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"AGRIGUARD" A Mobile Application for AI-Powered Crop Disease Detection and Personalized Advisory

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Abstract- In Agriculture, crop diseases are the main reasons for reduced productivity and financial loss for farmers. Disease detection at early stage is important so that farmers can take proper actions to prevent it. In this project, we developed an AI-based mobile application called AgriGuard, to identify crop diseases automatically. Our system uses CNN model known as Convolutional Neural Network to analyze plant leaves images that are captured using a smartphone. This trained model predicts the type of diseases and provides suitable suggestions related to treatment to help farmers make quick decisions. This model is optimized to reduce time processing and improve performance. Our model allows farmers to get instant results directly in the field. This developed approach provides accurate predictions making it practical for real-time agricultural use.

Keywords: Crop disease detection, Deep learning, CNN, Mobile application, Image classification and AI in Agriculture.

I. INTRODUCTION

Agriculture plays an important role in supporting the global population and economic development. However, crop diseases remain one of the main challenges that affects agricultural productivity and food security [11][17]. The diseases caused by fungi, bacteria and viruses can spread rapidly across the fields and result in significant yield loss if it is not identified at an early stage. Therefore, disease detection depends on manual observation and consultation which can be time consuming, costly and often unavailable to farmers in remote areas. So, there is a growing need for automated and accessible solutions that assist farmers in identifying plant diseases efficiently [1][2].

Recent advancements in AI and Deep learning have enabled intelligent analysis of agricultural data [18][19]. The image based plant disease detection has gained attention due to the availability of powerful machine learning models capable of recognizing visual patterns. CNN has been effective in extracting features from leaf images and classifying diseases with high accuracy. By using image classification techniques, crop health can be monitored quickly without requiring specialized equipment or expert knowledge.

The mobile technology enhances AI usability in agriculture by providing real time access directly in this field. Smartphones with cameras allow farmers to capture leaf images and obtain instant diagnosis results. However, using deep learning models on mobile devices creates new challenges such as limitations, delay and size constraints. To address this challenges, we use optimized and lightweight models for efficient mobile deployment.

In this project, an AI based mobile application named as AgriGuard is developed to perform crop disease detection automatically and provide advisory support. This system analyzes captured leaf images using a CNN model and predicts the diseases with suitable treatment recommendations [8][10]. This approach reduces dependency on manual inspection and enables fast decision making for farmers. So, there by combining deep learning with mobile technology, our system aims to provide a practical and accessible solution for real time agricultural needs.

II. LITERATURE REVIEW

Many researchers have used machine learning and deep learning techniques to help improve agriculture, in identifying crop diseases automatically. Image based disease detection has become popular because plant leaf images can be easily collected and analyzed using computer vision methods. Among different techniques, CNN models are widely used as they can recognize disease patterns from leaf images with good accuracy [3][5][12].

Earlier studies mainly focused on building CNN models for classifying plant diseases. Although models produced an accurate result, most of them required high computational power and was very difficult to use on mobile devices [6][9]. To solve this problem, later research introduced lightweight models that can run efficiently on smartphones and edge devices.

Some existing works also developed mobile applications that provide agricultural guidance along with disease detection [4]. These application helps farmers get information quickly without depending on agricultural experts. However, many of the existing systems focus only on disease protection and not fully on real time performance and mobile related challenges [20].

Considering these limitations, this project proposes an AI based mobile application that performs crop disease detection and provides advisory support. The aim of our project is to create an application that works faster and can be easily used by farmers in real field conditions.

III. PROPOSED METHODOLOGY

The proposed system focuses on developing an AI based mobile application for detecting the crop diseases automatically using leaf images. The overall working of the system begins when the user captures an image of a plant leaf by using a smartphone camera. Then the captured image is processed and analyzed by a deep learning model to identify the type of diseases. Initially, the collected dataset of plant leaf images is prepared for training the model. Techniques such as image preprocessing like resizing and normalization are applied to maintain uniform input size and improve model performance [8]. Methods like rotation and flipping are also used to increase dataset variation and avoid overfitting during training.

A CNN model is used for feature extraction and classification [10][16]. This convolution layers extract important features such as color, texture and patterns from the leaf images. By using pooling layers, we can reduce the image dimensions while preserving important information. Finally, fully connected layers classify the image into different disease categories using activation function.

After training, the model is optimized and is converted into a lightweight format suitable for mobile development. When a user uploads a leaf image through our application, the model predicts the disease and display the results along with treatment suggestions. This workflow enables quick and efficient identification of diseases directly in field.

IV. SYSTEM DESIGN

The system design describes the overall structure and working flow of the proposed application of crop disease detection. This system is designed to allow farmers to capture the leaf images using a mobile device and receive predicted disease results quickly. This architecture consists of image input, preprocessing, model prediction and result display modules.

Initially, the user captures a plant leaf through the mobile application and the image is sent to the preprocessing module where resizing and normalizations are performed to prepare the image for model input. This processed image is then given to the trained CNN model for feature extraction and classification.

This CNN model analyzes important features such as color variations, texture, patterns and disease spots present on the leaf surface. After classification, the predicted disease result is generated and displayed to user with treatment suggestions. This system provides fast prediction with lightweight performance suitable for mobile devices.

The overall workflow of the system is represented using the system architecture diagram, data flow diagram and CNN architecture diagram.

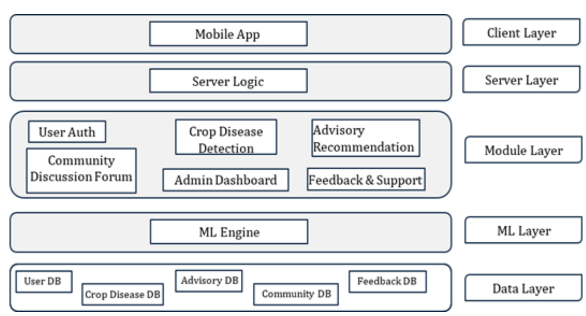

Fig 1: System Architecture

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The above figure shows the overall system architecture of our AgriGuard application. The system is divided into different layers such as client layer, server layer, module layer, ML layer and data layer. The mobile application act as the client interface through which users interact with the system. The server layer handles the application logic and manages user requests.

The module layer includes important functions such as user authentication, crop disease detection, advisory recommendation, admit dashboard and feedback support. The ML engine processes the uploaded leaf images and performs disease prediction using the trained CNN model. The data layer stores user details, crop disease data, advisory information and feedback records. This layered architecture helps in efficient data processing, easy system management and smooth communication between different components of the application.

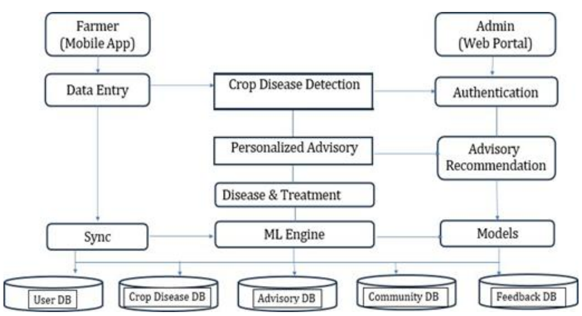

Fig 2: Data Flow Diagram

The above figure represents the data flow diagram of our AgriGuard system. It shows how data moves between the farmer, admin and different system components. The farmer uses the mobile application to enter and upload plant leaf images, which are then sent to the crop disease detection module for analysis. At the same time, the admin accesses the system through a web portal for authentication and management activities.

After receiving the image, the ML engine processes the data using trained models to identify the disease and generate advisory recommendations. The system then provides disease details and treatment suggestions to the user. All the information such as user data, crop disease records, advisory details and feedback are stored in their respective databases. This data flow ensures smooth communication between modules and enables accurate and real time disease prediction.

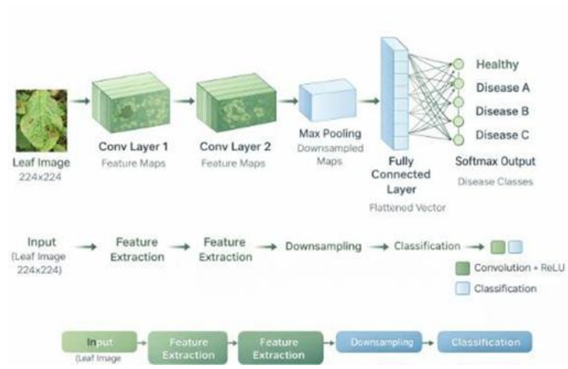

Fig 3: CNN Model Architecture

The above figure shows the architecture of the CNN model used for plant disease detection [10]. The process starts with the input leaf image, which is given to the convolution layers for feature extraction [8]. These layers identify important patterns such as color changes, spots and textures present on the leaf surface.

After feature extraction, max pooling layers are used to reduce the image size and remove unnecessary information while keeping important features. The processed data is then passed to the fully connected layer where classification is performed. Then finally, the model predicts whether the plant leaf is healthy or affected by a particular disease. This CNN architecture helps in achieving accurate and efficient disease recognition.

V. IMPLEMENTATION

The implementation phase focuses on developing and deploying the crop disease detection system using deep learning and mobile technology. This model process was carried out using Python programming language with deep learning libraries such as TensorFlow and Keras.

Initially, a dataset of plant leaf images containing both healthy and diseased leaves was collected. The dataset includes different crop diseases and healthy leaf samples which were organized into separate classes for training and testing the model. Before training the model, image preprocessing techniques such as resizing, normalization and data augmentation were applied. Data augmentation method such as rotation and flipping were used to increase the dataset size and improve generalization ability of the model.

A CNN model was designed to automatically learn features from the leaf images. The CNN architecture consists of multiple convolution layers that extract important features such as color patterns, texture and diseases spots from the images. Pooling layers are used to reduce the spatial dimensions of the feature maps while preserving important information. After feature extraction, fully connected layers are used to classify the images into different disease categories.

During training process, the model learns to identify disease patterns by minimizing loss function and improving classification accuracy over multiple training epochs. Optimization techniques are used to update the model weights and improve prediction performance.

After completing the training process, the trained CNN model was converted into a light weight format suitable for mobile application deployment. Model optimization techniques were applied to reduce the model size and improve prediction speed. The optimized model was then integrated into a mobile application that allows farmers to capture images of plant leaves and receive disease prediction along with treatment suggestions in real time.

The developed mobile application was tested by uploading different plant leaf images through the application interface. When the user uploads or captures a leaf image, the image is sent to trained CNN model for analysis. Then the model processes the image and predicts whether the leaf is healthy or affected by a disease. After the prediction, the result along with treatment suggestions is displayed to the user on the screen. This shows that the system can successfully detect crop diseases using deep learning and mobile technology.

VI. RESULT AND DISCUSSION

The developed crop disease detection system was tested using different plant leaf images to check its performance. The CNN model was able to identify diseases by analyzing the patterns and color change in the leaf images. During testing this system correctly classified both healthy and diseased leaves.

After applying model optimization, the prediction time was reduced and our application gave results quickly on a mobile device. The farmers can capture a leaf image and immediately receive the disease prediction along with treatment suggestions. This helps farmers to take faster decisions without depending completely on experts.

The obtained results show that our application works efficiently with maintaining lightweight model for mobile application. Our project demonstrates how AI can be practically used to support farmers in real agricultural environments.

Our project performs image classification using CNN to classify plant leaves as healthy or diseased. The performance of the proposed CNN model was tested using different plant leaf images. During testing, this model achieved an accuracy of around 82% in classifying the leaves. This system was able to correctly identify whether the leaf is healthy or affected by disease. This shows that this model works effectively and can be used for real time disease detection in agricultural application.

Accuracy is used as performance metric to evaluate the classification model. It measures how many predictions made by the model are correct. Accuracy of the model is calculated by using the following formula:
Accuracy = (No. of corrected predictions / Total no. of predictions) * 100

For example, if the model correctly classifies 26 images out of 32 test images then the accuracy will be:
Accuracy = (26/32) * 100 = 82%
This shows that CNN model correctly classified most of the plant leaf images.

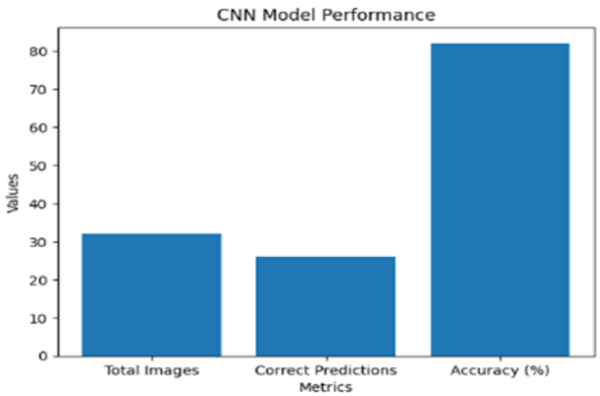

Fig 4: CNN Model Performance

The above graph represents the performance of the CNN model used in this project. The model was trained and tested using 32 plant leaf images. Out of these, approximately 26 images were correctly classified, resulting in an accuracy of 82%. This shows that the model is able to identify plant diseases with good performance. However, increasing the dataset size can further improve the accuracy of the system.

Table no.1: Classifier with Accuracy

Classifier	Accuracy
SVM	75%
KNN	78%
Proposed CNN Model	82%

From the above comparison table, the CNN model provides better accuracy than traditional machine learning classifiers [6][9]. This shows the effectiveness of deep learning for plant disease detection [13][14][15].

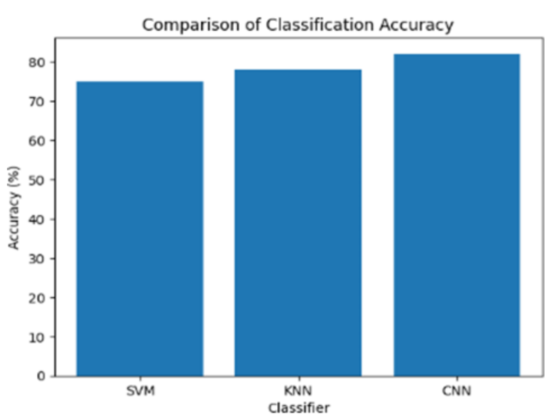

Fig 5: Comparison of Classification Accuracy

The above graph shows the comparison of classification accuracy between traditional machine learning algorithms and the proposed CNN model. The CNN based approach achieves higher accuracy as compared to SVM and KNN classifiers [6]. This demonstrate that deep learning techniques provide better performance for plant disease detection and improve prediction accuracy of the system.

VII. SCREENSHOT OF PROJECT WORK

Fig 6: Application Interface

The above figure shows the main interface of the plant disease recognition application. The user can upload a plant leaf image using the “upload image” option. After selecting the image, the system process it using the trained CNN model to detect the disease. This interface acts as the input stage of the system where image data is collected for analysis. The design is simple and user friendly so that the farmers can easily use the application without technical knowledge. This enables real time disease detection in agricultural fields.

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Fig 7: Detection Result 1

The above figure shows the disease detection result 1 of our AgriGuard application. After uploading the plant leaf image, this system analyzes the image using the trained CNN model and displays the detected result. Here, the leaf is identified as healthy and the system provides recommendation of plant health. This stage represents the output phase of the system where users receive prediction results and recommendations. The result is generated quickly which shows that the real time disease detection capability of the developed application.

Fig 8: Detection Result 2

The above figure shows the disease detection result 2 of the AgriGuard application when a diseased plant leaf image is uploaded. After user uploads the leaf image, then the system analyzes the image using the trained CNN model and identifies the disease present on the leaf. In this example, system detects the leaf disease as cercospora leaf spot and displays prediction result. It also provides treatment recommendation such as using appropriate fungicides and removing infected leaves to prevent further spread. This output demonstrates that the developed system can help successfully detect plant diseases and also provide guidance to farmers for crop protection.

VIII. CONCLUSION

In this project, an AI based crop disease detection system named AgriGuard was developed to help farmers identify plant diseases easily. This application uses a CNN model to analyze leaf images and check whether the plant is healthy or affected by disease. This system gives results quickly and also provides basic treatment suggestions for the crop.

The developed application reduces the need for manual checking and expert consultation. It helps the farmers to detect diseases at an early stage which can prevent damage of the crop and improve productivity. Our project shows how AI can be used in agriculture to support farmers with simple and useful technology.

The AgriGuard application is designed with a simple and easy interface so that anyone can use it without much technical knowledge. Farmers only need to upload a leaf image, and the system automatically analyzes it and shows the result. This makes application suitable for practical use in agricultural fields. This project also proves that deep learning techniques are useful for image classification. The CNN model identifies plant conditions by analyzing leaf color, texture and patterns. This help the farmers to make better decisions and take preventive actions at the right time.

IX. FUTURE SCOPE

In the future, the proposed system can be improved by adding support for more crop types and different plant diseases. Increasing the dataset size can help improve the accuracy and performance of the model. This makes the system more reliable for real agricultural use.
The system can also be enhanced by using more advanced AI models so that disease detection becomes faster and more accurate [20]. Real time monitoring

features can also be added to continuously observe crop health and provide timely alerts to farmers [7].

Further improvements may include adding weather based alerts and fertilizer recommendations to provide better guidance to farmers. These enhancements can make the system more useful for modern agricultural and help farmers make better decisions in large scale farming.

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