Apple Fruit Disease Detection Using Image Processing

Shweta Marandi[1], Prof. Chandrani Chakravorty[2]
PG Student, Department of MCA, RV College of Engineering, Bangalore, India[1]
Assistant Professor, Department of MCA, RV College of Engineering, Bangalore, India[2]

ABSTRACT: Agriculture played a major role in the economy of many developing countries. Apple falls under the commercial crops as a fruit that will be grown worldwide. In the whole growth cycle of apples, there are many types of apple diseases and pests, therefore, recognition and determination of these illnesses are essential. K-means Cluster segmentation is used to detect the diseases in the apple fruit. In the feature extraction method, the Threshold segmentation process is applied and extracts the pixels from the apple and predicts the disease present in apple fruit. The machine learning algorithm like, Support Vector Machine and Deep learning algorithm like Convolutional Neural Network algorithms are used to test & train the data. The tool used for implementation is Anaconda Spyder 3.7 and Python Language. It is free of cost and the most popular non-proprietary dispensation software of Python programming. The dataset contains both healthy and unhealthy apple fruit images and a confusion matrix for validating the proposed system will change depending on the dataset. The outcomes visualize the higher arrangement exactness of the proposed SVM and CNN model. At last, the outcome will be generated in the form of loss, accuracy, precision, recall, sensitivity, and specificity.

KEYWORDS: K-means Clustering, Support Vector Machine, Classification, Classification Neural Network

I.INTRODUCTION

Malady detection in apples is a major problem in economic and creation misfortunes in the agricultural industry worldwide. Due to illness their will, be gigantic misfortune confronting by the ranchers from Fruit. They will make mistakes in assessing agriculture due to a lack of knowledge and experience. Fruit diseases are the cause of a decrease in the quality and quantity of agricultural production. Fruit infections affect the quality of leaves, natural products, stems, vegetables, and their products. This firmly affects efficiency and therefore it is reflected in the cost. The Food and Agriculture Association (FAO) report estimates the total populace will arrive at 9.1 billion by 2050, which requires food creation to develop by around 70% for a consistent supply. Key factors for leafy food items can be divided into two categories: 1. Infections 2. Disorders. The illnesses Biotic elements are growths, microorganisms, or green growth, while messes abiotic factors are caused by temperature, precipitation, need of nutrients, stickiness, etc. Traditional strategies for treating illness include ranchers and organic product pathologists. The pesticide is most commonly diagnosed and used in the fields. This process is time-consuming, tests and in most cases leads to the correct conclusion from improper pesticide practice.

This work focuses on fruit identification and the proposed fruit according to the level of identifying the fruit. The proposed system helps purchasers select from assorted fruits good quality fruits. The aim of the proposed work is therefore to help buyers select the best fruits from the farmers without wasting their time. Digital image processing and techniques of the Neural Network are very popular and useful respectively for image classification and fruit identification. This work is carried out based on the fruit's color, size, and shape. Convolutional neural network methods are used according to size and color to detect infections in fruit.

In Deep Learning (DL) and Machine Learning(ML) technologies, progress has been made in developing automated models that are powerful, accurate, and timely identification of fruit diseases. This model uses a convolutional neural network for computer technology, which is used to classify images and object recognition. A convolutional neural network is working on the analysis of image, sound, and text. TensorFlow is Google's developed open-source artificial intelligence. It helps developers build a neural network that can contain many layers. For classification, prediction, and so on, TensorFlow is mostly used. Using a convolutional neural network algorithm validates the loss and accuracy graph and also result come in the form of precision, recall, score and support, and confusion matrix.

II.LITERATURE SURVEY

Shiv Ram Dubey, Anand Singh Jalal [1] used a K-means algorithm for image segmentation that can be identifying apple diseases like apple rot and apple stain. The feature extraction was applied to the segmented images. Color Histogram, color coherence, local binary patterns, and full local binary patterns are the feature considered for the feature extractions. They applied a multi-class support vector machine for identifying the diseased fruit.

Manisha Bhange and H Hingoliwala have given a solution for the detection of pomegranate fruit disease (bacterial rot) and also the solution for this disease after detection. The web-based system enables lay people to identify fruit diseases based on the image that represents the fruit symptoms. The system shows the farmer whether the fruit is infected with the bacterial pest. There proposed System, which is based on image processing, uses two image databases, one for train the dataset and the another for test the data. Fruit images are classified and assigned to their three feature vectors, namely: color, texture, and morphology using k-means clustering.

SVM is used for classification to classify the image as infected. After the experimental evaluation of the proposed, the approach is effective and 82% accurate to identify pomegranate disease [2].

Pushkar Dixit and Shiv Ram Dubey [3] presented an image segmentation of fruit defects based on Color Properties with a K-means Clustering Algorithm. They used color images of fruits for error segmentation. The error segmentation takes place in two steps. In its color and spatial properties, where the grouping process takes place. The grouped blocks are then merged into a certain number of regions. They had taken the apple as a case study and evaluated the proposed approach against defective apples.

Xiaojing Niu and Shihui Guo [4] proposed a programmed and effective answer for wheat leaf illnesses with K-mean grouping. To start with, the shading picture is changed from RGB into the Lab shading space. Grouping is finished by deciding the total contrast between every pixel and the bunching focus in the Lab shading space. The usefulness of this method is more than 90%.

Komal Sindhi and Jaymit Pandya [5] have mainly focus on evaluating the quality of fruits. In this article, the four most common diseases of the apple have been observed. First, it extracts various characteristics using k-means clusterings such as color, texture, and the basis on which the disease is classified. The database is trained according to the classification of the disease based on the characteristics, and the disease is recognized using this database.

Jagadeesh. Pujari Rajesh Yakkundimath, Abdulmunaf S. Byadgi [6] has given the solution for the detection of apple diseases, which are based in particular on the color function. This methodology is based on a reduced data set of functions to recognize and classify images of apples in normal and defective.

Mr. Abhijeet, Professor Patil [7] have been presented a solution of apple disease detection based on neural network clustering and learning vector quantification techniques. Image segmentation after feature extraction and based on this training and testing by a neural network is the final step. The outcome showed that the apple infection identification pace of this calculation can accomplish an exactness of over 95%.

Miss Kambale, Anuradha Manik, Doctor Ms. Chougule [8] gives the image processing-based solution for the classification and grading of apple images. In the first step, two databases are created, one with normal images and unhealthy images. The second step is preprocessing and segmenting the image. The third step is the extraction of features and then the classification and grading using MATLAB.

Samajpati & Degadwala [9] presented the three common apple fruit infections, including apple scab, apple rot, and apple stain. the color and texture features are merged and a random forest classifier is used to classify diseases. If the fruit is infected by any of the diseases, the infected part is segmented using the k-means grouping technique. The accuracy of the classification of diseases is improved by merging feature levels are done by deep learning.

Ravindra Naik and et al. [10] utilized SVM to decide if apples are influenced by sickness. The hereditary calculation is utilized for picture division, which is a vital angle in distinguishing infections in farming items. The NN classifier is utilized to arrange the illness of the specific organic product. The proposed calculation was tried and performed on bananas, beans, jackfruit, lemon, mango, potato, tomato.

Monika Jhuria, Ashwani Kumar and et al. [11] use picture handling to screen organic product sicknesses from planting to reap. Back-proliferated neural organization for preparing the framework. Two apple and three grape infections are chosen for execution. The arrangement and task of pictures to the separate illness classifications are done utilizing vectors with

attributes of shading, surface, and morphology. These three component vectors, the morphology gives 90% right outcomes contrasted with two others.

III.PROPOSED SYSTEM

The proposed system of this paper is shown in Figure 1. where each block tells the task performed or the modules that have to be computed to get the result. It shows the uses of a different dataset and how the module work and input and output. First, the healthy and unhealthy apple images are collected from the Internet, and then image preprocessing is applied to enhance the image data, which suppresses unwanted distortion or improves the image properties, which is suitable for further processing. Next process, image-segmentation is required to detect the infected part of the diseased color image by using the K-means clustering algorithm. After segmentation, the features are extracted from the segmented threshold of the Apple input images. After the feature extraction, the information apple pictures are characterized by the power worth of the pixel. Apple Dataset contains both healthy and unhealthy apple fruit images and the confusion matrix for validating the proposed system will change depending on the dataset. The outcomes visualize the higher arrangement exactness of the proposed SVM and CNN model. At last, the outcome will be generated in the form of loss, accuracy, precision, recall, sensitivity, and specificity.

Each step mention in this figure of the proposed system is discussed in this section.

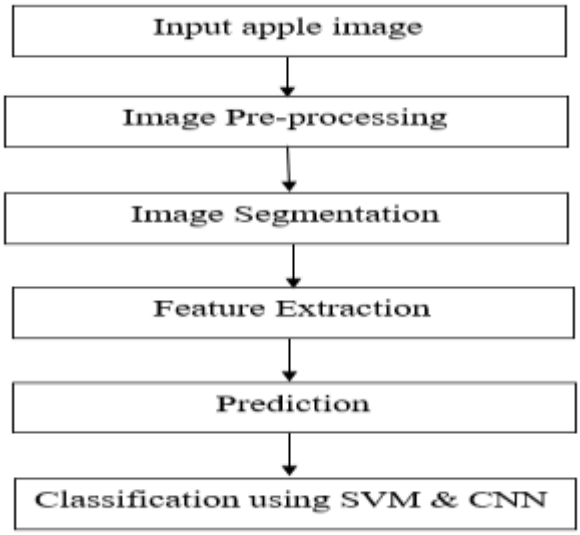

Figure 1: Proposed System Architecture

Input image: In this project, apple fruit was used to find an apple fruit malady. The dataset which contains the information about apple fruit disease image of healthy (fresh apple) and unhealthy (diseased affected apple) in two datasets contain fruit disease images.

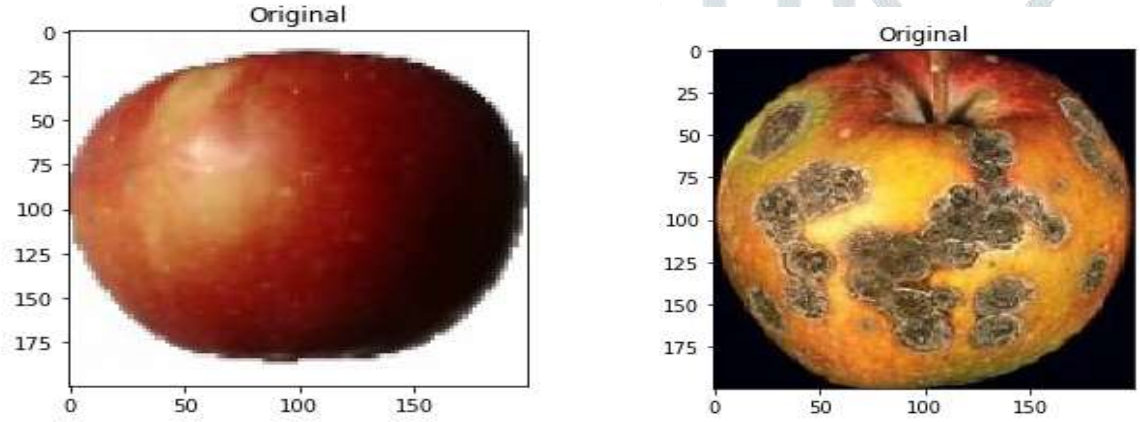

Fig 1: Healthy and Unhealthy images of apple fruit

Pre-processing: The process of restoring images is called image preprocessing. Image preprocessing generally includes the removal of low-frequency image components, noise reduction, sharpness, clarity, texture, and masking. Pre-processing is one of the most important techniques in image processing to enhance data images before computational processing, performed before main processing begins to prepare the image for testing. Figure 2 shows the process of getting the scaling data from the data set: (a) Change the size of the image data set (b) RGB color conversion of the original apple image.

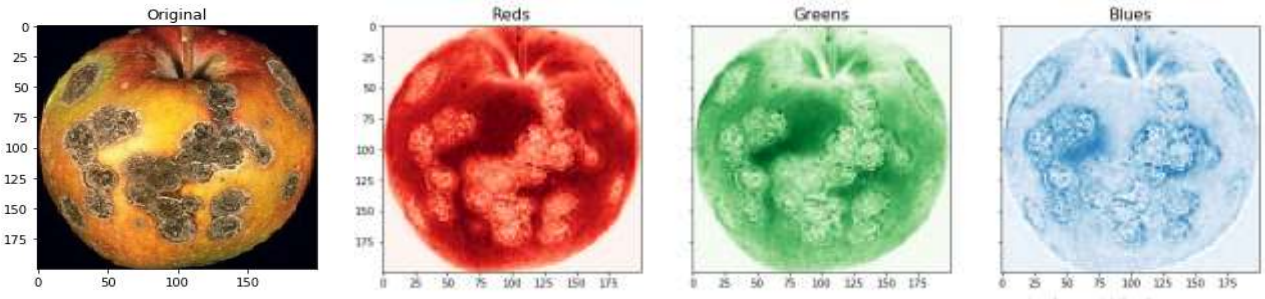

Fig 2: RGB color conversion of unhealthy apple

Image segmentation: Image segmentation is also a mechanism that is used to divide an image into multiple segments. K-means clustering is a technique used for defect segmentation. Before segmentation thresholding is applied to get the binary image with white background and dark color as a fungal infected region. The binary image is segmented using a pixel algorithm. The color segmentation is done by using k-means clustering. In this K-means technique images will contain an only infected region of the fruit image. Figure3 shown the image segmentation using K-means clustering through this it will predict disease from fruit.

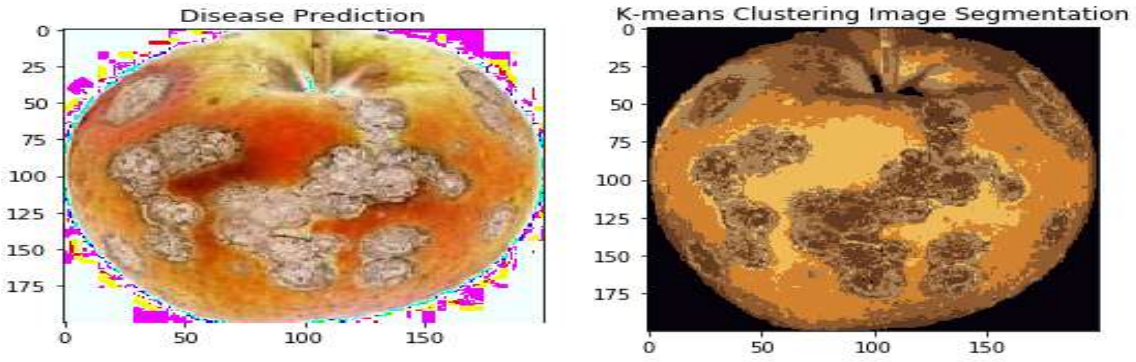

Fig 3: Disease prediction and K-means Image Segmentation of disease detection apple

Feature extraction: In this process, the desired features are extracted from the sample image for detecting the fungal-affected regions of the fruit. Feature extraction is a technique of redefining a large set of unnecessary data into a set of features of reducing dimension. This Threshold Segmentation technique is used for separating an object from its background. This also involves comparing each pixel value of the image to a specified threshold. This divides all the pixels of the input image into 2 groups: ¬ one is the pixels having an intensity value lower than the threshold which calls BINARY and another one is the BINARY_INV which having an intensity value greater than the threshold.

Fig 4: Feature Extraction using Threshold Segmentation of disease detection apple

Prediction: It's a process of predicting the apple fruit disease from the dataset. This project will effectively predict the data from the dataset by enhancing the performance of the overall prediction results.

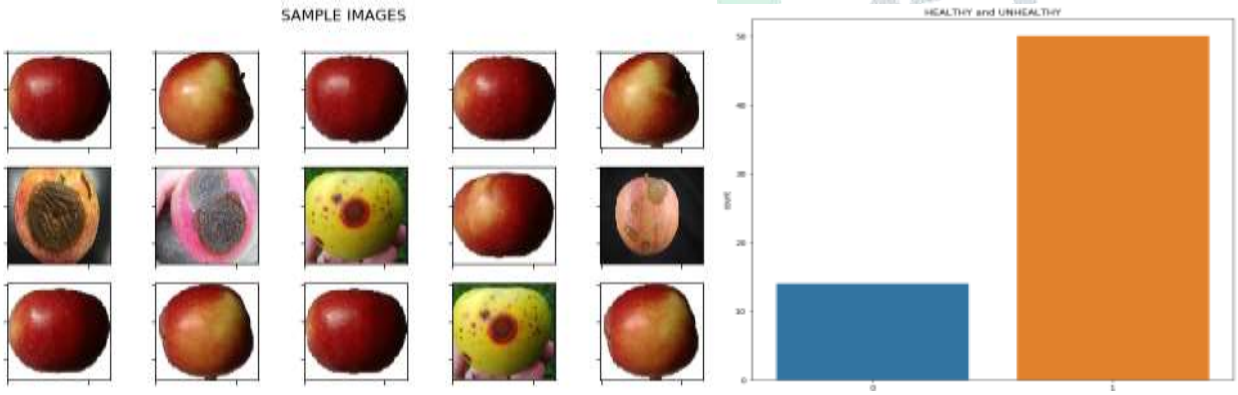

Fig 5: Sample images from the data set of type (a) healthy apple (b) unhealthy apple and target of the healthy and unhealthy of disease detection apple

Classification: Finally, the classification is applied to the image of the input block. After the feature extraction, the information apple pictures are characterized by the power worth of the pixel. The layout, which adjusts to the SVM and CNN calculations, is utilized for grouping. The portrayal of various classes in a hyperplane in a multi-dimensional space. The hyperplane is created iteratively by SVM with the goal that the mistake can be limited. The objective of SVM is to separate the datasets into classes to track down the greatest minimal hyperplane and accuracy, review, score and backing, and disarray network.

Convolutional neural network methods are used according to size and color to detect infections in fruit. This model uses a convolutional neural network for computer technology, which is used to classify images and object recognition. A convolutional neural network is working on the analysis of image, sound, and text. TensorFlow is Google's developed open-source artificial intelligence. It helps developers build a neural network that can contain many layers. For classification, prediction, and so on, TensorFlow is mostly used. Using convolutional neural network algorithm & support vector algorithm, it validates the result, shown in figure 6 of precision, recall, score, and support and confusion matrix.

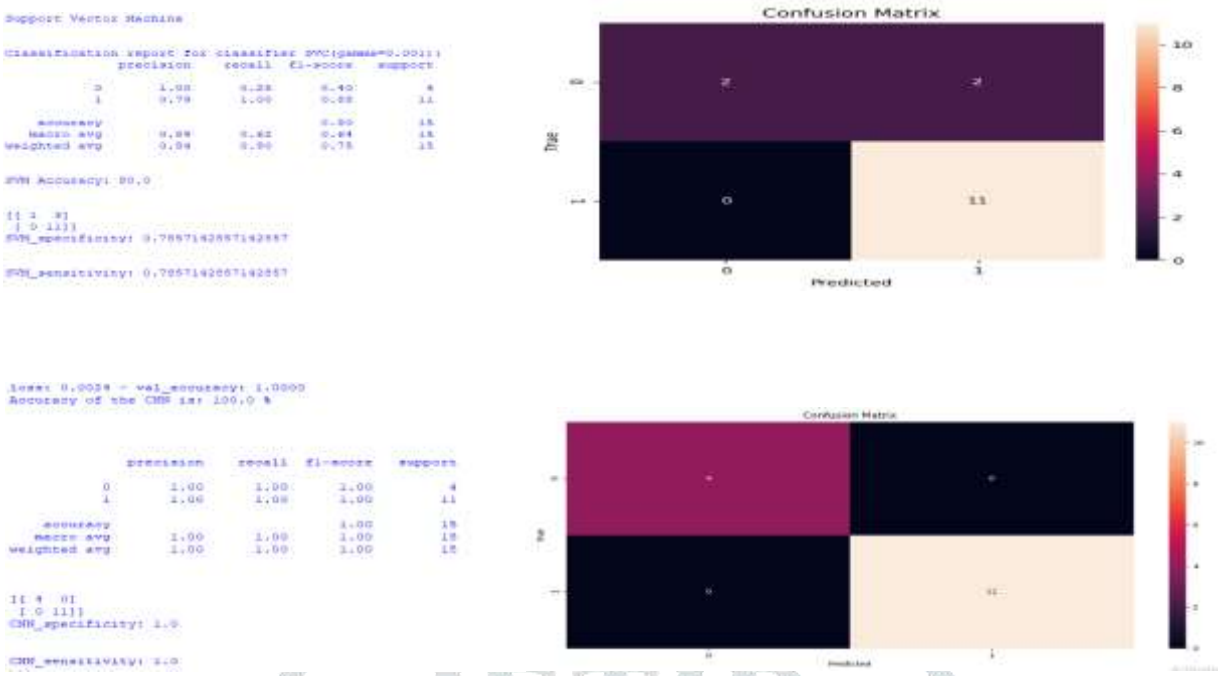

Fig 6.: CNN & SVM Algorithm of precision, recall, specificity, sensitivity, and confusion matrix

IV.RESULT

In this field, we discuss the result obtain by overall classification and prediction and model training of loss, accuracy graphs of the tests. From the loss graph, the model has comparable performance for both the train and validation datasets. If these parallel graphs start consistently, it could be a signal to stop training in an earlier epoch. From the accuracy graph, the model could probably still be trained a bit, as the precision trend in both data sets has continued to increase over the past epochs. The model has not yet learned the training data set and shows comparable capabilities in both data sets.

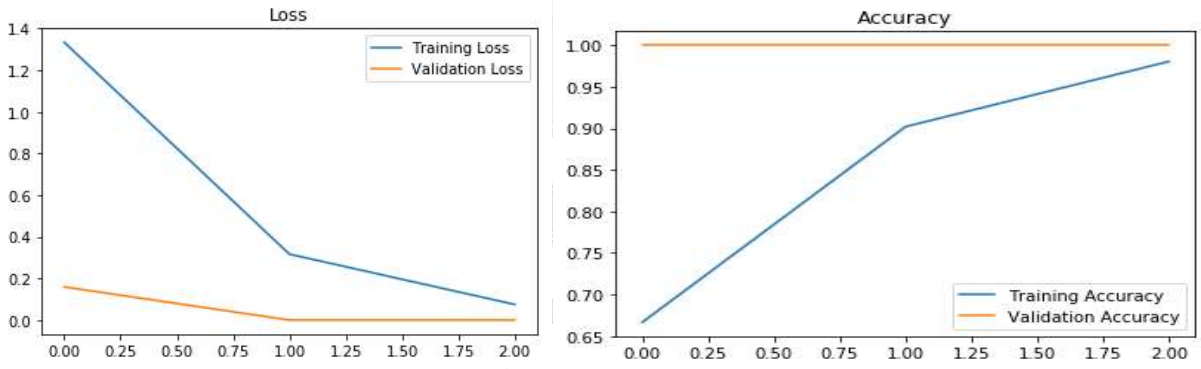

Fig 7: CNN and SVM of the loss and accuracy graph

V.CONCLUSION AND FUTURE WORK

In this paper, the conclusion of an image processing, based on approach is proposed and evaluated for detecting fruit disease of apple and using deep learning it will show the testing and validation accuracy of the apple fruit. The Multiclass SVM & CNN has effectively classified the healthy and unhealthy apple fruit. The number of testing and training epochs, batch size, and dropout had greater influences on the respective results. After the verification and checking out components of the assignment are completed by the usage of a number of the assessment metrics accuracy, loss, precision, and recall – we're proudly announcing that we've got done 100 percent of accuracy in comparing our neural community model. We have used take a look at records to test the optimal verification to achieve this milestone and this resembles that our dataset what we've got preprocessed flawlessly was useful for checking out verification components.

In the future, the segmentation algorithm will be used and the apple disease data set model will be trained. It is recognized by the deep learning neural network algorithm. The graphical user interface is used and recognized. The apple disease and will determine whether the apple is healthy or unhealthy, and also find out what kind of disease is in the apple fruit and diagnose the fruit and suggest the apple disease remedy, it can be improved to develop the application that will deliver the symptoms of the diseased fruit and also control the fruit. The disease that helps in agriculture.

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