Fruit Disease Detection and Classification Using Image Processing

[1]Nadendla Sucharitha, [2]Maddikara Likitha, [3]Malladi Karthik

[1,2,3] Undergraduate Students
[1] Electronics and Communication Engineering, Institute of Aeronautical Engineering College, Dundigal, India.
[2,3] Computer Science, B.V.Raju Institute of Technology, Narsapur, India.

Abstract: Diseases in fruit cause devastating problem in economic losses and production in agricultural industry worldwide. In this project, a solution for the detection and classification of fruit diseases is proposed and experimentally validated. The image processing based proposed approach is composed of the following steps; First step K-Means clustering technique is used for the image segmentation. Second step some features are extracted from the segmented image. Finally, images are classified into one of the classes by using a Support Vector Machine. The proposed solution can significantly support accurate detection and automatic classification of fruit diseases. This technique is used to determine the infection on fruits of the plants. The datasets consist of data related to fruit conditions and the symptoms of disease to be affected. The fruit details and the identification of disease from the feature extraction are stored in the datasets. An application is developed for processing the data and providing intimation to the farmers. Thus, the variation in image from the datasets and also indicates the disease in the fruits. The main objective of this project is to provide a method to prevent fruit diseases and maximize profit of a farmer.

Index Terms: Image processing, Classification, k-means segemntation, Support Vector Machine.

I. INTRODUCTION

Disease has always been one of the main reasons for the decline of apple quality and yield, which directly harms the development of agricultural economy. Therefore, precise diagnosis of apple diseases and correct decision making are important measures to reduce agricultural losses and promote economic growth. Many people these days who are into agriculture are not necessarily from agricultural background. Usage of modern techniques of image processing can help these people to make work easier and predict diseases beforehand and work providing possible solutions to these diseases to improve the quality of the produce. This will also help in maximizing profits and prevent soil erosion. Since all the updates of these can be received on mobile it makes the method effective. Fruit disease classification uses precise image segmentation because the features of the non-infected region will dominate over the features of the infected region. And then K-means based defect segmentation is used to detect the region of interest which is the infected part only in the image. The main objective of this project is to provide a method to prevent fruit diseases and maximize profit of a farmer.

II. LITERATURE SURVEY

Nowadays, apple is one of the most widely grown, highly productive and popular fruits in the world. The quality of fruits directly determines the economic development of the apple plantation industry. However, different kinds of diseases have always been one of the major causes for the decline in apple quality and yield, and directly harm the development of agricultural economy. Therefore, precise diagnosis of apple diseases and correct treatments are important measures to alleviate agricultural losses and promote economic development. The use of technology in agriculture may help in increasing the productivity and may improve the condition of farmers and protection of their product. The major problem of agriculture is of providing information to the farmers and storing the crop related information at some place for analyzing later. Agriculture has been the base for society and livelihood of the people. According to an estimate more than 60% of people are dependent on agriculture for their livelihood. The percentage of cultivable land is very high in INDIA; however, we lag behind in productivity. The per hectare yield is well behind the world average in almost all crops most of the times. When you have a population of billions, the advancement in the agriculture is must.

The technology like Agri-apps may help the farmers to make better decisions about seed selection, crop rotation, nutrients, pricing and markets. The technology may help farmers and Indian agriculture to come out of present disastrous state. This motivated us to propose a model to help farmers for better decision making about best farming practices as well as help the government for making better decisions for farmers and Indian agriculture, and keeping a count on the production and a crops-in-market to a greater extent. At present, the diagnosis of most plant diseases still depends on farmers. However, as the image features of some diseases are similar, and there is no obvious boundary between different grades of the same disease, the artificial diagnosis results might present a large deviation. This poses a challenge to disease management. Moreover, due to the random occurrence, some diseases cannot be found in time. This will affect the quality and yield of fruits, and then harm the development of agricultural economy. In farming the main and hard area is cultivation of fruits and vegetables. Work already done toward masterly optimality in terms of manufacture and standard, Image processing in MATLAB is one of the things which are widely used in order to find diseases present in the image of fruit. The main disadvantage of using MATLAB and neural network is that it requires large storage space and requires more time to execute. Neural networks are also more computationally expensive than traditional algorithms. The classification and segmentation of fruit images were performed using K-Means Algorithm and SVM technique. The various features of few fruits were initially extracted and segment the respective images. After comparison with feature values, the various disease names are analyzed and the optimal disease for the image is identified and the disease is indicated.

III. ANALYSIS

Recognition system is a grand challenge ‘s for the computer vision to achieve near human levels of recognition. In the agricultural sciences, images are the important source of data and information. To reproduce and report such data photography was the only method used in recent years. It is difficult to process or quantify the photographic data mathematically. Digital image analysis and image processing technology circumvent these problems based on the advances in computers and microelectronics associated with traditional photography. This tool helps to improve images from microscopic to telescopic visual range and offers a scope for their analysis. Monitoring of health and detection of diseases is critical in fruits for sustainable agriculture. Early detection of disease and crop health can facilitate the control of fruit diseases through proper management approaches such as vector control through fungicide applications, disease-specific chemical applications and pesticide applications; and improved productivity. The classical approach for detection and identification of fruit diseases is based on the naked eye observation by experts. In some of the developing countries, consultation with experts is a time consuming and costly affair due to the distant locations of their availability.

Fruit diseases can cause significant losses in yield and quality appeared in harvesting. For example, soybean rust (a fungal disease in soybeans) has caused a significant economic loss and just by removing 20% of the infection, the farmers may benefit with an approximately 11-million-dollar profit (Roberts et al., 2006). However, detection of defects in the fruits using images is still problematic due to the natural variability of skin color in different types of fruits, high variance of defect types, and presence of stem/calyx. The approach introduced in this paper can be used for designing automatic systems for agricultural process using images from distant farm fields. Several applications of image processing technology have been developed for the agricultural operations. The computer-based image processing is undergoing rapid evolution with ever changing computing systems. The dedicated imaging systems available in the market, where user can press a few keys and get the results, are not very versatile and more importantly, they have a high price tag on them. Additionally, it is hard to understand as to how the results are being produced. Diseases appear as spots on the fruits and if not treated on time, cause severe losses. Excessive uses of pesticide for fruit disease treatment increases the danger of toxic residue level on agricultural products and has been identified as a major contributor to the ground water contamination. Therefore, we have attempted to give an approach which can the diseases in the fruits as soon as they produce their symptoms on the growing fruits such that a proper management application can be applied.

Some common diseases of apple fruits are apple blotch, apple rot, and apple scab. In this paper, we propose and experimentally evaluate an adaptive approach for the identification of fruit diseases using images. The proposed approach is composed of the following steps; in first step the fruit images are segmented using K-Means clustering technique, in second step, some state-of-the-art features are extracted from the segmented image, and finally, fruit diseases are classified using a Multi-class Support Vector Machine. We show the significance of using clustering technique for the disease segmentation and Multi-class Support Vector Machine as a classifier for the automatic classification of fruit diseases. In order to validate the proposed approach, we have considered three types of the diseases in apple; apple blotch, apple rot and apple scab. The experimental results shows that the proposed approach can significantly achieve accurate detection and automatic identification of fruit diseases.

A. Architecture of the model:

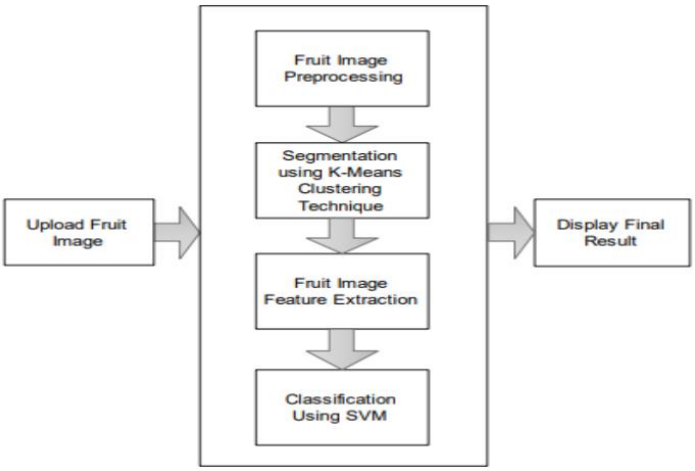

Figure -1: Architecture diagram

IV. DESIGN

This model consists of five Modules to detect the fruit disease. And all these modules will be displayed as buttons in the interface. And an exit button to exit from the application. These modules will get implemented by clicking the respective buttons in the interface. The five modules or the five buttons are:

1. Uploading dataset This button is used to upload dataset from which the fruit disease is detected.
2. Image Pre-processing & K-means Segmentation This is used for processing images that are present in the dataset which is uploaded. And then segmentation will be done using k-means segmentation.
3. Feature Extraction This is used to extract the features of the images. When this button is clicked, randomly an image is selected from the dataset uploaded and then its features are extracted and displayed how its features looks in a popup mini screen.
4. SVM Classification This is used to classify the images in the dataset based upon the K-means segmentation results and groups the images into their respective categories.
5. Uploading & Testing Image This is used for uploading the image and then testing will be done to classify which disease is occurred.

A. Data Flow Diagram:

Data flow diagram (DFD) maps out the flow of information for any process or system. It uses defined symbols like rectangles, circles and arrows, plus short text labels, to show data inputs, outputs, storage points and the routes between each destination. Here the figure below depicts the flow of data from one module to another, the data flows through each module and being manipulated there and that data is used to predict the results at the end.

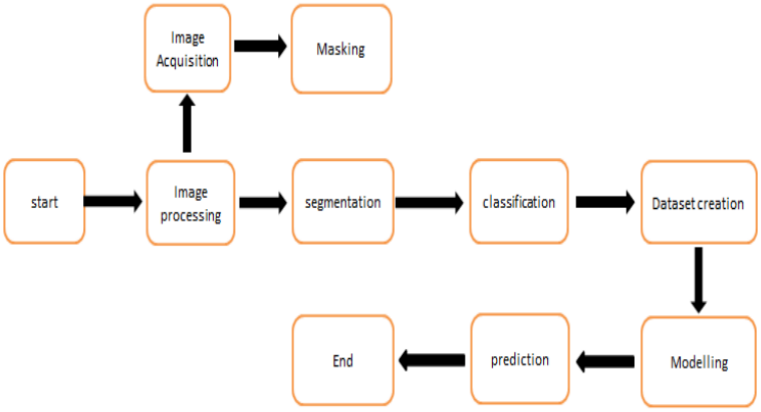

Figure-2: Data Flow diagram of the proposed model

V. IMPLEMENTATION AND RESULT ANALYSIS

A. Implementation:

1. Dataset Preparation:

The dataset employed in our research includes diseased fruit images and healthy fruit images. The fruit images were collected in the field. These images include four categories, including healthy apple fruit, blotch apple, rot apple, and scab apple.

2. Image Processing:

The fruit image processing using clustering is an efficient method. Clustering technique classifies the objects into different groups, or more specifically, partitioning of a data set into clusters (subsets), so that the data in each cluster (ideally) shares some common trait - often according to some defined distance measurement. Data partitioning is a usual technique for the analysis of statistical data, which is used in many areas, including machine learning, image analysis, pattern recognition, bioinformatics and data mining. The computational task of partitioning the data set into k subsets is often referred to unsupervised learning. There are many approaches of clustering designed for a wide variety of purposes. K-means is a typical clustering algorithm. K-means is generally used to determine the natural groupings of pixels present in an image. It is attractive in practice, because it is straightforward and it is generally very fast. It partitions the input dataset into k clusters. Each cluster is represented by an adaptively changing center (also called cluster center), starting from some initial values named seed- points. K-means clustering computes the distances between the inputs (also called input data points) and centers, and assigns inputs to the nearest center. K-means method is an unsupervised clustering method that classifies the input data objects into multiple classes on the basis of their inherent distance from each other Clustering algorithm assumes that a vector space is formed from the data features and tries to identify natural clustering in them. The objects are clustered around the centroids.

3. Image Segmentation:

Image segmentation using k-means algorithm is quite useful for the image analysis. An important goal of image segmentation is to separate the object and background clear regardless the image has blur boundary. Defect segmentation of fruits can be seen as an instance of image segmentation in which number of segmentations is not clearly known. operates in six steps as follows

4. Feature Extraction:

Features are the basic attributes or aspects which clearly help us identify the particular object, image, or anything. Features are the marked properties which are unique. While working on an image dataset we need to extract the features of different images which will help us segregate the images based on certain features or aspects. There is no exact definition of the features of an image but things like the shape, size, orientation, etc. constitute the feature of the image. Extracting these features can be done using different techniques using python. Scikit-Image is an open-source image processing library for Python. It includes algorithms for segmentation, geometric transformations, color space manipulation, analysis, filtering, morphology, feature detection, and more.

5. SVM (Support Vector Machine) Classification:

"Support Vector Machine" (SVM) is a supervised machine learning algorithm which can be used for both classification or regression challenges. However, it is mostly used in classification problems. In the SVM algorithm, we plot each data item as a point in n-dimensional space (where n is number of features you have) with the value of each feature being the value of a particular coordinate.

B. Outputs:

When the model is executed, a screen is displayed and click on 'Upload Fruits Dataset' button to upload dataset. After uploading the dataset, then select Image Pre-processing and K means Segmentation buttons. Next select Features Extraction. In fig-4 you can see one image as segmented image where you can see all similar colors pixels are in one place and now close above image to get train data details. In fig-5, it is depicted that a total 502 images application using 401 (80%) images to train model and 101 (20%) images for testing. Now both train and test images data are ready and now click on 'Train SVM Classifier' button to train SVM with above train and test data and then calculate prediction accuracy. Here the SVM classifier model is generated with prediction accuracy and specificity as 88% and now click on the ''upload the test image & classification'' to upload the test image and classify

it. For various test images, it is classified as different diseases like, scab, blotch, rot etc. The results of classification of diseases are shown in the following figures.

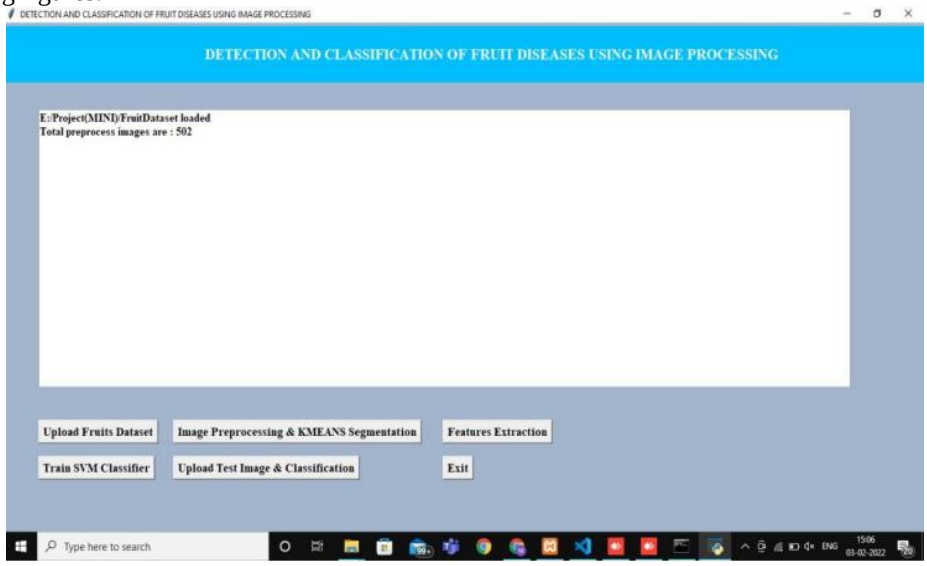

Figure-3: Loading dataset into the model

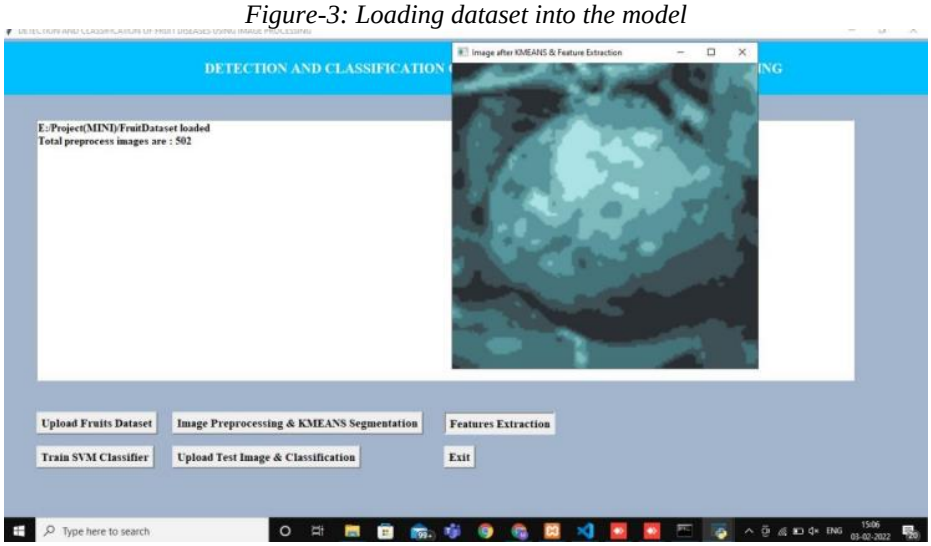

Figure-4: Feature extraction of the Fruit

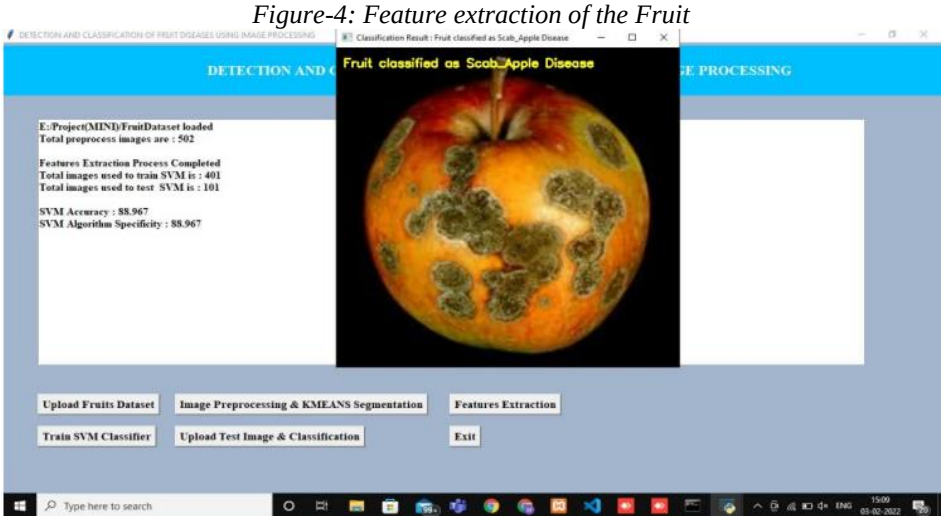

Figure-5: Fruit classified as Scab apple

Figure-6: Fruit classified as Blotch apple

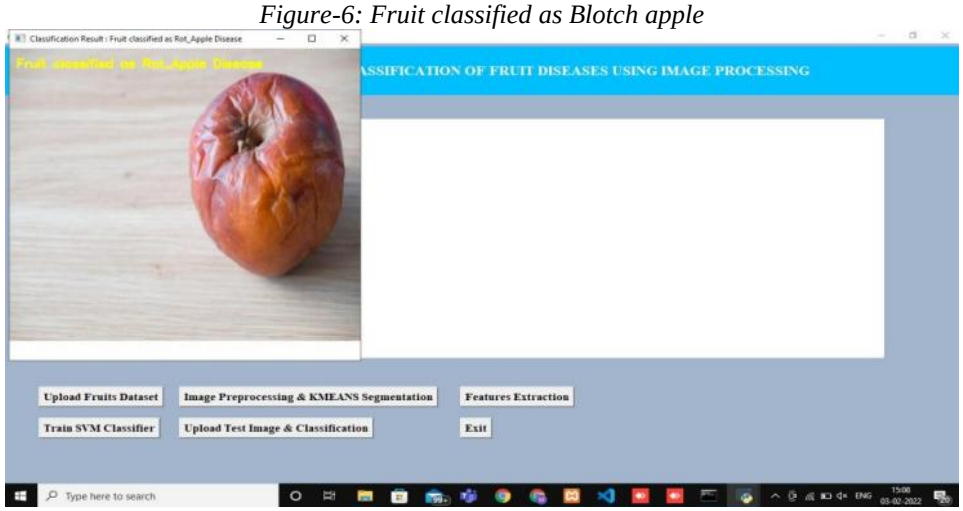

Figure-7: Fruit classified as Rotten apple

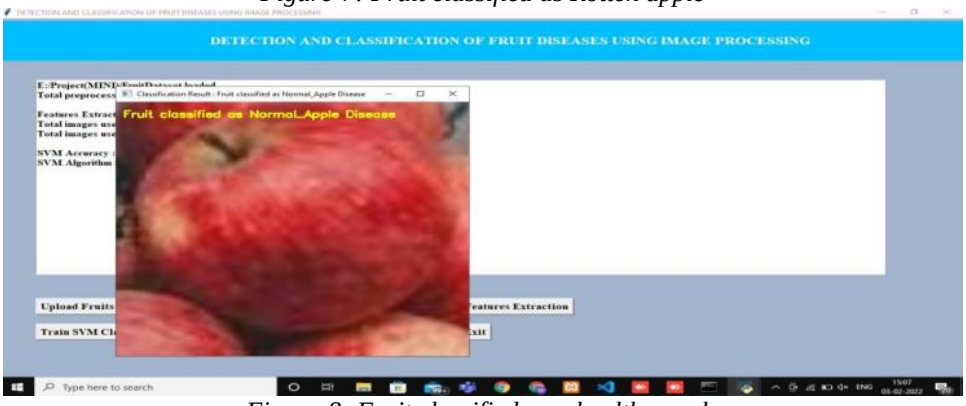

Figure-8: Fruit classified as a healthy apple

C. Result Analysis:

In this paper, we reviewed the progress that has been made in the application of information and communication technology in the agriculture sector. Specifically, we explored several computer vision and image-processing approaches adopted for the classification of fruits and their diseases. Most of these approaches involve three main steps:

(1) background subtraction,

(2) feature extraction, and

(3) training and classification. We also surveyed the literature for image-processing-based solutions that use color and texture features for automatic recognition and classification of fruits and their diseases. To improve the accuracy of classification, several features such as the shape, color, and texture of the produce also considered. These image-processing technique that we used involves three steps:

1.Image and defect segmentation is performed using the K-means clustering method.

2.The features are then extracted from the segmented image and infected region.

3.Finally, the images are classified into one of the fruit and disease classes.

For the evaluation of these methods, a total of four types of diseases of apples were considered. They are Blotch, Scab, Rot and healthy. An average classification error of 3% was reported for fruit disease classification. In this review, only a single type of fruit was considered and only one type of disease was present in the fruit or an image and only four types of diseases was Considered for the fruit. In the future, we will extend our work towards identifying different species and varieties of fruits in a single image,

and perhaps attempt this too in identifying different diseases in an image of a produce. Another possible direction may include the implementation of such systems in real-life scenarios.

VI. CONCLUSION

The development of application for helping Indian farmers and agriculture, to reduce the hoardings and in bringing up a prosperous safe and peaceful farmer society in India. The classification and segmentation of fruit images were performed using K-Means Algorithm and SVM technique. The various features of few fruits were initially extracted and segment the respective images. After comparison with feature values, the various disease names are analyzed and the optimal disease for the image is identified and the disease is indicated by an alert box.

REFERENCES

1. Roberts, M. J., Schimmelpfennig, D., Ashley, E., Livingston, M., Ash, M., & Vasavada, U. (2006). The Value of Plant Disease EarlyWarning Systems (No. 18). Economic Research Service, United States Department of Agriculture.
2. Hartman, J. (2010, April). Apple Fruit Diseases Appearing at Harvest. Plant Pathology Fact Sheet, College of Agriculture, University of Kentucky.
3. Mehl, P. M., Chao, K., Kim, M., & Chen, Y. R. (2002). Detection of Defects on Selected Apple Cultivars using Hyperspectral and Multispectral Image Analysis. Applied Engineering in Agriculture, 18, 219-226.
4. P. Deepan"Detection and Classification of Plant Leaf Diseases by using Deep Learning Algorithm"International Journal of Engineering Research & Technology (IJERT) ISSN: 2278-0181Published by, www.ijert.org,ICONNECT - 2020
5. Wang-Su Jeon1 and Sang-Yong Rhee,"Plant Leaf Recognition Using a Convolution Neural Network"International Journal of Fuzzy Logic and Intelligent Systems Vol. 17, No. 1, March 2019, pp. 26-34