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POMEGRANATE FRUIT DISEASE DETECTION AND CLASSIFICATION

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***Abstract*— In India, rural field assumes fundamental part in the improvement of India. Smart farming enables today's farmers to take early decision, which helps for better productivity, quality and profit using decision tools and automation technologies. The present work proposes a system for identifying the distinctive sorts of pomegranate fruit disease recognition early and precisely, using image processing strategies. The proposed methodology is an effective module that recognizes different infections of pomegranate fruits grown from the ground decides the stage in which the illness is. The proposed method uses different image processing and machine learning methods. Firstly, the captured pictures are prepared for upgrade. Later, image features shape, color and surface are extricated for the diseased part. These infected fruits are then used as contribution to detect the diseases. After this the classifiers are used to recognize the diseases and also used to grade the infections. Finally, in view of the phase of the sickness, the treatment admonitory module can be set up by looking for horticultural specialists, so that they can help farmers.**

Keywords— **Grading, Horticulture, Disease Detection, Disease classification**

I. INTRODUCTION

India is the farming nation. The part of the farming field is vital in the advancement of the nation. To increase the production of crops and preventing the losses due to pests, there is need of implementation of smart farming which helps the farmer's use of advanced technology for farming. In this development, contribution of agricultural field is major. Smart farming is about enabling today's agriculturists with the choice apparatuses and robotization advancements that flawlessly coordinate items, information and administrations for better profitability, quality and benefit [7]. Pomegranate fruit infections are normally brought about by parasites, microscopic organisms and infections. Likewise there are different infections which are brought about by unfavorable ecological conditions. There are various qualities and practices of such fruit diseases in which a lot of them are only recognizable [6]. Early stage disease diagnosis is a major and very important task. We have chosen pomegranate fruit for automatic fruit disease identification. This pomegranate fruit is primarily influenced now days the bacterial blight disease which prompts the significant loss for the farmers. The cultivation of pomegranate fruits are selected from the arid zones and also which gives the more benefit to the agriculturists. The diseases can be generally spread in stormy and winter season. This disease influences steam, leaf and fruits, yet major affected part is on fruits. Pomegranate (Punica granatum), is "product of heaven" which is one of the real fruit yields from "arid zones". It is popular to cultivate this fruit in Western and also Eastern parts of the globe. The fruit is developed for its attractive, "juicy", "sweet-acidic" and fully luscious grains called "Arils". The fruits are predominantly utilized for treat purposes. In India it is developed over the range of around 63,000 ha, and the production of pomegranate fruit is around 5 lakh tons/annum. Imperative assortments developed are Ganesh, Dholka, Seedless (Bedana), Bhagwa, Araktha. Fig.1 demonstrates three varieties of pomegranate fruits.



Fig.1.Varieties of pomegranate Fruits

Depending on size and color, pomegranate fruits are graded. Sadly there are no sorted out advertising frameworks for pomegranate. Typically farmers arrange their product and submit to contractual workers who will later transport too far-removed markets. There is scope for sending out Indian pomegranates to Bangladesh, Bahrain, Canada, Germany, United Kingdom, Japan, Kuwait, Sri Lanka, Omen, Pakistan, Qatar, Saudi Arabia, Singapore, Switzerland, U.A.E. What's more, U.S.A. Infections and insect and pests are the real issues that weaken the pomegranate development. So it requires careful analysis and convenient taking care of to shield the yields from substantial losses.

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(a)Anthracnose (b) Bacterial Blight (c) Scab

Fig.2. Various diseases affecting pomegranate fruit

Pomegranate fruit diseases can be seen in different parts, for example fruit, stem and leaf. Significant diseases that influence pomegranate fruit are bacterial curse (Xanthomonas axonopodis punicae), anthracnose (Colletotrichum gloeosporoides) and scab. Image samples of pomegranate fruit diseases are shown in Fig.2.

II. LITARATURE SURVEY

Over the previous years, distinctive disease discovery methods have been proposed.

The author Tejal et. al [1] Propose a system for disease identification and grading. They done their work on pomegranate leaf and fruit and detect bacterial blight disease. To remove the shadow, which causes during image acquisition, morphology technique has been used as pre-processing. For segmentation the author used the K-means clustering technique. After segmentation AT (Total Area of leaf or fruit) and AD (Total disease area) are calculated. Using AT and AD PI (percent-infection) is calculated, Using PI grade of the disease is determined. For disease identification they consider two characteristics as for the leaf they checked diseased spot on leaf is bordered by yellow margin if yes then it signifies that leaf is infected by bacterial blight and for the fruit first black spots are identified and if crack passing through that black spot it signifies that fruit is infected by bacterial blight. By using proposed system they achieve precise, accurate and acceptable result.

The author Pujari et. al (2013) used some statistical methods for detecting fruit fungal disease. The fruits choosen for research work are namely Pomegranate, mango and grapes. Two phases are used for image preprocessing. In first phase, input image is preprocessed by binarization and noise removal. In second phase image is thinned and bounding box is generated. Block wise feature extraction technique is used for feature extraction. In this technique image is divided into 5*5 blocks. The GLCM (gray level co-occurrence matrix) technique is used to extract the texture features.

The author Pertot et al. [3], recommended multilingual web based tool. The online device accommodated plant disease recognition. Strawberry fruit is considered as contextual investigation. The farmer in the homestead will watch manifestations and these side effects will contrast and pictures gave in the framework. The result will be distinguishing proof of fruit disease. The online framework comprises client and super client. Super client have power to include/alter/erase pictures and diseases. Furthermore, client disease identification technique/device for sickness location.

The author Deshpande et al. [4] provided a system that is useful for plant pathologist for disease detection on plant leaves of pomegranate fruit. The bacterial blight disease has been selected to carry out experiments. For image segmentation and fruit disease detection, k-means clustering algorithm is used. After segmentation, diseased area has been calculated and disease grading has been done.

The author Pujari et al. [5] proposed the statistical methods for fruit fungal disease detection. Pomegranate, grapes and mangoes are selected to carry out the experiments. Block wise features are extracted . The phases namely image pre-processing, image thinning and bounding box generation are used for image pre-processing. Grey level co-occurrence matrix is used for textual feature extraction..

III. PROPOSED SYSTEM

A proposed fruit disease recognition and classification makes utilization of different image processing procedures. The proposed work is primarily partitioned into four stages in particular image obtaining, image preprocessing, image descriptors, and disease classification and infection recognition [10]. Fig. 1 depicts the proposed method. It comprises two stages specifically, preparing stage and testing stage. In preparing stage, pre-processing, image descriptors and classification are performing on image dataset. In testing stage, diseased image is transferred by client, then pre-preparing, image descriptors and grouping is performed. Finally, decision is will be delegated to the former with disease name and how to prevent it.

A. Image Acquisition

Pictures of healthy and diseased fruits of pomegranate fruits are gained from six pomegranate forms. After this the images are taken by using computerized camera and are in JPEG format.

B. Image Pre processing

At first, the caught pictures are resized to a settled determination to lessen the computational in later preparing and in addition to enhance the capacity proficiency. Pomegranate fruit image samples are resized in to a standard format. Noise is removed by applying different image techniques. Gaussian low pass channel is utilized on resized picture as it lessens the signs of high edge in the picture [8]. Test fruit is divided by applying shading based picture division with k-means clustering strategy and the bunch with infected part is removed.

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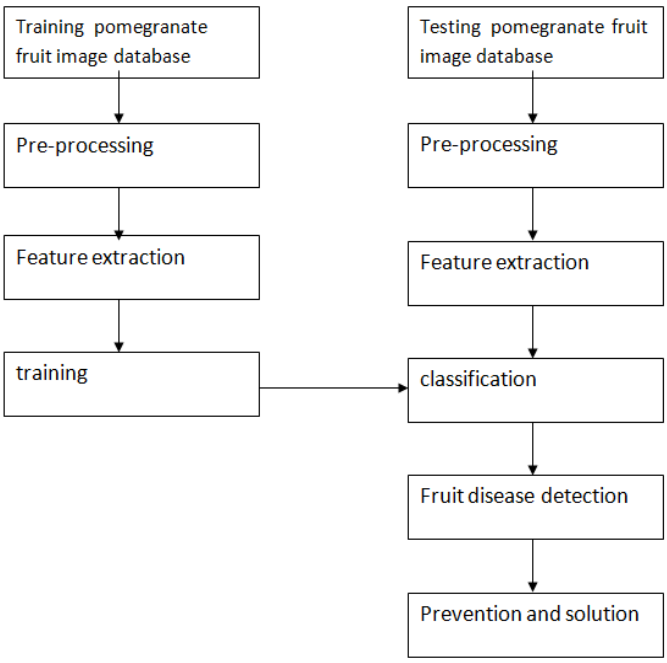


Fig.1.Proposed Framework

C. Feature Extraction

To reduce dimensionality, unique significant information is extracted from the image called image descriptors/features. All the color and texture features are shown in table-1 and 2.

Table-1 color features of sample diseased pomegranate fruit images

Fruit Sample	Red Mean	Green Mean	Blue Mean	Red Skewness	Green Skewness	Blue Skewness
1.	142.9	77.17	39.56	-0.784	-0.021	0.7854
2.	131.5	64.70	54.13	-0.577	-0.009	0.3465
3.	120.5	66.29	34.62	-0.386	0.1507	0.9578
4.	151.7	54.05	37.94	-0.600	0.5684	1.1935
5.	162.5	69.4381	42.7623	-0.713	0.1359	1.1308

Table-2 Texture features of sample diseased pomegranate fruit images

Fruit Sample	Entropy	Energy	Contrast	Homogeneity	Correlation
1.	5.57192	40.23	369.4	88.1207	0.0492
2.	0.00031	78.28	274.82	100.482	0.06108
3.	0.39634	79.16	252.70	96.6421	0.07542
4.	0.0157213	83.08	267.70	116.162	0.06768
5.	2.13274	100.238	291.76	108.498	0.0617481

Image descriptors normally incorporate shading, shape and surface components. Shading and composition are two distinctive however corresponding visual jolts that are extricated in the present work after division. Shading is identified with the ghostly substance of the picture, though composition alludes to the variety of the power in an area of pixels. Different shading and composition descriptors extracted in the present work are homogeneity ,correlation, contrast, energy and entropy. These separated components make the image descriptor database.

D. Categorization of Diseases

Probabilistic neural network(PNN) classifier is produced in the exhibited work that distinguishes the sort of the diseases in view of separated shading and composition highlights. Creating PNN classifier included four stages.
From image descriptor database. 1) Create system object. A testing information were picked indiscriminately 2) Assembling prepared information. Preparing and object of managed two layer nourish forward neural system is made with 20 neurons in the shrouded layer. The system object performs on back propagation calculation in cluster method of operation by relegating weights and inclinations iteratively amid learning. 3) Train the system. The proposed system is prepared using an arrangement of preparing feature test. Preparing test comprises of information vectors and target vectors to take in the yield conduct. Preparing proceeds until the system mistake is minimized. Mean Square Error(MSE) is utilized as an execution measure. Presently the system is utilized for arranging question picture amid web preparing. 4) Simulating system reaction to new inputs. After effective preparing of the system, it goes about as a classifier wherein the elements of the inquiry picture are taken as info and desired output is delivered, i.e. distinguishing sick example and grouping it as either Bacterial Blight or Wilt complex. In addition PNN, Support Vector Machine (SVM) and KNN classifiers are used to categorize the fruit diseases.

E. Disease Detection

Image Pre-processing is done on the captured image. Calculations are utilized to evacuate the shadow which is available at the season of disease recognition. The image correction algorithms are likewise utilized as a part of this stage. For removing shadow we are utilizing some morphology basics, for example, erosion and dilation. In image post processing the influenced part is extricated by using k-means clustering strategy and its features are investigated and after that we are applying those features. In the event that the pomegranate fruit containing chestnut to dark spot is circumscribed by yellow edge, signifies that the pomegranate fruit is affected by Bacterial Blight, If in the event that the fruit contains the huge patches on it then we can say it is a scab and for anthracnose we splits on fruits. For pomegranate fruits first the dim spots are recognized and if there is a part experiencing that dim spot it means that the

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characteristic item is evacuated by vigilant edge finder Bacterial Blight. Cracks are found using canny edge discoverer. Once the disease is identified, grading is done so that the appropriate treatment will be given or else provided by the agricultural experts to the formers so that they get more

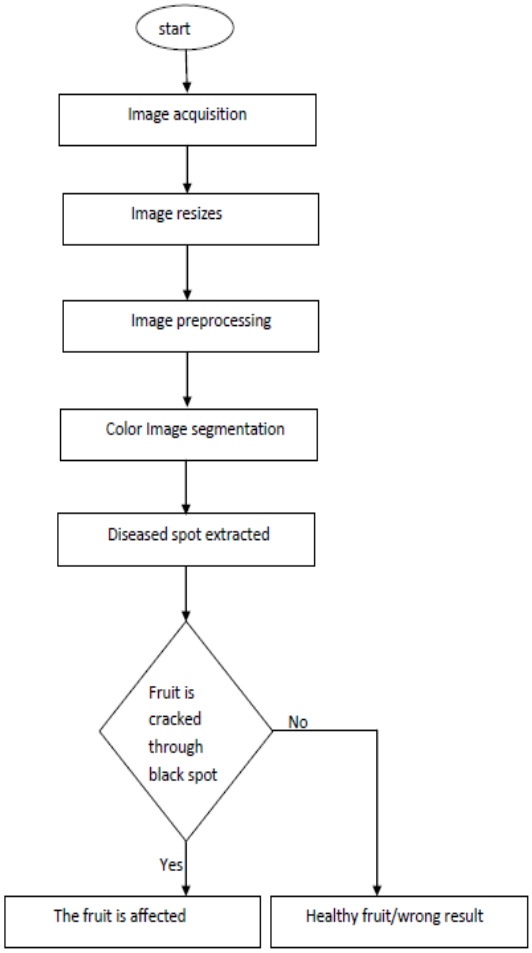


Fig.2. Disease detection Process

profit and also they came to know about prevention techniques [8]. Disease detection process is shown in fig.2.

IV. Experiment and Result

The proposed method of pomegranate fruit disease revealing and classification is implemented in MATLAB utilizing image processing, statistical and neural system tool boxes. Pomegranate fruit is picked as a contextual analysis. Considering Bacterial Blight, scab, anthracnose unhealthy fruits grown from the ground fruits. Pictures of diseased fruits are gathered and put away in JPEG design. These gathered pictures are resized to 200X250 resolutions and shifted utilizing Gaussian Low-Pass channel. In this approach, the total 166 samples are used. Among them 66 are used for testing and 100 are used for training. Out of 66 testing images, 15 samples are healthy fruits, 15 samples are scab, 15 samples are Bacterial blight, 15 samples are Anthracnose and 6 samples are orange fruits. 100 samples are used for training.

Table-3 Comparison between classifiers

Method	TP	FN	TN	FP	Accuracy	Precision
KNN	51	9	5	1	84.8485	98.0769
PNN	47	13	6	0	80.3030	100
SVM	31	29	5	1	54.5455	96.8750

Table 3 shows the comparison of three classifiers which are used in this approach for the classification purpose. The summarized results using ROC curve are shown in Fig 4. Accuracy and precision are computed using eq. (2) and (3) respectively.

$$\text{Accuracy} = (TP+TN) / (TP+FN+TN+FP)*100 \quad (2)$$

$$\text{Precision} = TP/ (TP+F) \quad (3)$$

Where TP = True Positive,

FN = False Negative,

TN = True Negative,

FP = False Positive

We observed from Fig.3 that, KNN classifier performs better than the other two classifier. Fig. 4 show the ROC curve for pomegranate fruit disease detection.

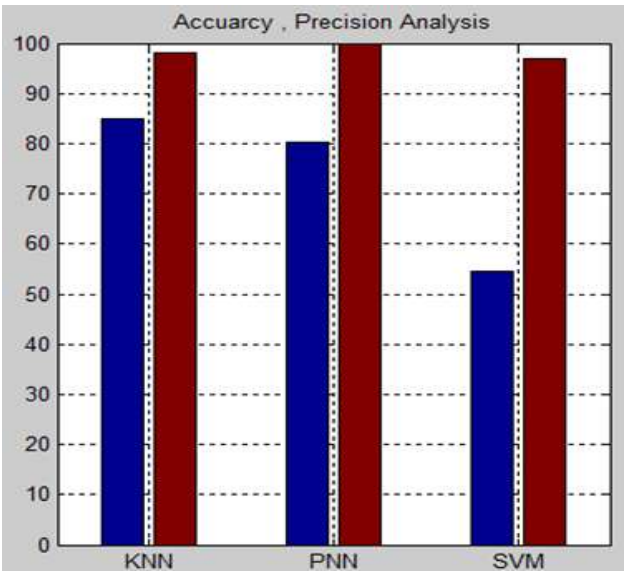


Fig. 3. Comparing accuracy and precision of all the three classifiers

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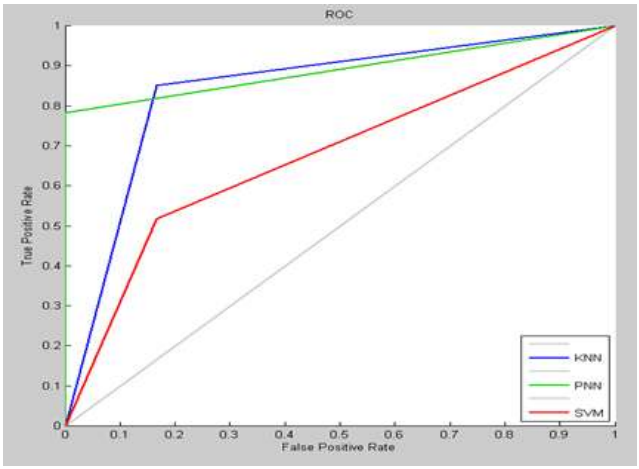


Fig.4. ROC curve for pomegranate fruit decease detection

V. CONCLUSION

The fundamental objective of this paper is to help the general population by enhancing the proficiency and efficiency through this proposed framework which can defeat the inadequacies of the manual procedure in forming. Fruit Disease detection is very momentous and efficient research field. The main purpose is to present an outline of established method for fruit disease detection and classification study of recent growth. The proposed techniques efficiently analyses the healthy and diseased fruits. Bacterial Blight disease is also identified on pomegranate fruit. By knowing decease, we have provided the proper treatment to that particular disease by taking agriculture experts suggestion to prevent further loss.

VI. FUTURE SCOPE

Present work can be extended to the Detection and Classification of different diseases by using fruits, leaf and also flower images. This work can be extended to use 3-D images. This type of relative system can be used in solar greenhouse. It can also be extended for the identification, detection and classification of various plants of various agricultural products. This work can also to be extended to give online information about various plants to the biological experts and farmers to help them in their research work and in agriculture field respectively.

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