Computerized Classification of Fruits using Convolution Neural Network

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***Abstract*— Now a days automation in every field becomes common. While coming to the agriculture field, it has become necessity for classification of fruits, leaves, soils, climatic conditions for better yielding of farming. Among these classification of fruits is very essential and challenging task as many fruits looks a like interms of colour, shape, size. It is very much needed for computerised detection of diseases in a fruits where early detection protects from damaging the entire crop. Here classification of fruits has become the first step in detection of fruits diseases. Here Convolution Neural Network(CNN) based classification method is proposed which gives a better classification result of 90% compared to other proposed methodologies till now. Experiments are held with the dataset of 200 images of fruits in which apple fruit images are 50,mango 50,orange 50 and the remaining 50 are grapes.**

Keywords—Computerized, CNN (Convolution Neural Network), Segmentation, Classification, Filtering, Detection.

I. INTRODUCTION

At present classification of fruits is gaining more focus in the agriculture sector as it is a difficult and very important task for many food production industries. Earlier labors who are very much trained in farming at the classification of fruits as many varieties of fruits are being grown. According to the food care department, there are more than 8000 varieties of apple fruits, and more than 5000 varieties of mangoes are being grown. Likewise, for each type of fruit, there are many varieties that are being found today. For classifying these all kinds of varieties only source available is trained farmers to classify the fruits which increase the labor cost for industries and wastage of time for classifying fruits. Situations of these kinds can be simplified by using the automation of the classification of fruits. Computer Vision and machine learning techniques of available. Neural Networks are being trained based upon the size of fruits, colors, and shapes.[1][2]shown the classification of fruits approach which makes to overcome the cost of recognizing the fruits manually. In the image processing approach as it is known that filtering technique is to be applied first, then segmentation followed by feature extraction and training and testing using the Neural networks. In the part of the proposed work median filtering technique is applied in the preprocessing and the K-Means clustering approach is applied for segmentation and here statistical features are extracted using Mean, Kurtosis, Skewness and Standard Deviation.CNN , BPNN(Back Propagation Neural Network), Support Vector Machine(SVM) are applied for Classification. Fig.1 represents the Image Processing Techniques For Classification,Which contains all image processing steps like preprocessing stage, Segmentation ,Feature Extraction, Classification.

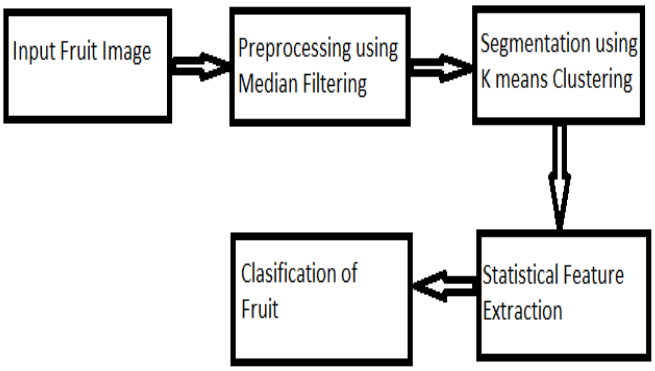

Fig. 1. Image Processing Techniques For Classification

II. LITERATURE SURVEY

Among the literature review already available, it is found that In object detection and also image classification it has made very good progress by the deep neural network[1][2]. For major works of image classification and also the object detection, Convolution Neural Network is being used[3]. For fruit classification region-based CNN is being used[4]. Combination of NIR(near infra-red) and using trained RGB for better performances[5].Deep learning approaches are being used most popularly nowadays on fruits and leaves[6].CNN is being proposed by many authors in[7][8] for fruit classification and disease detection. Some authors[9][10] proposed BPNN and SVM for classification and detection of diseases in fruits.[11]proposed using of median filtering technique for preprocessing stage.K-Means clustering is

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proposed in [12] for better segmentation of fruit images.Feature extraction techniques is proposed in[13].

III. PROPOSED METHOD

Fig.2 represents the proposed methodology where 4 kinds of fruit images are taken as dataset in which all the images undergoes image processing techniques. Here the input image is first taken for preprocessing.In this work few fruit images are taken initially and checked for PSNR(Peak Signal Noise Ration).For few images PSNR value is getting more and for few images PSNR value is less. [14]As all the images are not noise free which forces to undergo pre-processing. Here literature survey is done for finding the best filtering technique for pre-processing, where median filtering results in more PSNR value which is the indication of better filtering.

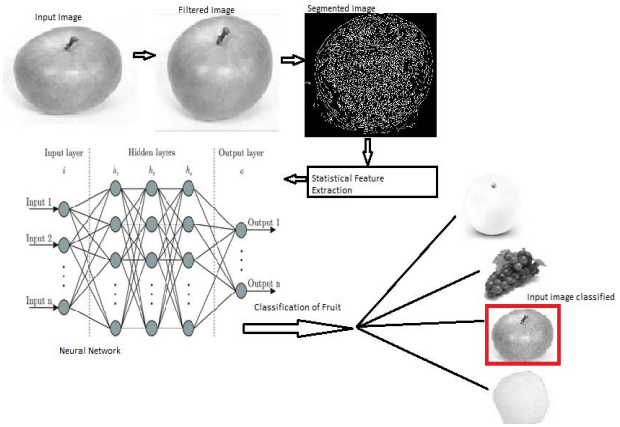

Fig. 2. Proposed Methodology

A. Median Filtering

A nonlinear method is a median filtering method that reduces the noise in an image with its unique characteristic.[15]Median Filtering is that which replaces its each pixel with median value of its neighbouring filter.Fig.3 represents how median filtering is applied on the pixels in an image. Initially in the proposed work input image is given for filtering.

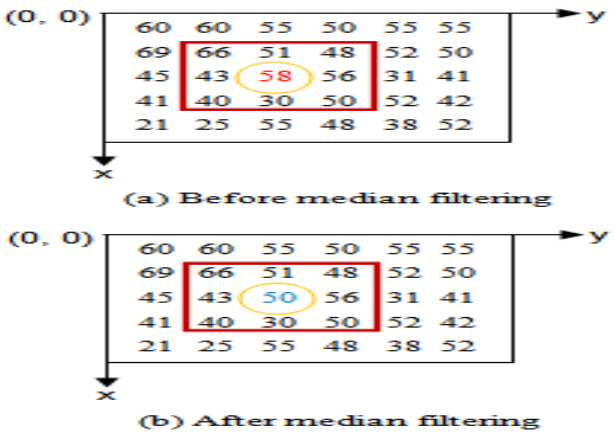

Fig. 3. Median Filtering

Fig.4 shows input image and the filtered image where filtered image is obtained after filtering.

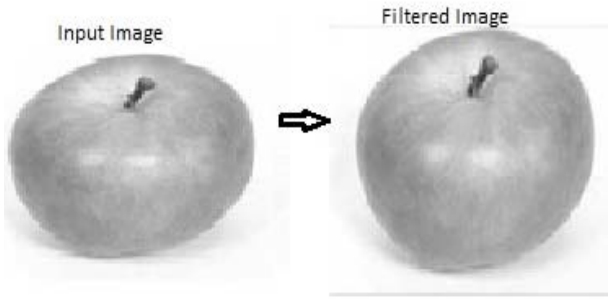

Fig. 4. Input image and filtered image

B. Segmentation Using K-Means Clustering

A clustering algorithm with vector quantization which divides the image into k number of clusters where each observation in possession to cluster centre which is the centroid. Here clustering is done along with the Euclidean distance.

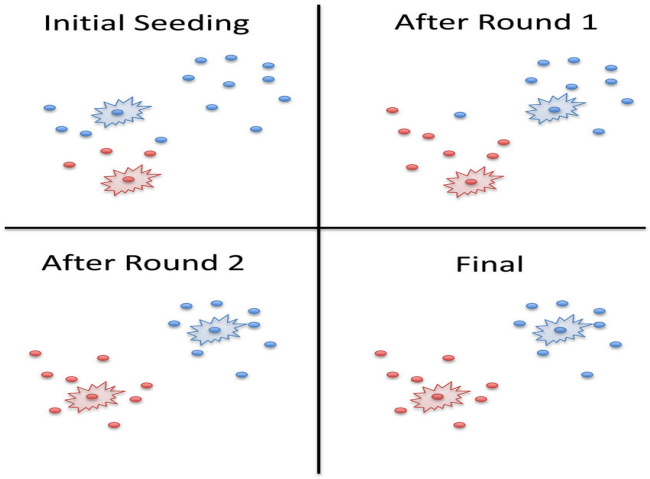

Fig. 5. K-Means Clustering Steps

Fig.5 represents the K means clustering steps where pixels are clustered based on the centroid and with the help of Euclidean distance.Fig.5 shows how pixels in step 1 is shifted to 2 clusters in final stage.

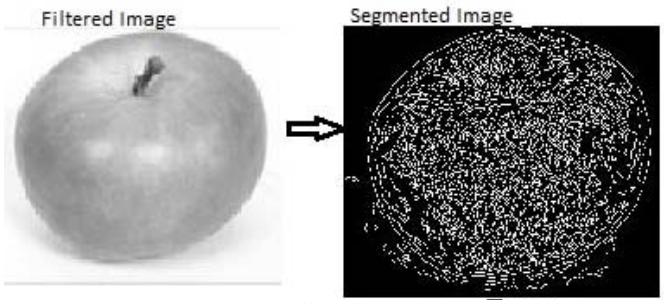

Fig. 6. Transformation of filtered image into segmented image

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Fig.6 represents how the filtered image is transformed to the segmented image and here segmentation is done using K-means clustering technique.

C. *Feature Extraction:*

Entropy, Kurtosis, Standard Deviation, Mean are the statistical feature taken from the image and fed into the classifiers like PNN, BPNN, CNN.

D. *Classification Using Neural Network:*

Here obtained features are fed into the classifiers for training and testing.In the proposed work three kinds of classifiers are used like CNN,BPNN,PNN. CNN is a multilayered special neural network which contains a special architecture for finding the complex features in data. Fig. shows the architechture of neural network which contains the input layer, hidden layer and output layer.

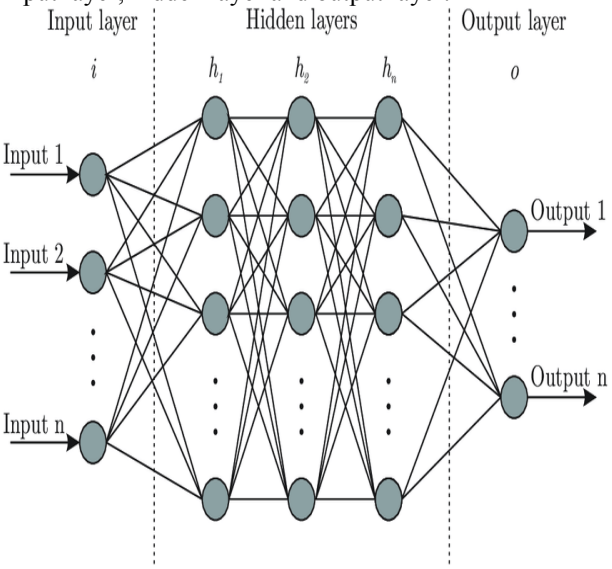

Fig. 7. Neural Network Architechture

IV. RESULTS AND DISCUSSIONS

Experiments are held with the dataset of 200 images of fruits in which apple fruit images are 50,mango 50,orange 50 and the remaining 50 are grapes. Experiment are held using a Matlab2018b.Here classifiers used are BPNN,SVM and CNN where CNN gives the highest accuracy of 90% when compared to other classifiers.Table.1 shows the resultant values of accuracy, specificity and sensitivity of CNN where grape fruit image accuracy is 90 and mango is 91 and apple is 88 and orange is 91 where overall accuracy is 90%

TABLE I. ACCURACY,SPECIFICITY AND SENSITIVITY USING CNN

	Accuracy	Specificity	Sensitivity
Grapes	90	91	91
Mango	91	89	92
Apple	88	90	90
Orane	91	90	91

Fig.8 shows the graphical representation of results occurred in Table.I.

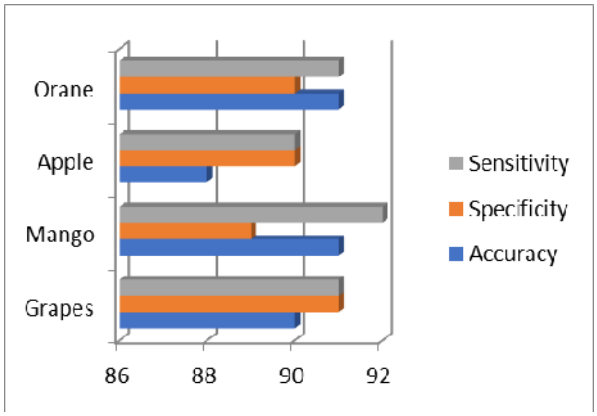

Fig.8. Accuracy,Specificity and Sensitivity using CNN

Table II shows the resultant values of accuracy,specificity and sensitivity of BPNN where grape fruit image accuracy is 88 and mango is 86 and apple is 83 and orange is 86 where overall accuracy is 88%

TABLE II. ACCURACY,SPECIFICITY AND SENSITIVITY USING BPNN

	Accuracy	Specificity	Sensitivity
Grapes	88	89	88
Mango	86	87	86
Apple	83	88	87
Orange	86	87	87

Fig.9 shows the graphical representation of results occurred in table II.

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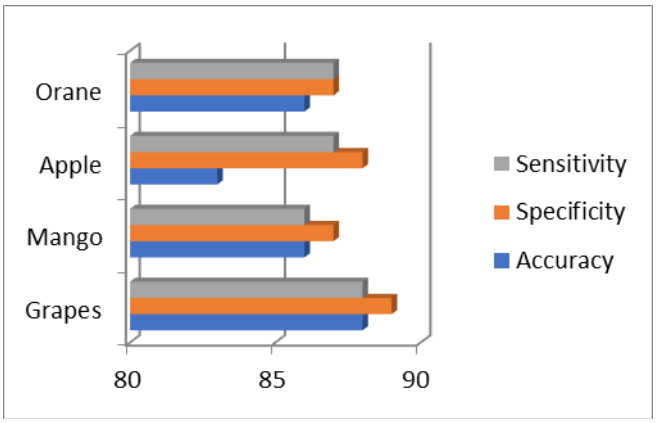

Fig. 9. Accuracy, Specificity and Sensitivity using BPNN

Table.III shows the resultant values of accuracy, specificity and sensitivity of PNN where grape fruit image accuracy is 84 and mango is 87 and apple is 88 and orange is 86 where overall accuracy is 86%

TABLE III. Accuracy, Specificity and Sensitivity using PNN

	Accuracy	Specificity	Sensitivity
Grapes	84	83	86
Mango	87	80	86
Apple	88	84	88
Orange	86	82	87

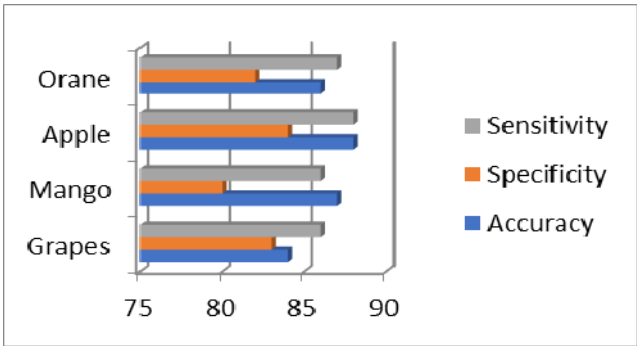

Fig.10 Accuracy, Specificity and Sensitivity using PNN

Fig.10 shows the graphical representation of results occurred in table.3

V. CONCLUSION

Proposed work concludes overall accuracy of 90% using CNN when compared to other classifiers like PNN and BPNN.A Dataset of 200 fruits are taken for experiments which also can be extended to more varieties of fruits which helps in lessening of waging charges for fruits based industries by automatically classifying the fruits.

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