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Leaf Disease Detection

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Abstract—

Plants have become an important source of energy and are a fundamental piece in the puzzle to solve the problem of global warming. Plant disease is a critical issue in agricultural countries, there are many types of diseases which are present on plants. The agriculture sector ensures both economic growth as well as food security. Every year production of crops sustains heavy loss due to diseases. To increase crop yield, monitoring the health of crop is important as health of crop directly affects production quality and quantity. Health of the crop is damaged due to presence of crop infection; hence to avoid spread of such diseases it is important to identify the infection at early stage. We can recognize the crop diseases by observing various part of the plant like leaf, stem, flower and fruit. However, plant leaves are commonly used for disease diagnosis. It is quite difficult to detect leaf diseases with human eyes. So it is essential to build an automated system to detect the diseases. The proposed disease detection model takes an image of a plant leaf as input, processes it and uses deep convolutional neural network to detect and identify the disease. The model is trained with a large dataset, The trained model is lightweight and is used to build an android application. The application also provides solutions based on detected disease. The developed mobile application is user-friendly and can be used by farmers without much technical knowledge.

Keywords- **Deep Convolutional Neural Network, Image Processing, Android Application, Infection identification.**

I. INTRODUCTION

Agriculture sector is main source of earning in rural area. The country needs a huge supply of food every year. Plant diseases hamper the production of crops often. As a result, the price of food gets higher and poor people have to stay half-fed or unfed. Hence, Plant diseases have become a great threat to crops. Moreover, due to the illiteracy of farmers, most of the time they cannot understand what's wrong with the crops. This causes them great sorrow. With the increase in the human populace and the decrease in croplands, the production rate of crops is in danger. Preventing plant diseases is one of many ways to keep the crop production rate above the necessary margin. The common diseases of leaf are Bacterial Blight, Anthracnose, Alternaria Alternata and so on. Most of the diseases symptoms are found in leaves, stem and fruit. Diseases in crop causes major production and economic losses as well as reduction in both quality and quantity of agriculture product. Diseases detection is done by consulting experts which costs high as well as time consuming. Occurrence of plant disease has a negative impact on agricultural production .Early detection is the basis for effective prevention and control of plant diseases and they play a vital role in the management and decision making of agriculture production.

Android mobile phones are now cheap and affordable for lower-earning people. An automated system can greatly help the farmers to diagnose crop diseases easily and take actions accordingly to avoid the waste of crops. Hence, we got motivated to create an android application that can detect the diseases of plants from captured images of leaves.

Researchers around the world have taken the plant disease problem seriously and are searching for ways to prevent plant diseases and detect them at an early stage. Many researchers have approached various techniques to identify plant diseases. Image Processing, Machine Learning, Deep Learning are some of the techniques being use to solve the problem. By using TensorFlow, the models trained using deep convolutional neural network (CNN) can be used in wide varieties of mobile devices, even low-end devices.

This study aims to develop a system for the detection of plant diseases through deep CNN and image processing. Furthermore, the study aims to develop a model to create a user-friendly android application to detect plant disease from images captured with the camera of the phone and give solutions to cure the disease. Plants show a range of symptoms such as colored spots, or streaks occurring on the leaves when they are diseased. As the disease progresses, the visual symptoms change their color, shape, and size. With the help of deep CNN, we can train these patterns and create a model to recognize them. By using the application, farmers can capture the images of plant leaves using any mobile camera of average quality. The image is then processed and cross-matched with the integrated model to identify the disease and provide solutions based on the detected disease. Thus, the farmers can save their time and money as well as their crops.

II. LITERATURE REVIEW

The literature survey is conducted to compare different methodologies previously proposed for identifying plant diseases using deep learning and image processing. Many studies have proposed different solutions to detect diseases.

Some papers are describing to detection leaf disease using various methods suggesting the various implementation ways as follow. Visual Analysis, Image Processing and Optical Sensor are mainly implemented in three ways as the disease detection method. By using these three methods, the system can be developed to detect the disease earlier and that can overcome the challenges and disadvantages. By means of the methods comparison, disease detection by using visual analysis does not give the accurate output while in case of optical sensor, the system is not easy to implement and costly. So, image processing is the only way to build the simple, robust and accurate disease detection system [1].

While working with image processing, on the other hands, the database collection is the most challenging task. For database collection, it is necessary to collect the basic information about the crop and its diseases as the important task. Therefore, a detail study should be done on the types of disease, their symptoms on crop and the patterns of disease. By observing the patterns of disease, the system will get designed. The mainly occurring diseases on leaf are Bacterial disease, Fungal disease, Viral disease and diseases due to insects. The paper gives the detailing of these diseases [2].

An IoT-based system was presented that can automatically detect and identify plant leaf diseases. The authors used sensor devices to collect images of plants and plant leaves. Image processing, k-means clustering algorithm, and artificial neural networks are used. The invented device classifies diseases based on monitoring the temperature, humidity, and moisture of the plant with an accuracy over 90% [3].

The authors proposed a system that uses an edge detection technique to detect the diseased zones of the plant or fruit. Images of the fruit are captured first. Then, image segmentation is done using a segmentation technique. Afterward, the edges of the diseased zones are calculated in pixels. Depending on the number of pixels, the rate of contamination in the plant or fruit is provided. The control and treatment methods are provided hinged on the affected disease of the fruit [4].

Deep learning neural network algorithm was explored. Tensor flow is used to process the data to be usable for training. Through the use of deep learning and neural network algorithm and based on the F1 score, the model for detecting plant diseases is built. An application was implemented and evaluated by specialists in this area of study. The accuracy of their developed model is mentioned to be 80% [5].

Different kinds of deep learning model architectures were implemented, which are based on CNN architectures, to identify plant diseases with leaf images of healthy or diseased plants. VGG CNN architecture performed the best. It accomplished the accuracy of approximately 99% in classifying 17,548 plant leaf images [6].

The authors focused on recognizing a paddy plant disease using image processing. The system takes the paddy leaf image as an input and converts the RGB image to grayscale. Then the morphological opening operation is applied to reduce noise and finally image segmentation. After these processes, they find the infected region of the paddy leaf [7].

Image Processing is a procedure to change over an image into digital shape and play out a few operations to get an enhanced image and concentrate valuable information from it. It is most recent innovations and its applications in different parts of a business. Image Processing shapes center exploration zone inside designing and software engineering trains excessively [8].

A mobile application was developed for plant disease recognition using image processing which analyzes the color patterns of the diseased marks in plant leaves and bodies. The dataset images were captured under laboratory conditions with the help of a digital camera. The distance matrix is employed to calculate the distance between each pair of species. Image segmentation is used to partition the image of a plant into distinct regions containing each pixel with similar attributes. Mainly, the k-means clustering algorithm is implemented to identify the diseases. The authors claimed to have achieved 90% accuracy for their model using a small training set [9].

The authors showed effective and correct plant disease detection and identification techniques through the use of image processing in MATLAB. K-means clustering algorithm and multi Support Vector Machine (SVM) methods are used which are organized for both plant and fruit disease identification. Image segmentation and feature extraction are used to prepare the images for training [10].

The authors presented a study on various disease identification methods that are utilized in detecting plant diseases. They also described a method for image segmentation which is used to detect and identify plant diseases. The accuracy of the presented system is described to be approximately 95%. But, the number of sample images used in the system is only 60 for 4 different species [11].

A model is trained on images of plant leaves using the deep CNN with the goal to classify both crop species and the identity of the diseases. The proposed model can classify very quickly which is ideal for implementing into an application. However, the accuracy gained on the images which are not from the dataset is mentioned to be just above 31% [12].

Different procedures to segment the diseased area of the plants were explained. The authors studied various feature extraction and identification methods that are used for extracting the features of the diseased leaf, additionally identifying the plant diseases. The utilization of artificial neural network methods for the detection of plant diseases like back-propagation algorithm and SVM are discussed [13].

III. METHODOLOGY

a. Proposed Model

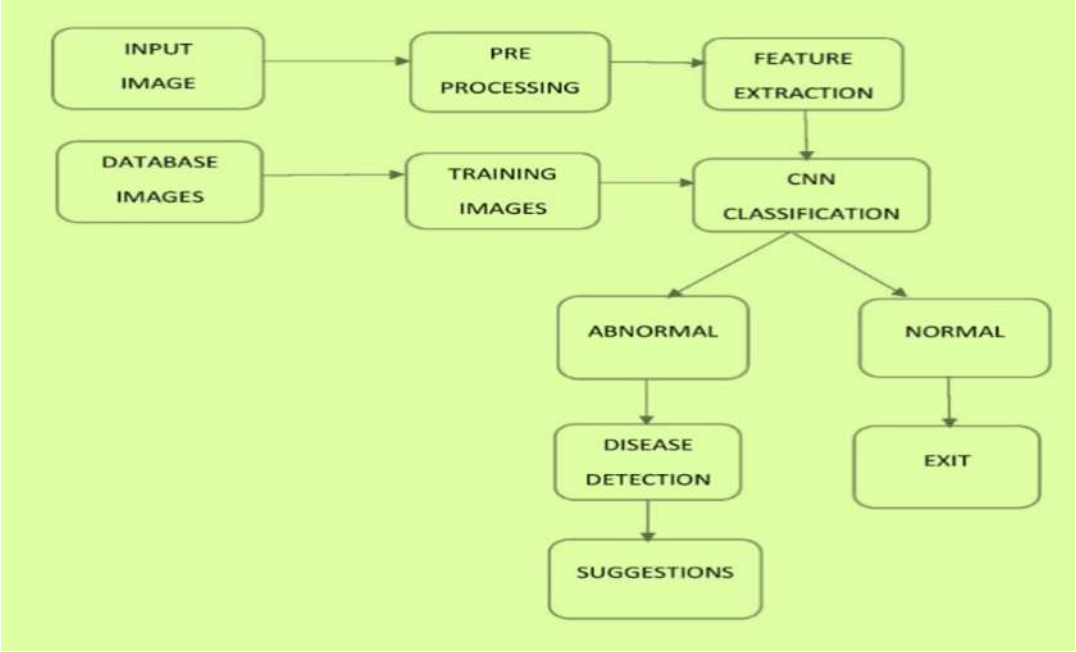

Fig 1: Proposed System

INPUT IMAGE: According to conceptual diagram, leaf image will be taken as input.

A. *Data Pre-Processing:* Pre-processing is the progression of concentrated effort to the data from redundant elements.it increases the accuracy of the consequences by means of reducing mistakes inside the statistics. Pre-processing of data is one of the most important tasks that must be done before the dataset be able to be used for machine learning. The real- world statistics are incomplete and incompatible. So, it is necessary to be cleaned. Not by means of pre-processing, such as enchantment corrections, may lead the system to disregard important words. Preprocessing and concentrating the effort of data is one of the most important tasks that must be done before the dataset be able to be used for machine learning. The real-world statistics are strident, incomplete, and incompatible. So, it is necessary to be cleaned. It must be done before the dataset is able to be used for machine learning. The real-world statistics are improper and incompatible. So, it is necessary to be cleaned.

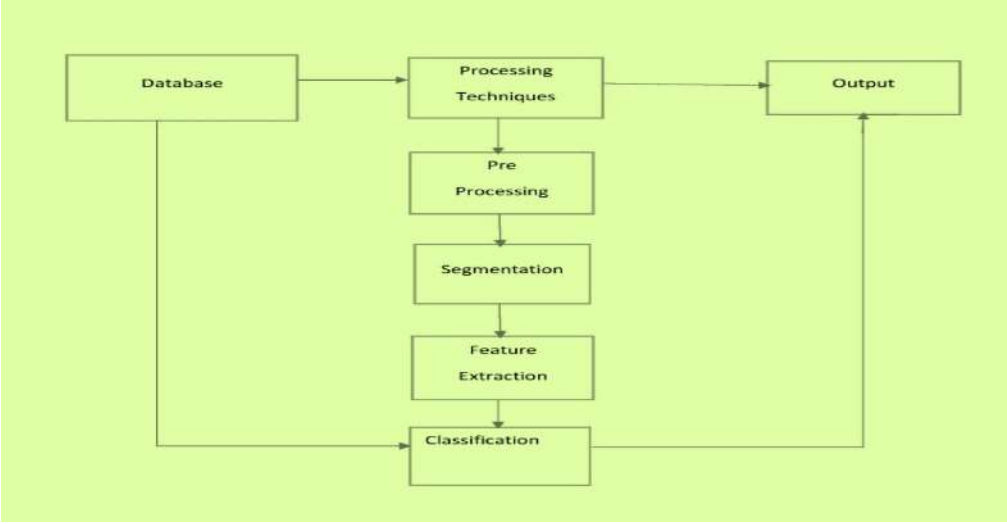

Fig 2: Data Pre-processing Techniques

B.. Feature Extraction:

Feature presents information related with objects which differentiates one object from another, features are important to detect and label objects which is useful when classification of object takes place. In literature for identification of crop infection various parameters like color, texture and shape are observed; the performance of entire set-up is based on the feature extraction technique.

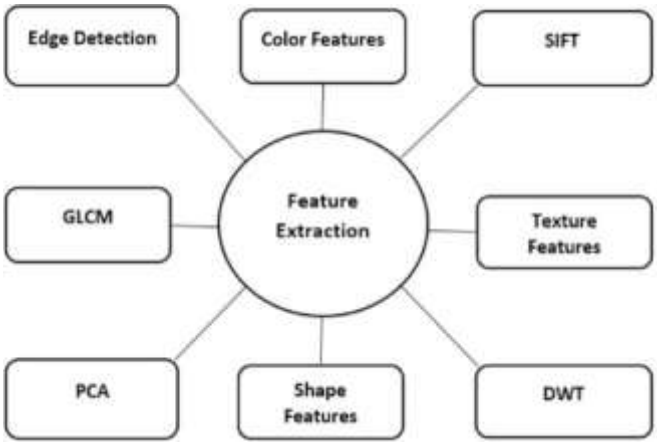

Fig3. Feature Extraction Techniques

C.CNN Classification:

The Convolutional Neural Network (CNN or ConvNet) is a subtype of Neural Networks that is mainly used for applications in image and speech recognition. Its built-in convolutional layer reduces the high dimensionality of images without losing its information.

Convolutional neural networks (CNNs) are the current state-of-the-art model architecture for image classification tasks. CNNs apply a series of filters to the raw pixel data of an image to extract and learn higher-level features, which the model can then use for classification.

CNN's are equipped with an input layer, an output layer, and hidden layers, all of which help process and classify images. The hidden layers comprise convolutional layers, ReLU layers, pooling layers, and fully connected layers, all of which play a crucial role.

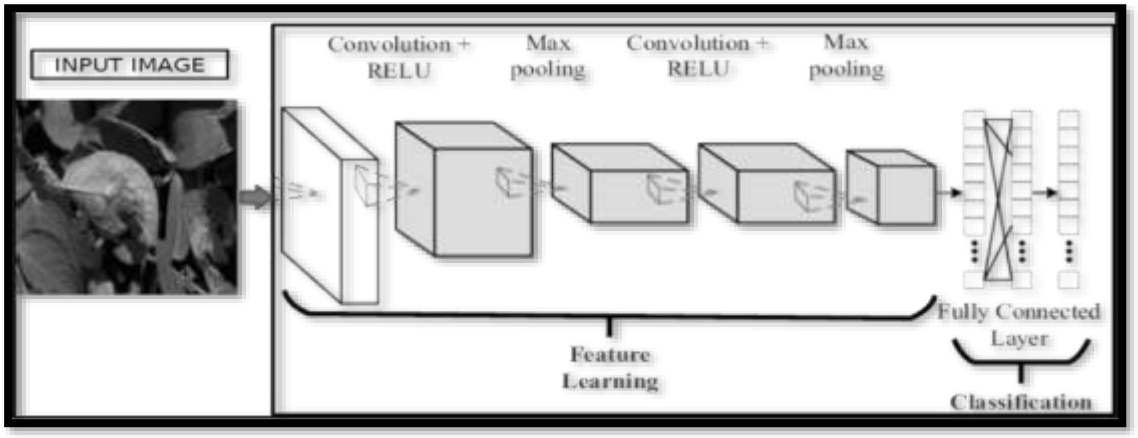

Fig3. Internal CNN Block

CONCLUSION

Every year a huge amount of crops are damaged due to infection, in many cases it is too late to identify the type of infection and its precautionary action. The software model is designed to take any leaf image as input and predicted whether it is infected or not. During this project we learnt about deep learning concepts like neural networks with extension of convolutional neural network. The program can be further extended to include more functions in this software model.

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