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Optimization of Fruit Disease Detection Process: Using Gaussian Filtering Along With Enhanced SVM

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***Abstract* - Fruit disease detection becomes critical since economic and related issues are influenced through the healthy and non-healthy fruits. Technology has advanced and is used to primarily detect and abnormality which is not visible through the naked eye. This paper proposes a new technique of fruit disease detection at early stage for which Gaussian smoothening is used at pre-processing stage along with weighted kernel function within SVM for achieving higher classification accuracy. Feature extraction and selection mechanism uses rank based mechanism that allocates ranks on the basis of predictive significance. The result is obtained in terms of prediction accuracy and mean or average error. Result is optimized by the factor of 10%.**

Keywords: **Gaussian Smoothening, Weighted Kernel function, Enhanced SVM, Prediction Accuracy, Mean or Average Error**

I. INTRODUCTION

Image processing in the field of disease detection and prediction provides a way out to determine the problems at early stage within the fruits at early stage. Quick accurate analysis of the images is the key idea behind use of technology for the fruit disease detection[1]. In this work, image presented first of all go through the Gaussian filtering to smoothen the image and then feature extraction is performed using rank based policy [2]. As the image is captured there could be legion of noises that could appear within the captured image. These noises could be due to electromagnetic interference or due to problems in lens used to capture the image. Noises occurring this way are divided into number of categories [3]. Salt and Pepper Noise occurs within the image due to the application of temperature and heat. This noise could cause some of the pixels within the image to be excited from ground state and emit white colour as electrons within the image comes to the ground state [4]. This type of noise could lead to black and white spots within the image. Clarity of image is lost due to the presence of such noise within the image. In addition, Gaussian noise could also appear within the image due to rise in temperature [5].

Gaussian Noise is the statistical noise that appears within the image due to temperature whose magnitude is equal to the probability density function (PDF) of the normal image [6]. This noise can take any value from PDF and hence is difficult to detect and correct. Gaussian noise can be rectified using Gaussian smoothening [7]. Shot noise is another common noise that originates from electric charge. Shot noise disturbs the pattern within the image, hence making it difficult to analyse and process. Feature extraction and selection becomes extremely difficult by the application of shot noise [8]. These are the noises which are primarily considered within the proposed system. The proposed system handles these noises by the use of Gaussian filtering at pre-processing stage. Feature extraction and selection is through rank based mechanism and modified support vector machine at segmentation and classification phase. Dataset used is from UCI machine learning website. Next section gives the techniques which are commonly used and required enhancement for accurate detection of diseases within fruit images.

II. RELATED WORK

Support vector machine for segmentation and classification is common, but problem of classification accuracy always exists [9]. To tackle the issue, kernel function is required to be modified to determine diseases if any present within the fruit images. Classes that can be predicted using SVM are limited mostly normal and abnormal images. But in most of the cases, multiple disease prediction through SVM becomes unstable due to inadequate feature extraction [10].

Fruit disease detection through K-means clustering provides high degree of accuracy but with least amount of work on multiple classes of diseases [11]. It also does not concentrate on the fusion of more than one feature so if disease is present within the fruit image it is difficult to detect. By using KNN clustering of various features that are extracted from fruit image and then detection of the disease is to be done. But its accuracy is less as compared to other methods [12]. K-means clustering calculation with Neural networks for programmed identification of leaves diseases. In neural network, it's hard to comprehend structure of calculation and to decide ideal parameters when preparing information isn't directly separable. ANN and Fuzzy Logic with other delicate processing system can be utilized to detect the fruit diseases. Disease spot can be processed for appraisal of loss in fruit image. Disease can be ordered by ascertaining measurements of disease spot [13].

III. PROPOSED METHODOLOGY

The proposed system consists of pre-processing, feature extraction, selection and segmentation, and classification phase. But the primary step includes dataset selection. The dataset selection phase takes the images from the UCI machine learning website corresponding to fruit disease. The description of dataset along with size as given below

TABLE I DATASET USED WITH 512X512 SIZED IMAGED DERIVED FROM UCI MACHINE LEARNING WEBSITE

Image(RGB)	**Size**
	512 X 512
	512 X 512
	512 X 512
	512 X 512
	512 X 512

After fetching the information pre-processing using Gaussian smoothening is applied.

A. Pre-Processing Phase

Pre-processing mechanism used in this literature contains noise handling along with resizing operation. Noise handling is done using Gaussian filtering mechanism. This filter is capable of handling impulse noise along with smoothening operation. Equation 1 gives the operation of filtering along with smoothening.

$$G_{Smoothened_{image}} = \frac{1}{2\pi\alpha^2} e^{(a^2+b^2)\frac{1}{2a^2}}$$

Equation 1: Gaussian Filtering

'α' is slandered deviation, 'a' is distance from horizontal axes and 'b' is a distance of origin from vertical axes.

B. Feature Extraction and Selection Using Rank based Selection

So as to get a viable feature subset by feature choice, the first feature set must be adequate. Since low level visual features, for example, shading, texture, and shape are the key to describe pictures. 75 features of these three sorts are extricated to make the pool out of features for determination. Absolutely 54 shading descriptors are extricated from each picture by consolidating diverse shading models and quantization methodologies [14]. Texture descriptors portray the auxiliary example of a picture, subsequently 11 texture descriptors are examined altogether. Like shading and texture descriptor, shape feature is likewise a vital low-level descriptor and has been broadly utilized as a part of picture order. Absolutely 10 shape descriptors are gathered from each picture. Note that the majority of the features have in excess of one measurement and each of the 75 feature descriptors comprise of 3268-measurement feature segments. In the following investigation, each feature part will be dealt with as a solitary feature to be chosen by our techniques.

C. Segmentation Using Kernel based SVM

SVM calculations utilize an arrangement of numerical capacities that are characterized as the kernel. The capacity of kernel is to take information as info and change it into the required shape. Diverse SVM calculations utilize distinctive sorts of kernel capacities. These capacities can be diverse composes[15]. For instance direct, nonlinear, polynomial, spiral premise work (RBF), and sigmoid. Present Kernel capacities for grouping information, charts, content, pictures, and in addition vectors. The most utilized kind of kernel work is RBF. Since it has limited and limited reaction along the whole x-hub. The kernel capacities restore the inward item between two focuses in an appropriate feature space. In this way by characterizing a notion of similarity, with minimal computational cost even in high-dimensional space.

Kernel or windows function as follows

$$K\left(\overline{x}\right) = \begin{matrix} 1 & \text{if} \left\|\overline{x}\right\| \leq 1 \\ 0 & \text{otherwise} \end{matrix}$$

Proposed Methodology

1. Obtain the input image.
2. Apply Pre-processing for smoothing the image using Gaussian Filter.
3. Perform feature extraction and selection using rank based KNN methodology.
4. Apply SVM with Kernel for segmentation and classification.
5. Obtain results in terms of classification accuracy, mean or average error.

IV. RESULTS AND DISCUSSION

Results are obtained in terms of classification accuracy and mean square error. Classification accuracy is difference between the actual and obtained results. Difference obtained is compared against the existing approach. Result is obtained on an average with 10% which is a significant margin.

A. Classification Accuracy

TABLE II CLASSIFICATION ACCURACY COMPARISON BETWEEN EXISTING AND PROPOSED SYSTEM

Parameter	Existing	Proposed
Image1	78.9876	99.0799
Image2	81.8976	98.9076
Image3	80.98765	99.1234
Image4	81.1145	98.9876

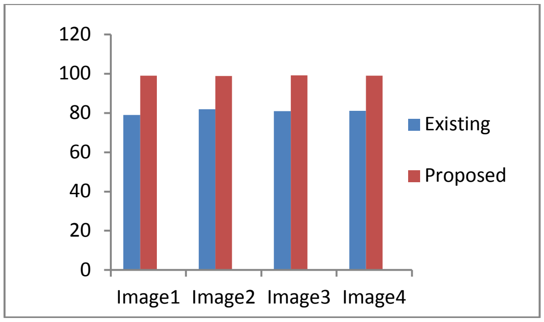

Fig. 1 Comparison of Classification Accuracy of Existing and Proposed System

Mean or average error can be obtained from accuracy. Error rate which is obtained is the difference of 100 from the accuracy. Accuracy obtained is inversely proportional to error. This is given as under:

B. Mean or Average Error

TABLE III COMPARISON OF MEAN ERROR RATE OF EXISTING AND PROPOSED SYSTEM

Parameter	Existing	Proposed
Image1	3.6723	0.920136
Image2	7.6543	1.9874
Image3	2.8761	0.2356
Image4	3.7623	1.7640

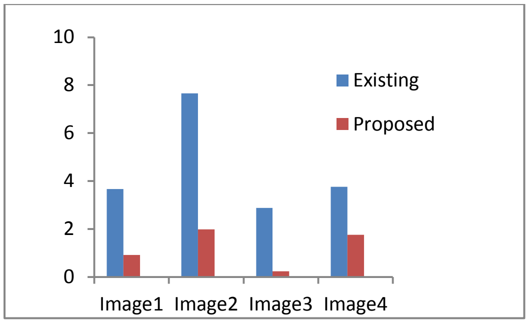

Fig. 2 Error Rate Comparison of Existing and Proposed System

V. CONCLUSION

The proposed work enhances both the pre-processing and segmentation phase for better fruit disease detection classification. Classification accuracy and Mean or average error is optimised by the use of Gaussian smoothening and kernel optimisation in SVM. Fruit diseases are detected at early stage and hence necessary steps to tackle the disease can be taken at early stage to prevent rest of the fruits from corruptions. The rectification process is tested on smaller dataset fetched from UCI machine learning website. In future, larger datasets can be operated upon using the proposed methodology for checking its validity upon such datasets.

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