AI powered detection of tomato leaf disease

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Abstract: The growing computation power has made the deep learning algorithms so powerful that creating an indistinguishable human synthesized image popularly called as deep fakes have become very simple. Scenarios where this realistic face swapped deepfake are used to create political distress, fake terrorism events, revenge porn, blackmail people are easily envisioned. In this project, System will detect fake images that have been generated using AI. Deep Fakes are created by using deep learning techniques and neural networks to manipulate or replace parts of an original image, such as the face of a person. This project is an important application of deep learning technology, which is characterized by its strong capability of feature learning and feature representation compared with the traditional image detection methods. System will describe a new deep learning-based method that can effectively distinguish AI-generated fake images from real images. System is capable of automatically detecting the replacement, reenactment deep fakes and trying to use Artificial Intelligence (AI) to fight Artificial Intelligence (AI). Our system uses a Res-Next Convolution Neural Network to extract frame-level features and these features and further train a Convolutional Neural Network (CNN) based InceptionResnetV1 and InceptionResnetV2 to classify whether the image is subject to any Type manipulation or not, i.e. image is deep fake or real image. It will allow us to detect deep fake images and can further help in reducing fake news.

Keywords: Deep Learning, Deepfake, Neural Network, Artificial Intelligence, InceptionResnetV1, InceptionResnetV2 sheet.

I. INTRODUCTION

Tomatoes are a crucial crop worldwide, but they are highly vulnerable to diseases caused by fungi, bacteria, and viruses. These diseases can lead to significant crop losses and reduced quality, posing challenges for farmers who rely on manual inspection methods that are often slow and prone to errors. Early detection of these diseases is essential to prevent extensive damage and maintain crop health.

The project involves building a CNN model that can classify tomato leaf images into ten categories, including healthy leaves and those affected by diseases such as yellow leaf curl virus (YLCV), bacterial spot (BS), early blight (EB), and late blight (LB). A dataset containing 32,500 labeled tomato leaf images will be used for training and testing the model. Preprocessing steps such as image resizing, normalization, and augmentation will be applied to improve the model's performance.

The model will be trained using multiple epochs to achieve high accuracy, allowing it to learn the disease-specific patterns in the leaf images. Once trained, the system will automatically classify images of tomato leaves, enabling early detection of diseases. This early detection is crucial for farmers to take timely action, preventing the spread of diseases and improving crop yield. The project's ultimate goal is to provide a scalable and practical solution that can be integrated into agricultural practices, potentially through mobile applications for real-time field use.

The purpose of our project is to introduce a technology-driven solution for detecting diseases in tomato plants for farmers. Many farmers still rely on traditional methods to identify plant diseases, which often yield inconsistent results and can lead to crop damage or reduced yields. Our project focuses on creating a website or application where farmers can easily up load images of their tomato plants. Using image-based analysis powered by Convolutional Neural Networks (CNN), the system will automatically detect whether the plant is infected and, if so, provide a diagnosis of the specific disease.

In addition to identifying the disease, the system will offer detailed information about the causes of the disease and suggest solutions, including recommended pesticides and treatments.This will enable farmers to take prompt and informed actions to protect their crops. The goal is to enhance farming practices by incorporating modern technology, making disease detection more reliable and accessible for farmers, ultimately leading to healthier crops and better productivity.

II. Literature Review

Farmers face significant challenges in accurately identifying diseases that affect their crops, particularly tomatoes. Traditional methods of disease detection often rely on visual inspections and subjective assessments, which can be time-consuming and prone to errors. This can lead to delayed interventions and reduced crop yields, ultimately impacting farmers' livelihoods. To tackle these challenges, researchers have increasingly focused on advanced machine learning techniques, especially Convolutional Neural Networks (CNN), to provide more effective and reliable disease identification solutions.

In a similar vein, Ferentinos (2018) developed a CNN-based framework specifically designed for diagnosing plant diseases. His work showcased the effectiveness of deep learning models in automatically identifying diseases from leaf images, providing farmers with timely and accurate information to manage their crops better. Additionally, an IEEE research paper by Praveen et al. (2020) further explored the application of CNNs in agriculture, emphasizing their role in enhancing disease detection across various crops, including tomatoes. The authors noted that integrating machine learning techniques could lead to significant improvements in disease management and decision-making processes for farmers.

III. System Architecture

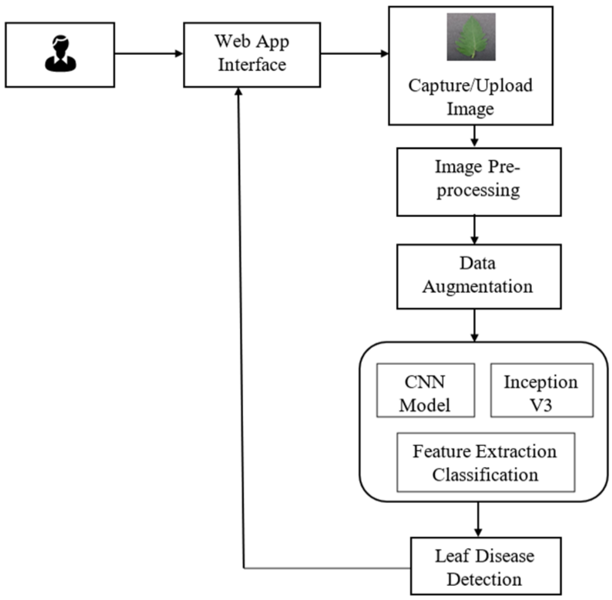

Fig.III.I system architecture

The user will provide the required image through web interface. Once the input file is given to the model, it will process the file such as it will extract frames and will resize the image. After that model will extract features from each frame. Then the extracted data will be given to CNN model which will classify and detect the image of tomato leaf. After detection the output will be given through web interface whether the plant is infected or not.

- **Web App Interface:** This is the interface that users, such as farmers, interact with to upload leaf images. It serves as a gateway for users to input data into the system.
- **Capture/Upload Image:** Users can either capture an image using a device camera or upload an existing image of a leaf. The image is then processed further by the system.
- **Image Pre-processing:** This stage involves preparing the image for analysis, such as resizing, normalization, and noise reduction to enhance its quality and ensure uniformity.
- **Data Augmentation:** To improve the performance of the model, data augmentation techniques like flipping, rotating, or altering brightness might be applied. This helps in artificially expanding the dataset by creating modified versions of the uploaded image.
- **CNN Model (Convolutional Neural Network) and Inception V3:** The core of the system where the machine learning happens. The CNN model, specifically using Inception V3 architecture, is responsible healthy or diseased.
- **Feature Extraction & Classification:** Features extracted from the image during the CNN processing are used to classify the image. The system identifies which features correlate with specific diseases.
- **Leaf Disease Detection:** Finally, the system delivers the result, detecting the presence and type of disease affecting the leaf.

IV. METHODOLOGY

To develop the automated system for tomato leaf disease detection, we began by collecting a diverse dataset of tomato leaf images representing various diseases, such as early blight, late blight, and tomato mosaic virus. Special attention was given to ensuring the dataset's quality and diversity by including images captured under different lighting conditions and angles. The collected data underwent preprocessing steps, including resizing images to a consistent size, normalizing pixel values, and applying augmentation techniques like rotation and scaling. These steps enhanced the dataset's diversity and improved the robustness of the model.

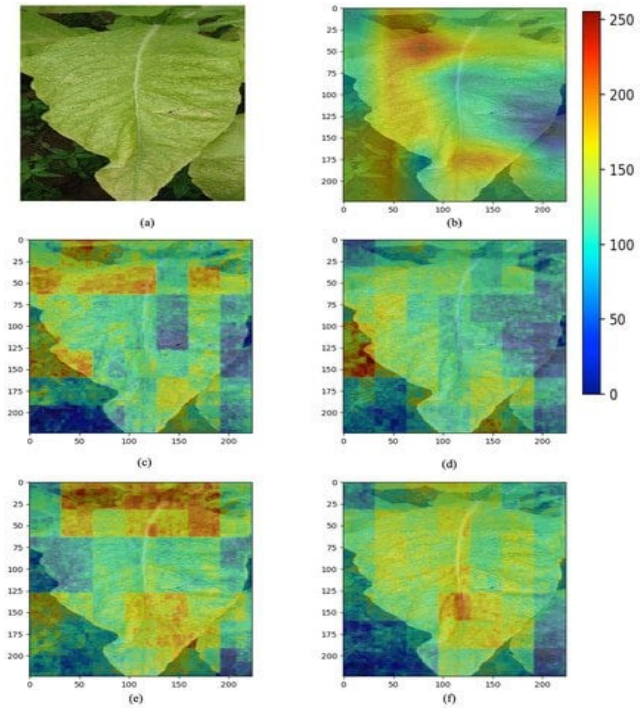

Fig IV.I CNN model Processing

For model selection, we initially experimented with simpler CNN architectures like AlexNet to establish baseline performance. Subsequently, we tested advanced architectures, including VGGNet and ResNet, to identify the most effective model. Performance metrics such as accuracy, precision, recall, and F1-score were used to evaluate and compare the models. Critical hyperparameters, such as learning rate, batch size, and number of epochs, were fine-tuned systematically using grid search and random search techniques. Validation data was used throughout the process to monitor performance and prevent overfitting.

The selected CNN model was trained on the preprocessed dataset and validated with a separate validation set to ensure its reliability under controlled conditions. Once the model achieved satisfactory performance, we deployed it in a real-world application. This included creating a user-friendly web-based interface where users could upload images of tomato leaves for real-time disease classification. The deployed system was rigorously tested with real-world images to ensure its reliability under diverse environmental conditions.

Post-deployment, feedback was collected from target users, including farmers and agricultural experts, to identify potential issues and areas for improvement. This feedback was instrumental in refining both the model and the user interface. Iterative Finally, the system's performance was evaluated against traditional manual inspection methods, demonstrating its superior efficiency and effectiveness in detecting tomato leaf diseases.

Results and Discussion

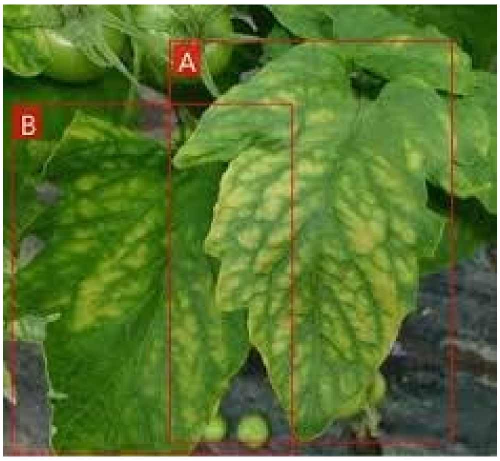

Fig no VI.II final detected disease

V. Conclusion

The Tomato Leaf Disease Detection project effectively combines advanced technology to help farmers identify and manage diseases affecting their tomato crops. Through a user-friendly web and mobile application, farmers can upload images of their plants and receive quick, accurate diagnoses using Convolutional Neural Networks (CNNs). The system not only provides information about the detected diseases but also recommends treatment options.

By addressing the limitations of traditional farming methods, this project empowers farmers with timely information, improving their disease management practices and increasing crop yields. Overall, the initiative promotes sustainable agriculture and enhances productivity within the farming community. As we continue to refine the system, we aim to ensure its effectiveness and reliability, ultimately benefiting both farmers and the agricultural sector.

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