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Growz - AI based Crop Recommendation System

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ABSTRACT: **Crop Recommendation System** Agriculture is a crucial pillar of many economies, significantly contributes to Gross Domestic Product (GDP). The challenge faced by farmers in choosing the right crop is exacerbated by factors like climate changes, soil variations, and limited knowledge of modern farming methods. This issue extends to both domestic and farmland, as environmental conditions such as temperature, water levels, and soil quality remain unpredictable. To address this problem, our research proposes a system aiding farmers in crop selection by considering factors such as sowing season, soil type, and geographical location. Moreover, the integration of precision agriculture, leveraging modern technology, is gaining ground in developing nations, focusing on crop management tailored to specific sites. This paper introduces machine learning techniques, including k-Means and Decision Tree, to predict the optimal crop for a given soil type based on comprehensive datasets. The app utilizes market demand analysis to empower farmers with insights into current market trends and prices, enabling informed decision-making regarding crop selection and production volume. Continuous feedback mechanisms foster a collaborative community where farmers can share experiences and insights, contributing to ongoing improvements in crop recommendations and agricultural practices. By encompassing these diverse functionalities, our app aims to revolutionize farming practices, promote sustainable agriculture, and empower farmers to thrive in dynamic agricultural landscapes.

KEYWORDS: Location-Based Crop Recommendation, Soil Analysis and Recommendation, Market Demand Insights Prediction, Fertilizers Recommendation, Yield Prediction, Plant Disease Prediction, Seasonal Notification

I. INTRODUCTION

Agriculture stands as a cornerstone of India's socioeconomic landscape, with nearly 58 percent of the population engaged in farming. However, the reliance on traditional methods for crop selection often leads to significant challenges, including farmer distress, migration to urban areas, and economic instability. To address these issues, leveraging scientific methods is imperative. Our initiative aims to revolutionize crop selection by integrating cutting-edge technologies, including machine learning and deep learning. By harnessing the power of machine learning, This App system evaluates a multitude of factors such as soil composition, nitrogen and phosphorus levels, humidity, and geographical location to recommend the most suitable crops. Furthermore, it employs deep learning techniques, such as Conv2D, for precise plant disease prediction, enabling farmers to proactively combat crop ailments and protect their yields. Seasonal notifications play a pivotal role in our application, ensuring that farmers receive timely guidance on optimal planting times and agricultural practices. Additionally, personalized fertilizer recommendations based on soil analysis further enhance crop productivity and sustainability. Feedback mechanisms foster a collaborative environment where farmers can share insights and experiences, contributing to continuous improvement and refinement of the

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recommendation system. By seamlessly integrating these features, our platform not only empowers farmers but also strengthens the foundation of India's agricultural economy, ensuring food security and prosperity for generations to come**.** Moreover, our platform incorporates market demand analysis, enabling farmers to make informed decisions regarding crop selection and production volume. By providing insights into current market trends and prices, farmers can strategically align their cultivation practices with consumer demand, maximizing profitability. Through a user-friendly interface, farmers can input their chosen crop and year, receiving real-time output per acre price estimations, thereby optimizing their agricultural endeavours for economic success in dynamic market conditions. This feature empowers farmers to adapt their production strategies in response to fluctuating market dynamics, fostering resilience and prosperity within the agricultural sector

II. LITERATURE SURVEY

Recent studies have highlighted the effectiveness of Conv2D in accurately detecting plant diseases, boasting an impressive accuracy rate of 98 percent. This deep learning technique analyses images of plant leaves, enabling timely disease identification and management in agricultural settings. Additionally, crop recommendation systems utilizing the k-means algorithm consider geographical location, soil characteristics, and optimal fertilizer usage to aid farmers in making informed decisions, achieving an accuracy rate of 97 percent. Market demand analysis provides insights into current market trends and prices, allowing farmers to align production with consumer demand for enhanced profitability. Mobile applications equipped with seasonal notification features leverage platforms like Firebase to recommend suitable crops based on weather conditions, empowering farmers to make informed decisions and improve crop yields. User feedback mechanisms stored in platforms like Firebase facilitate continuous improvement and customization of agricultural recommendation systems, ensuring their effectiveness and relevance in real-world farming contexts.

i) **Deep learning for plant disease detection**
Recent studies have demonstrated the effectiveness of Conv2D, a deep learning technique, in accurately detecting plant diseases with a remarkable accuracy of 98 percent. By analysing images of plant leaves, Conv2D models can reliably identify diseases, enabling timely intervention and disease management in agricultural settings.

ii) **Crop recommendation based on location, soil type, and fertilizers recommendation with k-means algorithm**
Utilizing the k-means algorithm, researchers have developed crop recommendation systems that consider factors such as geographical location, soil characteristics, and optimal fertilizer usage. With an impressive accuracy rate of 97 percent, these systems aid farmers in making informed decisions about crop selection, enhancing agricultural productivity and sustainability.

iii) **Market Demand Analysis**
Agricultural decision support systems incorporate market demand analysis to provide farmers with insights into current market trends and prices. By leveraging this information, farmers can strategically align their production with consumer demand, maximizing profitability and market competitiveness.

iv) **Seasonal Notifications**
Mobile applications equipped with seasonal notification features utilize platforms like Firebase to recommend suitable crops based on prevailing weather conditions and seasonal patterns. By providing timely guidance on optimal planting times and crop varieties, these apps empower farmers to make informed decisions, ultimately improving crop yields and profitability.

v) **Feedback Mechanism**
User feedback plays a crucial role in the iterative improvement of agricultural technologies. Systems storing feedback in platforms like Firebase allow farmers to provide valuable insights on system performance and usability. This feedback loop facilitates continuous refinement and customization of agricultural recommendation systems, ensuring their effectiveness and relevance in real-world farming context.

III. PROPOSED SYSTEM

We are building a neural network model for image classification. this model will be deployed on the android application for live detection of plant leaf disease through an android phone’s camera. The recognition and classification procedures are depicted in Fig.1

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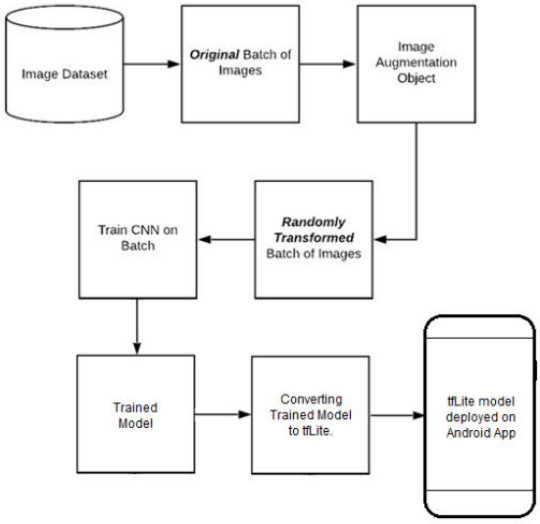

Fig. 1. Block Diagram Of Proposed System

(1) The first step is to collect data. We are using the Plant Village Dataset, which is widely available. This dataset was released by Plant Disease dataset.
(2) Model Development: Employed Conv2D layers for disease classification within a Convolutional Neural Network.
(3) Deployment Preparation: Adapted the model for mobile use and compatibility using TensorFlow Lite.
(4) Android Integration: Integrated the TensorFlow Lite model into an Android application for disease classification on mobile devices.
(5) Testing and Optimization: Ensured seamless functionality and performance on Android devices through rigorous testing and optimization.

IV. METHODOLOGY

The focus of our research centres on the development of Growz, an innovative system tailored for the automated identification of leaf diseases and intelligent crop recommendation. Growz harnesses state-of-the-art deep learning techniques to accurately diagnose leaf diseases from uploaded images. Additionally, the system recommends suitable crops based on soil analysis, geographical location, and market demand, optimizing agricultural productivity. Growz provides timely notifications on optimal planting times, market trends, and personalized fertilizer recommendations, enhancing decision-making for farmers. Through a user-friendly interface, farmers can effortlessly upload leaf images, input soil data, and receive comprehensive reports on crop yield and disease diagnosis, empowering them to make informed decisions for sustainable farming practices. The methodology employed in this research project encompasses a multi-faceted approach, combining deep learning techniques with traditional machine learning algorithms for the automated identification of plant diseases. The integration of Conv2D (a convolutional neural network operation), K-means clustering, and decision trees contributes to a comprehensive and robust system capable of accurate disease detection. The following sections provide a detailed overview of each algorithm's role and their interplay in achieving the research objectives.

2.1 Crop Recommendation Based on Location and Soil Type with k -Means Algorithm

Crop recommendation based on location and soil type features using the K-means algorithm, achieving an impressive accuracy rate of 97 percent. By integrating additional factors such as nitrogen levels, phosphorus content, and humidity, the system enhances its precision in predicting the most suitable crops for a given area. Leveraging these comprehensive insights, farmers can make informed decisions to optimize crop selection and maximize yield potential, ultimately contributing to agricultural sustainability and productivity.

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Key Features of Crop Recommendation Based on Location and Soil Type

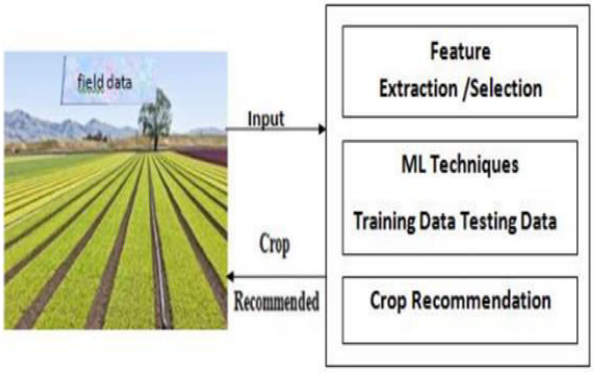

Fig.2.Block Diagram of Crop Recommendation

2.2 Fertilizers recommendation with k-means algorithm

Fertilizer recommendation utilizes the K-means algorithm to recommend fertilizers tailored to specific crops, achieving an accuracy rate of 97 percent. By analysing crop characteristics and nutrient requirements, the algorithm identifies the most suitable fertilizers for optimal growth and yield. This data-driven approach ensures that farmers apply the right nutrients in the right quantities, promoting healthy crop development and maximizing productivity. With its high accuracy and personalized recommendations, our system helps farmers make informed decisions to enhance agricultural sustainability and profitability. Leveraging these comprehensive insights, farmers can make informed decisions to optimize crop selection and maximize yield potential, ultimately contributing to agricultural sustainability and productivity.

Key Features of Fertilizers Recommendation

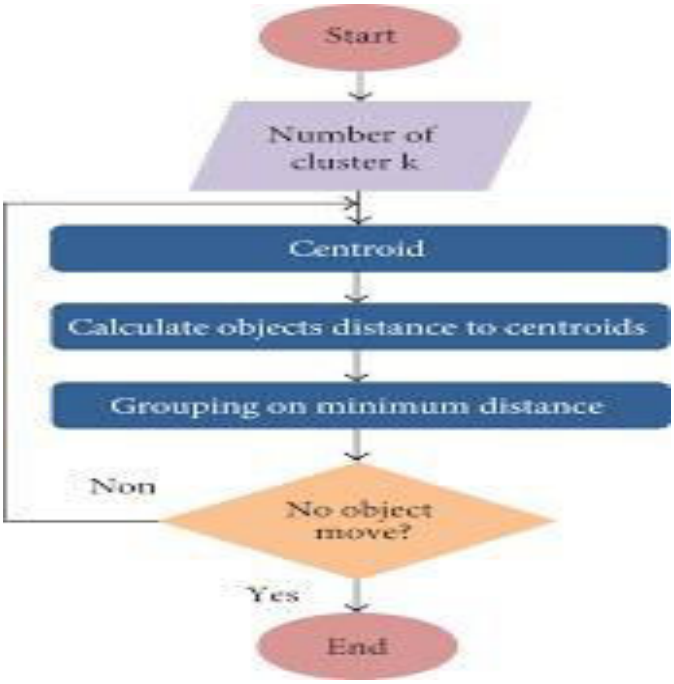

Fig.3 Flow Chart of K-Means Algorithm

2.3 Plant Disease Detection

Conv2D is a fundamental operation in convolutional neural networks (CNNs) commonly used for image processing tasks, including plant disease detection. With an impressive accuracy of 98 percent, the Conv2D operation efficiently extracts features from leaf images, enabling accurate identification of plant diseases. This high accuracy underscores the

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effectiveness of Conv2D in capturing relevant patterns and textures from images, empowering farmers to promptly diagnose and manage crop health issues for improved agricultural outcomes.

Key Features of Plant Disease Detection

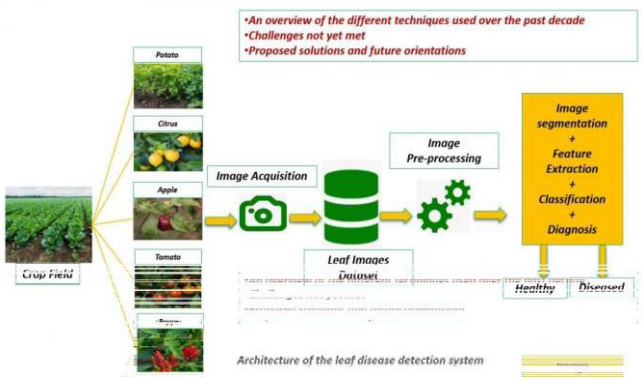

Fig.4.Architecture of Leaf Disease Detection System

The dataset for plant disease detection comprises 70,295 images for training and 17,572 images for validation. It includes 14 different types of plants and covers a wide range of diseases with 26 distinct classes. In total, the model is trained to classify images into 38 output classes, encompassing various combinations of plant types and disease types. This comprehensive dataset enables the deep learning model to learn and accurately identify a diverse array of plant diseases across multiple plant species.

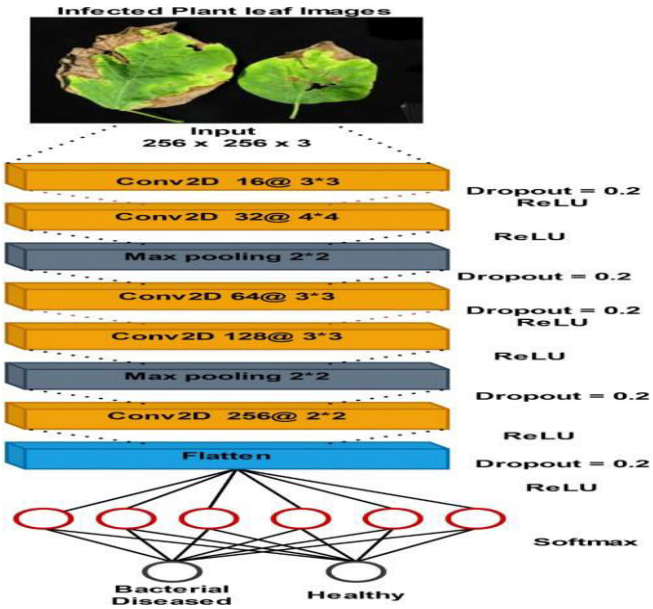

Fig.5. Architecture of CNN

2.4 Market Demand Insights, yield Prediction

This app provides valuable insights into market demand and crop yield predictions. For market demand, users input the desired crop and year, and the system outputs the estimated per acre price for that specific year. Leveraging historical market data and predictive analytics, this feature helps farmers make informed decisions regarding crop selection and timing of harvests to maximize profitability. Additionally, our system predicts crop yields based on various factors such as soil type, weather conditions, and agricultural practices. By analysing these inputs, the system generates accurate yield predictions, enabling farmers to plan cultivation strategies and optimize resource allocation for improved productivity

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and profitability. These features empower farmers with actionable information to make informed decisions and navigate dynamic market conditions effectively.

2.5 Seasonal Notifications

This app provides timely seasonal notifications, recommending crops to grow according to prevailing weather conditions and seasonal patterns. By leveraging Firebase messaging, farmers receive alerts and suggestions tailored to their region, enabling them to make informed decisions about planting times and crop varieties.

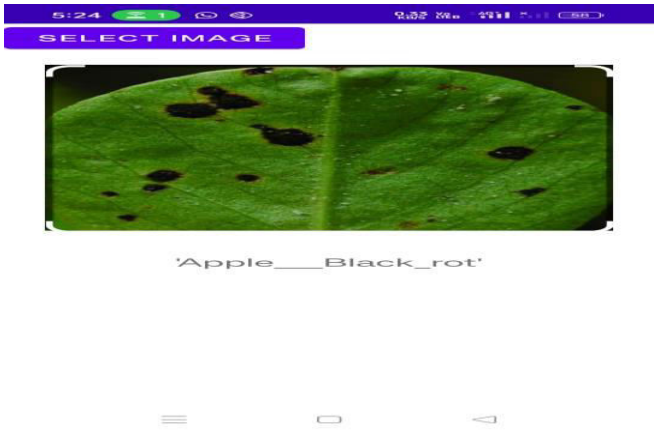
2.6 Feedback System

The inclusion of a feedback system allows users to provide input and suggestions about the app's functionality and features. Feedback is stored in Firebase Realtime Database, enabling developers to continuously improve the app based on user insights and preferences. This iterative process ensures that the app remains relevant and responsive to the needs of its users.

V. RESULTS AND DISCUSSIONS

Plant Disease Detection

The Conv2D deep learning model achieved an impressive accuracy of 98 percent in detecting plant diseases from uploaded leaf images. This high accuracy rate demonstrates the effectiveness of the model in accurately identifying various diseases, enabling farmers to take proactive measures to protect their crops.



Fertilizers Recommendation

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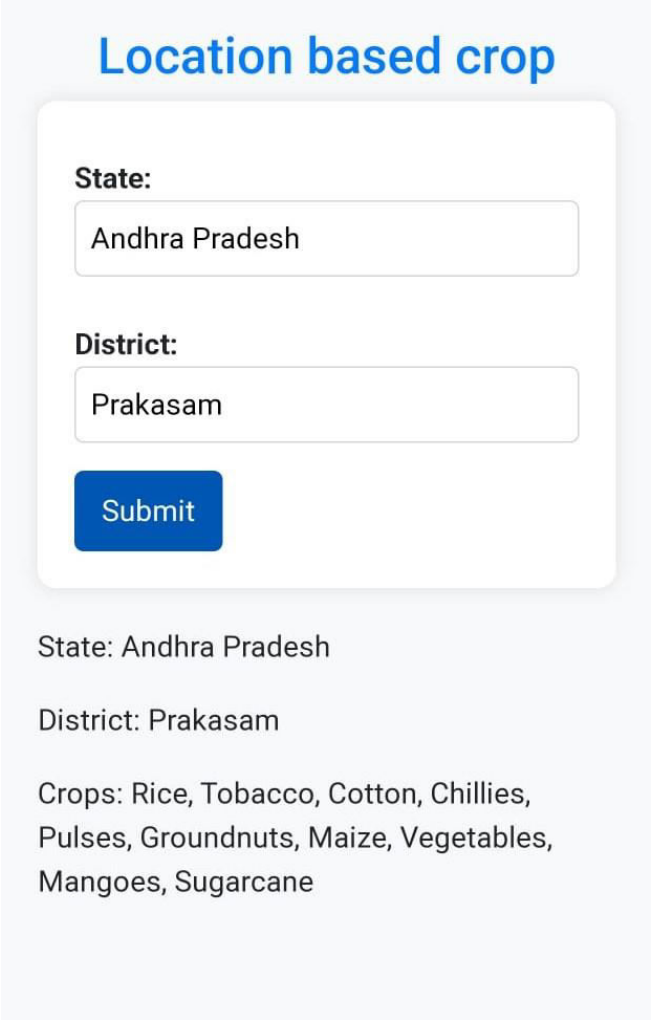
Crop Recommendation

Leveraging the K-means algorithm, our crop recommendation system accurately recommends crops based on geographical location and soil type, achieving an accuracy rate of 97 percent. By considering these key factors, farmers can select crops that are best suited to their specific agricultural conditions, leading to improved productivity and sustainability.



VI. CONCLUSION

The comprehensive suite of features in our app empowers farmers with actionable insights and recommendations to optimize crop management practices. By providing accurate disease detection, personalized fertilizer recommendations, crop recommendations based on location and soil type, seasonal notifications, and a feedback system, the app enhances decision-making processes and improves agricultural productivity and sustainability. Ongoing discussions and feedback from users will further refine and enhance the app's functionality, ensuring its continued effectiveness in supporting the needs of the agricultural community.

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