disease name and treatment recommendations. This paper outlines the system design, model architecture, implementation, and real-world results that demonstrate how Cropsecure makes intelligent agriculture accessible and scalable.

Keywords: Cropsecure, CNN, Crop Disease Detection, Mobile App, TensorFlow Lite, On-device Inference, Smart Agriculture

INTRODUCTION

Agriculture remains the livelihood of millions in India, but farmers often face challenges in identifying crop diseases early. Manual inspection can be time-consuming, inconsistent, and highly dependent on experience. In remote areas, the lack of access to agronomists further delays critical interventions. Leveraging the widespread availability of smartphones and advances in artificial intelligence, Cropsecure bridges this gap. It's a smart mobile app that enables farmers to capture leaf images, analyze them through a lightweight CNN model, and receive instant results – even without internet connectivity. By offering disease names, care instructions, and prevention tips, Cropsecure empowers farmers with data-driven decisions to protect their crops and maximize yield.

PROBLEM STATEMENT

In today's agricultural landscape, farmers face immense challenges when it comes to identifying crop diseases early and accurately. Traditional methods such as visual inspection or consulting local experts are often time-consuming, subjective, and not always accessible to farmers in remote or under-resourced regions. Due to the lack of awareness or technical support, many farmers end up misidentifying the disease or applying incorrect remedies, which leads to crop damage, reduced yield, and financial losses.

One of the key barriers is the lack of accessible, real-time diagnostic tools that can function without requiring high-speed internet or technical expertise. While machine learning-based solutions exist, they are mostly cloud-dependent or require powerful hardware, which limits their usability in the field—particularly for farmers using low-cost Android smartphones. Furthermore, many existing platforms fail to provide simple, actionable feedback. Even when a disease is detected, the advice given is often too technical, not localized, or not presented in a farmer-friendly format.

METHODOLOGY

The development of Cropsecure followed a structured and thoughtful methodology, combining deep learning with mobile-first design to ensure the app is both powerful and easy to use. The first step involved collecting and preparing image data of crop leaves—both healthy and diseased. These images were sourced from publicly available datasets and carefully organized to include various crops and multiple disease types. To improve model accuracy and adaptability to real-world conditions, several preprocessing techniques were applied. This included resizing, normalization, and data augmentation methods such as rotation and flipping. These steps helped the model learn better, even when images varied in lighting or angle.

The next major phase focused on model development. A Convolutional Neural Network (CNN) was trained to recognize disease symptoms from leaf images with high accuracy. Once trained, the model was converted to TensorFlow Lite (TFLite**)** format, making it lightweight and optimized for mobile devices. This step ensured that disease detection could happen directly on the user's smartphone—without the need for internet access—allowing real-time results even in remote farming regions.

Once the model was ready, it was integrated into an Android application designed with farmers in mind. The app features a clean and simple interface where users can either capture an image using the phone's camera or upload one from their gallery. After the image is selected, it's processed locally through the TFLite model, and results are generated almost instantly. If the crop is healthy, the user is notified; if a disease is detected, the app shows its name along with helpful suggestions and preventive measures. This makes the app not just a detection tool but a real-time agricultural assistant.

To support continuity and personalization, Firebase was used on the backend. Firebase Authentication enables secure user login and account creation, while Firebase Realtime Database stores the scan history for each user. This allows farmers to track previous detections, monitor recurring issues, and maintain a personal crop health record over time.

Finally, the app was tested across different Android devices, including lower-end models commonly used in rural areas. Emphasis was placed on making the app responsive, fast, and usable without technical knowledge. Feedback from trial users helped fine-tune the interface and improve detection output clarity. The combination of real-time mobile inference, ease of use, and smart disease tracking positions **CropSecure** as a reliable and scalable solution for modern farming challenges.

OBJECTIVES

1. **To develop a mobile-based application** that enables real-time crop disease detection using deep learning techniques, specifically Convolutional Neural Networks (CNN).

2. **To empower farmers with instant and accurate feedback** by analyzing leaf images and identifying diseases directly through their smartphones—even without internet connectivity.

3. **To provide actionable suggestions and disease-specific care tips**, helping farmers make informed decisions for better crop management and treatment.

4. **To implement an on-device machine learning model using TensorFlow Lite**, ensuring efficient performance even on low-end Android devices commonly used in rural areas.

5. **To create a user-friendly interface** that supports easy image capture, seamless navigation, and clear result display tailored for farmers with varying levels of digital literacy

6. **To integrate Firebase Authentication** for secure user login and personalized interaction, along with a database system to track detection history and monitor crop health over time.

7. **To ensure accessibility and scalability by** designing the app to support a wide range of crops and diseases, and enabling updates as new agricultural data becomes available

8. **To contribute toward precision agriculture and sustainable farming,** by reducing dependence on manual inspection and bridging the gap between traditional practices and smart technology.

REQUIREMENT SPECIFICATION

Table 1: Software Requirements

OPERATING SYSTEM	WINDOWS OS/ ANY OS
IDE	ANDROID STUDIO
PROGRAMMING LANGUAGE	PYTHON , JAVA/KOTLIN
ML FRAMEWORK	TENSORFLOW/TENSORFLOW LITE
DATABASE	FIREBASE
CLOUD SERVICES	FIREBASE AUTHENTICATION,STORAGE

Table 2 : Hardware Requirements

PROCESSOR	INTEL CORE i5 OR HIGH
CPU	MINIMUM 2 CORES AND 4 THREADS
RAM	MINIMUM 4 GB
MEMORY	MINIMUM 20 GB

- Database Requirements: Firebase Realtime Database for storing user image scan history, results, and authentication data. Supports real-time sync and secure access control.
- User Requirements: Laptop or PC with browser and internet connection.

TECHNOLOGIES USED FOR IMPLEMENTATION

- **Frontend: Android (Java/Kotlin)**
- **Backend (Model Training): Python with TensorFlow**
- **Machine Learning Framework: TensorFlow / TensorFlow Lite (for on-device inference)**
- **Database: Firebase Realtime Database**
- **Authentication: Firebase Authentication**
- **Development Environment: Android Studio**

SYSTEM ARCHITECTURE

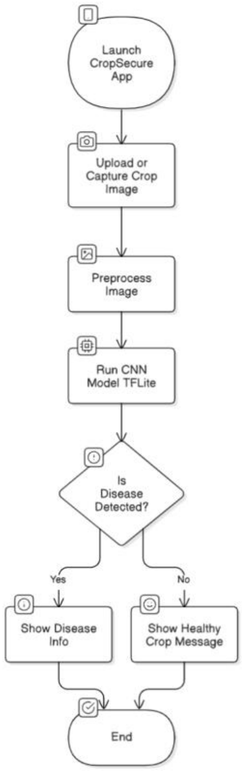

Fig 1.0: System Architecture

The Cropsecure system is designed as a lightweight, mobile-first application for real-time crop disease detection. When the app is launched, users are prompted to log in or register via Firebase Authentication, enabling secure access and personalized scan history tracking.
Once logged in, users can either capture a crop leaf image using the device camera or upload an existing one. The selected image goes through a preprocessing step that includes resizing and normalization to ensure it meets the model's input requirements and maintains consistent performance across varying image conditions.
The processed image is then passed to an embedded TensorFlow Lite CNN model, trained to detect disease symptoms from leaf images.
After inference, the system evaluates whether the crop is healthy or diseased. If a disease is detected, the app displays the disease name along with treatment suggestions and preventive measures. If no disease is found, a simple "Crop is Healthy" message is shown to the user.
All results, including image scans and model outputs, are stored in the Firebase Realtime Database linked to the user's profile.

CONCLUSION

Cropsecure is a mobile-based solution designed to simplify and improve crop disease detection. By using a lightweight TensorFlow Lite CNN model, the app enables real-time diagnosis directly on a smartphone without needing internet access. With image upload, intelligent processing, and instant feedback, the system helps farmers take quick and informed action. The integration with Firebase allows result tracking and secure user management. Future improvements may include expanding crop and disease coverage, adding local language support, and integrating expert advisory modules. Cropsecure has the potential to enhance agricultural decision-making, making farming more proactive and efficient.

RESULT :

Fig 1.1 : Idle Page

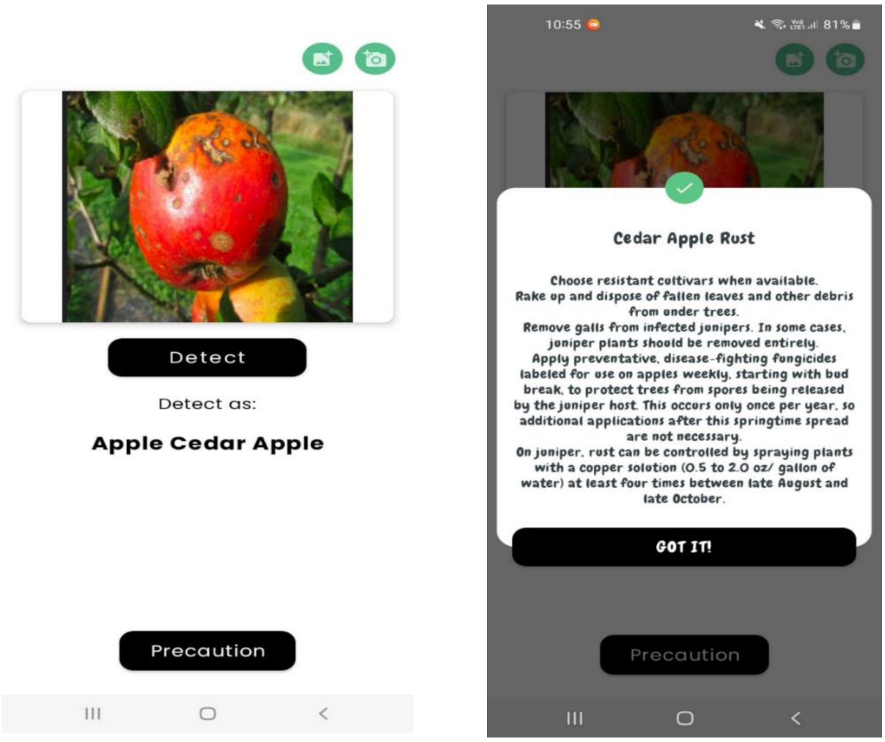

Fig 1.2 : Result Page

Fig 01 : Python

Fig 02 : Android Studio

Fig 04 : Firebase

Fig 05 : Java

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3. **Khan et al. (2023) –** Optimized MobileNetV3 for edge devices, enabling 99.5% accurate detection in mobile environments.
4. **Elinisa & Mduma (2024) –** Developed a mobile TensorFlow Lite app for early banana disease detection with 91% accuracy
5. **Chen et al. (2022) –** Identification of plant leaf diseases by deep learning based on channel attention and channel pruning.
6. **Asani et al. (2023) –** Presented mPD-App, a user-friendly CNN-powered mobile tool for plant disease diagnosis in rural farms**.**

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