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LeafScan: Plant Leaf Disease Detection Using Convolutional Neural Networks (CNN)

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Abstract- Developing countries like India have Agriculture as a major part of their economy. Diseases in crops can damage yields and lead to a reduction in farmer's earnings. Traditional crop disease diagnosis approaches are still laborious and require an expert knowledge. To overcome this issue; this research brings Leaf Scan: an intelligent web application-based Vegetable and Crop Disease detection using Convolutional Neural Network (CNN). The system detects and predicates diseases using images of affected leaves and also suggests the treatment and prevention methods. The system was developed using the Plant Doc dataset and deep learning Mobile Net V2 architecture. The web application brings multi-lingual interaction, disease prediction based on real-time images, scan history management, visual reports, treatment and prevention data, information based on the use case and adaptive browsing interfaces etc. The system has estimated a correctness of 86% on 27 disease classes as per experimental analysis. This project aims to showcase the role of Artificial Intelligence and Deep Learning in augmenting agricultural productivity and crop yield and minimizing crop losses and supporting Precision Farming Technologies.

Keywords: Electromagnetic Braking System (EMBS), Contactless Braking, Magnetic Braking, Electromagnetic Force, Automobile Braking System, Auxiliary Brake, Kinetic Energy Dissipation.

I. INTRODUCTION

Agriculture is one of the most prominent and essential sectors for humans' life and economy. Thousands of farmers in India are dependent on cultivation. Diseases of plants affect A lot the yield and result in financial loss. traditional disease diagnosis methods require expert human visual inspection which is expensive and often unreachable for many farmers. Perspectives of Intelligent systems, Machine Learning, Artificial Intelligence, Computer Vision, Deep Learning and more recently Convolutional Neural Network (CNN) based approaches were resulted as a promising solution for plant disease detection and diagnosis. CNN shows superior performance in image classification as it learns automatically the related visual features as textures spots color change, discoloration. LeafScan, was realized as a turnkey solution to build an intelligent and accessible platform for farmers. This application compares the uploaded leaf picture with its trained dataset and automates the disease prediction with a specific confidence score. It gives treatment procedures, prevention measures as well as pro-farmer agricultural recommendations. Multilanguage support and various types of responsive UI/UX design were implemented.

II. OBJECTIVES

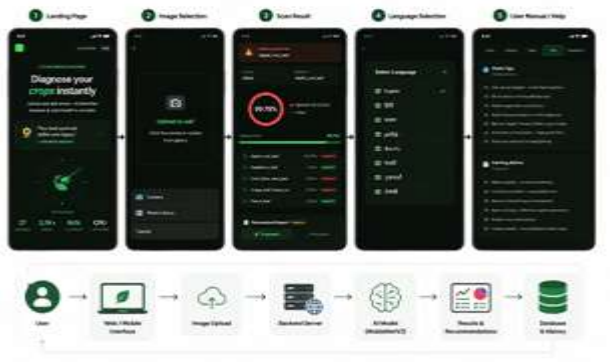
The main goal of this work is to create a smart plant disease detection system to be used with CNN. This system will classify diseases from images of leaves. It will also provide a profitable solution for farmers on how to proceed. Other goals are a CPU friendly design, multilingual support, data storing, more AI agricultural understanding.

III. LITERATURE REVIEW

Many researchers have investigated deep learning for plant disease detection. Mohanty et al. showed the effectiveness of deep learning models in classifying plant diseases using transfer learning approaches. Ferentinos has proposed various CNN architectures for large scale disease identification problems. Too et al. studied CNN structures such as ResNet DenseNet VGG and MobileNet on classifying images in an agricultural domain. Researchers have stressed the benefits of having real world datasets,

as laboratory datasets may not be as well generalized for use within real agricultural settings. MobileNetV2 proved to be necessary for its efficient predictive ability on low-end devices with its light-weight structure. In current systems, many of which focused on classification accuracy alone, farmer-centric functionalities are missing like multilingual support, prevention suggestions, and a statistical dashboard. LeafScan addresses these constraints by integrating its AI prediction with agricultural recommendations.

IV. SYSTEM DESIGN AND SCREENSHOT ANALYSIS

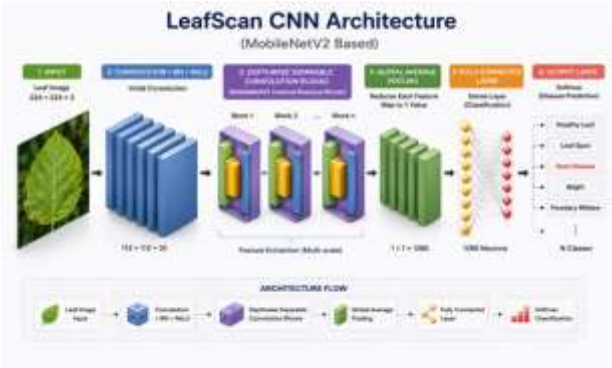


The screenshots of LeafScan even showcase its powerful AI driven Agri application for easy utilization. The homepage consists of animated scanner, the agricultural focused design, real time various system status. The multilingual language selector supports many Indian regional languages such as Hindi Bengali Gujarati Tamil Telugu, Marathi and Punjabi. The disease prediction page represents the confidence score and ranked prediction probability for greater clarity and transparency to users. The treatment and prevention modules suggest the users about the various remedial measures such as the application of fungicide, crop rotation, drip irrigation, neem oil spraying etc. The infected leaf removal, statistics screen and the history module help the users track the plant disease trend over a period of time. The ratings and suggestions module allows the users to provide suggestions and rate disease Scan.

V. METHODOLOGY

The outline of the approach employed in LeafScan went from dataset collection to CNN training and prediction and on to the delivery of the application to the Web. For nature of the project, the PlantDoc data set was employed. The PlantDoc data set contains an image of crops and plants as they are seen in nature. Image pre-processing included: Resize normalization Augmentation, rotate & flip. Image rotations (augmentation) are used to reduce the over-fitting of the data and increasing robustness of the classifier to generalize. An architecture called the MobileNetV2 allowed a fast yet accurate classier. With the CNN trained classifier, the application produces the probability of each class of disease. The result with the most confidence value will produce the final application output. The CNN classifier was embedded into a web application via an injecting Flask system.

VI. CNN ARCHITECTURE



Convolutional neural networks are designed as deep learning architectures to image processing. The architecture of the CNN employed in LeafScan incorporates use of convolutional layers, activation functions, pooling layers and fully connected layers. Convolutional layers are used to predict features including texture variations, and spots of disease. Pooling layers are used to decrease the dimensionality, and the architecture MobileNetV2 was determined to be best suited for the leaf disease classification as it offers power having c efficiency on a CPU based platform, and has minimal computational complexity, and is Because of this good for use in potential agricultural applications.

VII. EXPERIMENTAL RESULTS

Experimental results showed good performance with several common disease types. The system reached about 86% accuracy of discrimination. Sample prediction shows Apple Rust Leaf with value of confidence about 99%. The ranking-based prediction system helps transparent by providing second rank of tested output.

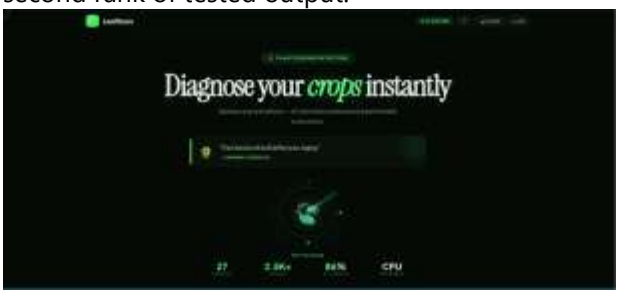


Figure 1: Landing Page

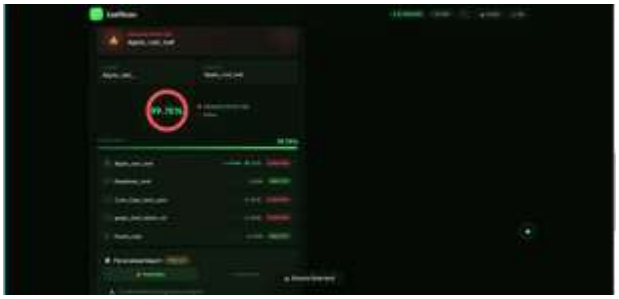


Figure 2: Disease Prediction Result

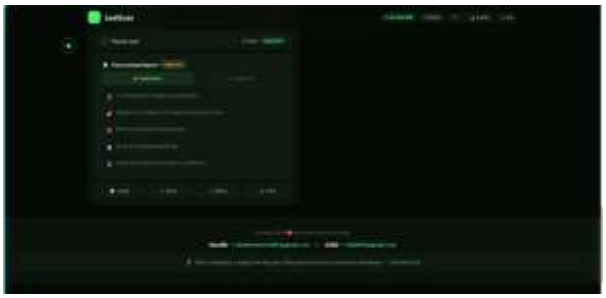


Figure 3: Treatment Section

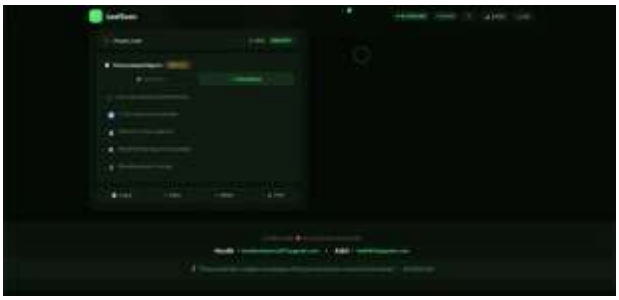


Figure 4: Prevention Section

Figure 5: Statistics Dashboard

VIII. ADVANTAGES AND FUTURE SCOPE

Ultimately, the LeafScan system brings benefits of fast disease prediction, low-end optimized architecture, multilanguage support, historical scan records, Mobile responsive UI, and farming useful tips. The mobile optimized system is well adapted for low-end devices and farmer use. The future development cycle includes application deployment, on mobile camera scan, integration with IoT devices, weather predicting, ground monitoring with drones and other deep learning architectures like transformers.

IX. CONCLUSION

LeafScan has been able to showcase how Convolutional Neural Network can be implemented practically for smart plant disease identification. The project is a marriage of Artificial Intelligence, Computer Vision and Interactive web technologies to create a smart agricultural assistant platform. The system caters to the farmers with prevention guidance treatment multi language, scan history and statistics apart from identifying the diseases. LeafScan emphasizes the growing need for AI enabled precision agriculture by pointing out how intelligent systems can actually help in sustainable farming.

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