International Journal of Engineering Applied Sciences and Technology, 2023
Vol. 8, Issue 05, ISSN No. 2455-2143, Pages 129-132
Published Online September 2023 in IJEAST (http://www.ijeast.com)

PLANT CHECK: POTATO LEAF DISEASE DETECTION USING CNN MODEL

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Abstract- **Agriculture accepts a basic part by virtue of the quick improvement of the general population and extended interest in food in India. Hence, it is required to increase harvest yield. One serious cause of low collect yield is an infection brought about by microorganisms, infection, and organisms. Potatoes are a well-known vegetable to all of us. Potato cultivation has been very popular in India form the last few decades. But potato production is being hampered due to diseases like early blight and late blight which are increasing the cost of production. The objective of this research is to establish an efficient and expedited process for detecting diseases in potatoes, with the aim of boosting potato production and digitizing the existing system. Our primary aim is to diagnose potato diseases by utilizing a CNN algorithm to analyse leaf images. This study presents an automated system, based on image processing and machine learning, for the detection and classification of potato leaf diseases. Image processing emerges as the most effective approach for identifying and analysing these diseases. To conduct this analysis, our team divided more than 2000 leaf pictures of healthy and unhealthy potatoes, obtained from the Kaggle platform. We incorporated several pre-prepared models to accurately identify and classify healthy and diseased leaves. Through rigorous testing, the program demonstrated an impressive accuracy of 91.41%, using a 30% test data and 70% train data split. The dataset used in this study was sourced from the renowned public data repository, Kaggle, specifically the "Plant Village" dataset.**

Key Words: **CNN, Potatoes leaf disease, early blight, late blight, image processing**

I. INTRODUCTION

Potatoes are widely recognized globally and play a vital role as a staple food in numerous countries. They are commonly referred to as the foundation of all vegetables. In India, an agricultural-based nation that cultivates various crops, potatoes hold significant importance. In fact, India stands as the second largest potato producing country on the planet, with a staggering 43,000,000 tonnes produced in 2018. With the demand for potatoes escalating worldwide, it is crucial for us to maximize our production and export capabilities in our region. Unfortunately, in recent years, we have encountered a decline in both export and production due to severe diseases like early blight and late blight affecting potato plants. The farmers also suffer due to this issue. In this project, we explain a technique to identify plant diseases by analysing pictures of their leaves. Image processing, a branch of signal processing, allows us to extract useful information from the images. Machine learning, a subset of artificial intelligence, automates tasks and provides instructions. Its main goal is to comprehend the training data and create models that aid in making informed decisions and accurate predictions using a large amount of data. We utilize leaf colour, extent of damage, leaf area, and texture parameters for classification purposes. In this project, we have analysed different images and features to identify various types of plant leaves. Sometimes, the disease can be seen on affected potato leaves, with spots appearing on the plant leaves as well. The most common diseases found in potato plants are early and late blight. Early blight shows small, black lesions, while late blight causes blistered leaves that eventually rot and dry out, resembling scalding by hot water. To differentiate between these disorders on potato leaves, we will be using a CNN algorithm, which will greatly benefit farmers. We have three types of processed images available: early blight, healthy, and late blight. The total number of photos has been divided into two sections for training and testing purposes. Around 75% of the photographs are allocated for training, while the remaining ones will be used for testing. The proposed model will classify the normal and diseased potato leaves accurately.

II. LITERARY SURVEY

Several studies have investigated potato leaf disease detection, some are listed below:

A research paper titled "Krishi Mitra: Using Machine Learning to Identify Diseases in Plants." In this study, the researchers utilized the TensorFlow Framework and implemented their project using the CNN model methodology. One noteworthy benefit of this model is that it only calculated the leaf area and could accurately identify diseases caused by fungi in sugarcane. However, it should be noted that the

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implementation of this model required high computational complexity.

In a research paper titled "Severity Identification of Potato Late Blight Disease from Crop Images Taken in Uncontrolled Environments," the researchers implemented Fuzzy c-mean clustering and Neural Network techniques. One notable advantage of the model was that it did not require special training for farmers as the dataset included images from various angles. However, a drawback was observed when untrained farmers captured images that were not correctly oriented, resulting in clustered leaves with visible background segments.

In the research paper titled "Potato Disease Detection Using Machine Learning", image processing emerged as the enabling technology. Leveraging the CNN model yielded an impressive 90% validation accuracy, greatly benefiting this project. However, it is noteworthy that the model's primary drawback lies in its heavy reliance on a large training model.

In the research paper titled "Detection of infectious areas in tomato plant leaves using deep learning", the authors employed the mask R-CNN methodology, a form of deep learning. The use of R-CNN masks yielded numerous advantages, primarily by enhancing and expediting the identification of pathogens on plant leaves. Nevertheless, it is important to note that this approach does require additional processing time..

III. METHODOLOGIES

In this project, there are multiple stages of research as can be seen from below figures. In the form of research framework. In the proposed research framework, there are four stages which are:

Fig 1. Potato Leaf Image Data

3. Proposed Research Framework

CNNs, which are feedforward neural networks consisting of layers of perceptron's, have the ability to process multidimensional data. This paper outlines the step-by-step process for implementing a CNN model for detecting leaf diseases. First, it involves obtaining images of leaves as input, then preprocessing and converting these images into arrays. The next step is to segregate and preprocess the leaf image database. Afterwards, the model is trained using CNN classification techniques. Subsequently, the pre-processed test image is compared with the trained model to identify any defect regions in the leaf. If a defect region is found, the disease is displayed along with its corresponding treatment. Proper data preparation is crucial when training a CNN model. Therefore, it is imperative to resize and normalize the photos to ensure consistency in size. Similarly, it is essential to ensure precision in the dataset's labels.

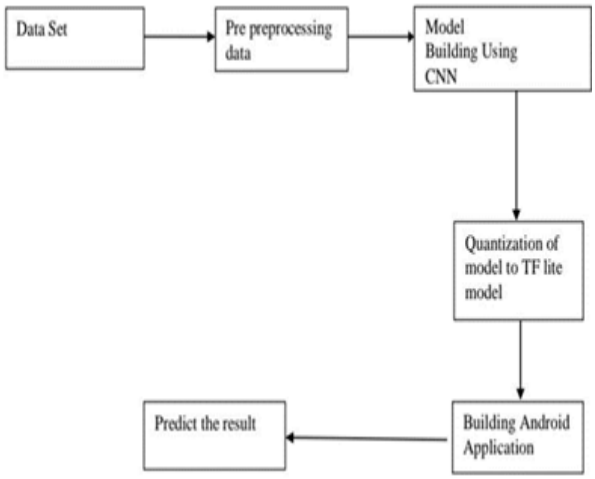

Fig 2. Data Flow Diagram

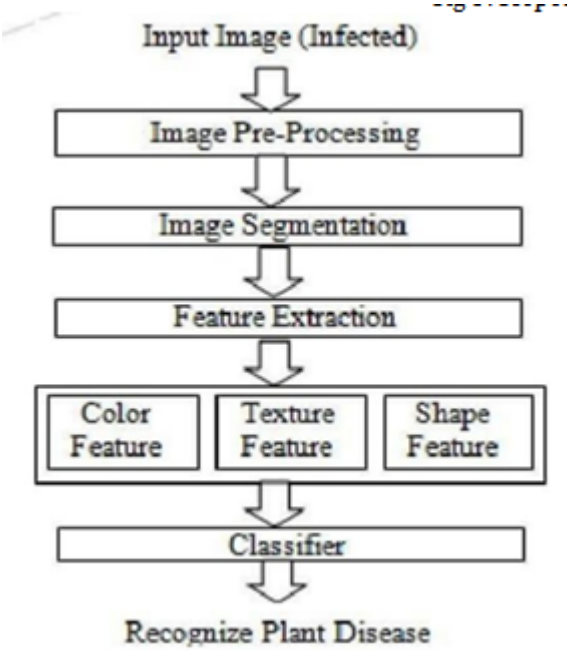

Fig 3. Proposed Research Framework

A) Data Collection

Model using diverse and high-quality data. Consequently, they enhance accuracy and performance, contributing to an improved overall outcome.

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C)Image Segmentation
Segmentation refers to the process of dividing an image into distinct parts that share similar characteristics or exhibit some level of resemblance. There are several approaches that can be applied to achieve segmentation, such as clustering k-means or converting an RGB image into the HIS model. In this particular case, we utilized CNN (Convolutional Neural Network) by converting the image into the Red Green Blue (RGB) format. Initially, the leaf image is convoluted with a filter, followed by applying pooling to effectively reduce the image's resolution while preserving its quality. We specifically made use of MaxPooling on the resulting output image.
Subsequently, the image is flattened in the subsequent step, thereby transforming the feature map acquired through pooling into a vector form.

D)Feature Extraction
The detection of plant diseases heavily relies on the extraction of features. The utilization of the extraction function is widespread across various image processing applications. Characteristics such as colour, texture, shape, and edges can be effectively employed to identify plant diseases. Among these features, morphological results have been proven to yield superior outcomes compared to others. Texture refers to the formation of the image in terms of colour, roughness, and the image's hardness.

E) Classification
CNN is a supervised learning method that utilizes a pre-existing dataset to train and identify images by targeting specific image variables. Within the CNN architecture, the convolutional layer plays a crucial role in enabling the neural network to identify potato leaves based on their distinctive attributes. By leveraging the pixels present in the images, the neural network becomes capable of recognizing potato leaf patterns. In CNN, there are four convolutional layers, each equipped with a different number of filters: 128, 64, 64, and 128 respectively. Following these convolutional layers is a maximum pooling layer with a pool size of 2. The purpose of the max pooling layers is to reduce the spatial dimensions of the convolutional layer output, while the filters themselves aid in extracting significant features from the input images. To introduce non-linearity into the network and facilitate the learning of intricate features, the Rectified Linear Unit (ReLU) activation function is applied to all convolutional layers within the CNN architecture. This activation function is pivotal for the network's ability to handle complex patterns and optimize its learning capabilities. The final convolutional layer's output is passed to a fully connected output layer that incorporates a softmax activation function. Additionally, the model employs global average pooling to shrink the output's size. This reduction allows the model to generate predictions by leveraging the probability distribution created by the softmax activation function across multiple classes.

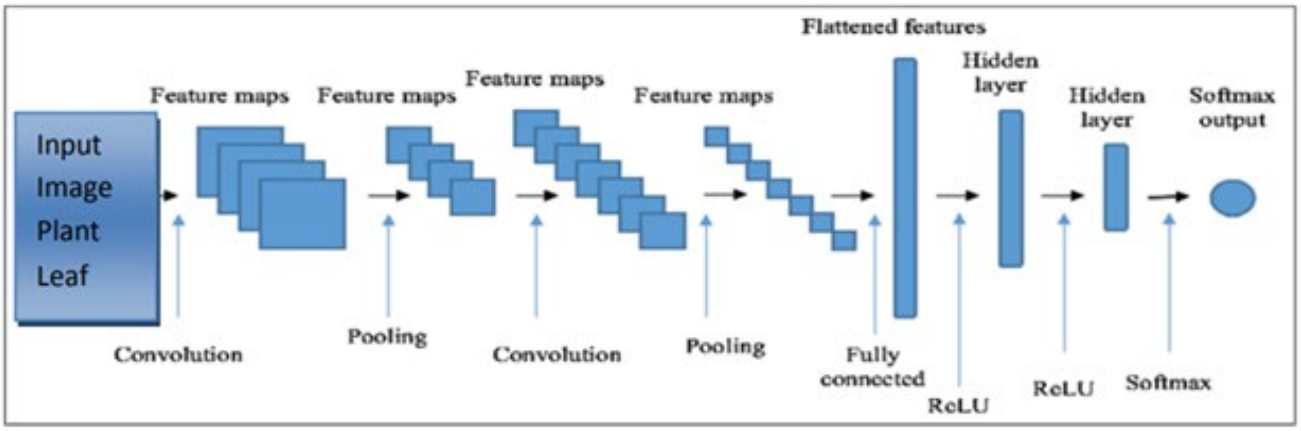

Fig 4. CNN Architecture for classification

F) Result
Our project introduces a fast and user-friendly multi-level deep learning model for the recognition of potato leaf diseases. This model, integrated with ChatGPT, allows for the classification of various potato leaf diseases and provides corresponding remedies. The application enables farmers to easily capture an image of a potato leaf for disease identification, with automatic detection and generation of outputs. This user interface proves highly beneficial for farmers as it offers a rapid and efficient approach to identify diseases affecting their potato crops. By utilizing this tool, farmers can promptly determine the type of disease and implement necessary precautions to minimize its impact. This may involve selecting the appropriate fungicide or adjusting their farming practices accordingly. Acting swiftly to halt the further spread of the disease potentially spares farmers' crops from severe damage

G) FUTURE SCOPE

The development of a voice-activated mobile application designed exclusively for farmers with low literacy levels presents a groundbreaking approach to enhance agricultural practices. This software is designed to be accessible and user-friendly, eliminating the need for written text and instead leveraging voice-based instructions. Its primary objective revolves around the identification and control of leaf diseases, which can have a significant impact on agricultural yields. Through a comprehensive database of leaf diseases, farmers can accurately determine the specific ailments affecting their crops. Additionally, the software incorporates a visual representation tool that visually represents the extent of leaf damage, allowing farmers to gauge disease severity effectively. By providing illiterate farmers with the necessary skills and knowledge to manage their crops efficiently and ultimately improve productivity and livelihoods, this innovative application serves as an empowering tool.

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