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Identification of Various Diseases in Guava Fruit using Spiral Optimization (SPO) Technique

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Abstract:
Now a days, farmers are finding difficulty to identify the fruits affected by various diseases. Especially, affected fruits from diseases results in huge loss of revenue to the farmers and the nation. Anthracnose disease affects all the parts of plants during the growth stage like leaves, stems and fruits. In this paper, spiral optimization (SPO) algorithm is used to segment normal and anthracnose affected guava fruit. Optimal cluster position is determined using SPO technique and the clustering process is done to predict the normal and anthracnose affected guava fruit. Manual segmentation process requires more time to find out and sometimes leads to error and may cause huge loss for the farmers. The proposed automated spiral optimization (SPO) technique requires less time to segment the normal and affected fruits. This process help the farmers to predict the diseases in the early stage and quality of crop production yield can be improved.

Keywords: *spiral optimization, new spectral indices.*

INTRODUCTION

Prediction of diseases in the fruits is a challenging task for the farmers, visual symptoms of affected fruits can be observed, specialists could diagnose the affected leaves and fruits either in the research lab or with the aid of domain expert by manually observing the affected portion [1]. Anthracnose diseases affect the tender parts of trees (flowers, young leaves, shoots and fruits). During high humidity, the soil level covered with dense foliage is affected severely and fallen fruits are poorly affected [2]. The growing tip of plant usually appears in greenish colour and later it changes to dark brown during i the affected periods. Fruits and leaves infection is affected more during the period of rainy season. Pin-head spots are first appeared in the young fruits and gradually increase [3]. The affected spot appear dark brown in colour, circular, sunken and localized in the centre of the lesion. Several spots combine together to form bigger lesions. The infected portion of fruits become hardy and develops cracks as a result of severe infection. Manual diagnosis requires more time to perform the operation and sometimes lead to take wrong decision. The consultation charge of domain expert demands high and inaccessible to the farmers located in remote location [4].

I. LITERATURE REVIEW

The Padmavathi et al. [5] applied the image processing techniques for segmentation. First, the

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images are pre-processed, later feature extracted and the plant diseases are classified. In recent days, farmers face many problems in prediction of various diseases occurring on plants. Because of the above said issues, productivity rate of farm products is gradually reducing every year. Manual monitoring of plants diseases requires tremendous amount of work and need more processing time for performing the task.

Thangadurai et al. [6] suggested the features of object shaping technique to identify the objects with similar appearances, where predefined shapes are used to identify the various diseases identified in various plants. The authors used similar features in overlapping of plants and leafs, flowers and shadow of images. Edge detection is used to identify the edges, in terms of pixel variation of gray and white matter.

Monica Jhuria et al. [7] used various database for the validation of suggested technique. In the network, one is used for training of already stored database and another is used for query. The weight adjustment of training database is performed by back propagation technique. Three features namely texture, color and morphology are used to classify and mapped to their respective diseases. The accuracy of the proposed techniques is 90%. Based on the two features vectors the network produces better result based on the training data.

Lili et al. [8] used digital image processing strategies to identify and classify diseases of plants. Diseases symptoms can appear in different shapes and in different location of the plant. The three classes are used by the proposed system such as detection, classification of disease and severity quantification. The quality of detection of various diseases in plants needs more improvement.

Huang et al [12] classified the healthy and leaves infected with yellow rust, powdery mildew and aphids. The classification accuracy produced by the suggested technique is 86.5%. The authors used new spectral indices (NSIs) approach that could be useful for identifying different diseases on crops. Different types of data, plants affected with various diseases have been considered for the validation of the suggested technique. The authors combined features of single band and normalized wavelength difference of two bands. Reflectance of single band and normalized wavelength difference from all possible combinations were used to produce optimized spectral indices. The limitation of the technique is it cannot be able to classify the distinguished diseases.

Xia et al. [13] summarized the different techniques related to leaf and fruit diseases detection using image processing. Different techniques related to the image processing are classified based on the analysis and applications used for processing. The authors discussed about the economic growth of country induced on the crop production quality metrics. The production rate can be improved by identifying the various diseases in the early stages.

May et al. [14] proposed a method for grading and classification of anthracnose fungal diseases of fruits. Statistical methods are combined with network classifier for the grading and classification. The authors considered three fruits such as pomegranate, mango and grapes for the validation. The classification accuracies for normal fruit type are 84.65% and affected anthracnose fruit type is 76.6%. The classification accuracy needs more improvement.

Most of the related works were focused on detection of diseases on different crops. There is a lot of expert system that were designed to diagnose agricultural diseases such as, tomato, plant and other diseases. But there is no specialized expert system for diagnosis of guava fruit disease available. Hence, it is the motivation of the present work to focus on assessing image samples affected by anthracnose on fruit.

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The proposed spiral optimization (SPO) techniques enables farmers to asses the fruits, On looking at the possibility of diseases at early stages, better decision on possible treatment can be undertaken. In this paper, proposed segmentation technique helps to separate the anthracnose affected lesion areas from normal area. This methodology is developed for determining whether the fruit is normal or affected by anthracnose.

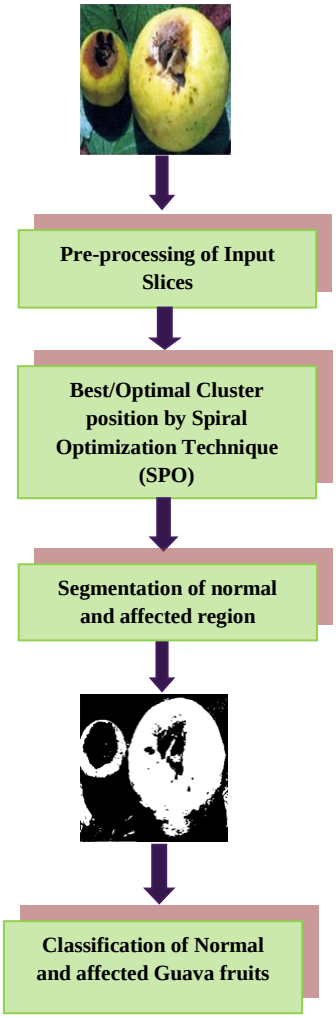

Fig.1.Flow diagram of proposed spiral optimization (SPO) techniques

In the proposed methodology, first pre-processing of input slices is peformed, then the optimized cluster location is determined with the aid of spiral optimization (SPO) techniques and clustering is performed. After the segmentation process, finally the classification of guava fruits into normal and affected is performed.

II. METHODOLOGY

The spiral optimization (SPO) algorithm is one of the best techniques for searching and it is stimulated by the behavior of spiral phenomena. The purpose of this technique is to generate logarithm spirals and to share the intensive and diverse behaviors. The behavior of diverse can be used for a global search (exploration) and the intensive search is enabled with the help of intensification behavior to find the current found good solution (exploitation) [9].

Algorithm

Step 1: Define the number of searching point $n \geq 2$ and the number of maximum iteration p_{max}

Step 2: Consign the initial searching point $y_i\,(0) \in Q^n$ *(i=1,....m)* and the centre of cluster $y^*\,(0) = y_{ib}(0)$, $ib=\frac{argmin}{i=1,2..m}\{f(y_i\,(0))\}$ and set pixel (p) =0.

Step 3: Decide the step rate $s(k)$ by a rule.

Step 4: Update the searching points:$y_i(p+1)= y^*$ (p)+ $s(p)\,Q(\theta)(\,y_i(p)- y^*(p))$ *(i=1,....m).* The condition $s(k)$ works to utilize the periodic descent direction under the search iteration p_{max} and$Q(\theta)$ $=\begin{bmatrix} 0_{n-1} & -1 \\ I_{n-1} & 0_{n-1} \end{bmatrix}$ where I_{n-1} is the $(n-1)*(n-1)$identity matrix 0_{n-1} is the $(n-1)*1$ zero vector.

Step 5: Update the centre y^* (k+1) = $\begin{cases} y_{ib}(\mathrm{p}+1)\left\{\text{if } f\left(y_{ib}(p+1)\right) < f\left(y^*(\mathrm{p})\right)\right), \\ y^*(\mathrm{p}) \qquad\qquad \{\text{otherwise}\} \end{cases}$
where $ib=\frac{argmin}{i=1,2..m}\{f(y_i\,(p+1))\}$.

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Step 6: set $p := p + 1$ if $p = p_{max}$ is satisfied then terminate the output y^*(k) otherwise return to step 2.

III. EXPERIMENTAL RESULTS AND DISCUSSION

In this study, twenty five images were taken from new plant diseases (2018) data set for the validation of the suggested Spiral Optimization (SPO) technique. Different dimension of Anthracnose affected fruits are considered.

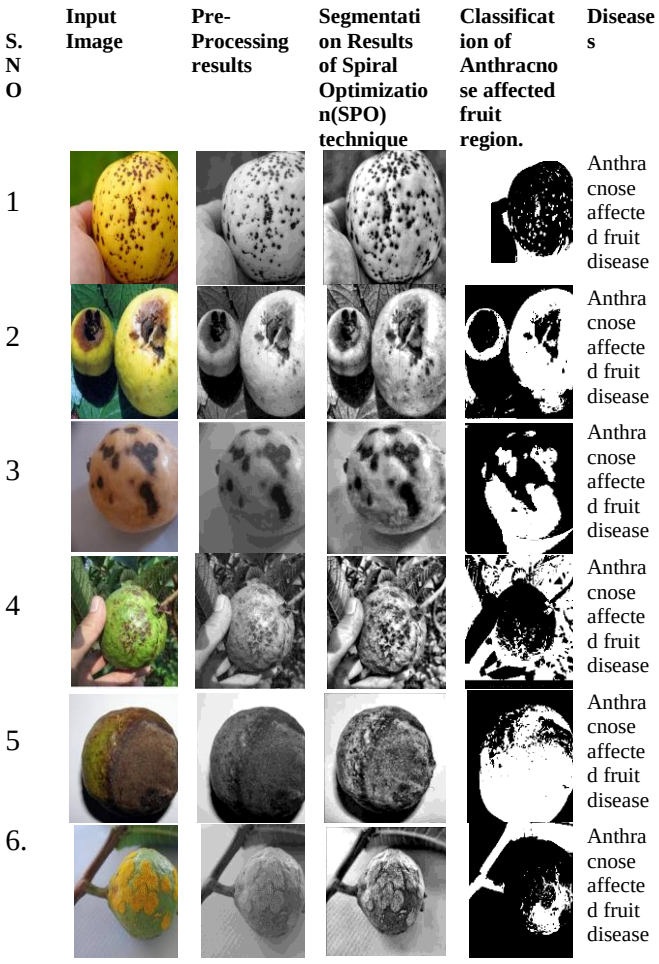

Fig. 2: Results of Suggested Spiral Optimization (SPO) technique

I. ACCURACY

The accuracy rate of the proposed technique is measured with the help of following equation.

$$Accuracy = \frac{M_{TP}}{M_{TP}+N_{FP}} \quad (1)$$

In the above mentioned equation (1) , M_{TP}- denotes the number of correction prediction (positive). N_{FP}- represents the number of wrong prediction (neagtive). The classification accuracy delivered by Spiral Optimization (SPO) technique is 99%, which is much better than the competitive techniques [10].

Table 1: Comparison metrics used for the validation of Spiral Optimization (SPO) technique

Comparison Techniques	Accuracy (in percentage)	Computational time (in seconds)
AlexNet	89.4	7.216
GoogLeNet	89.8	5.784
VGG16	90.5	4.542
VGG19	90.3	2.456
ResNet-50	90.1	1.234
Proposed Techniques	99.2	0.1601

The proposed Spiral Optimization (SPO) technique deliberates a better accuracy rate, while compared with competitive techniques. Normal and affected portion segmented and classified by the suggested technique is quite impressive and shown in the figure.3.

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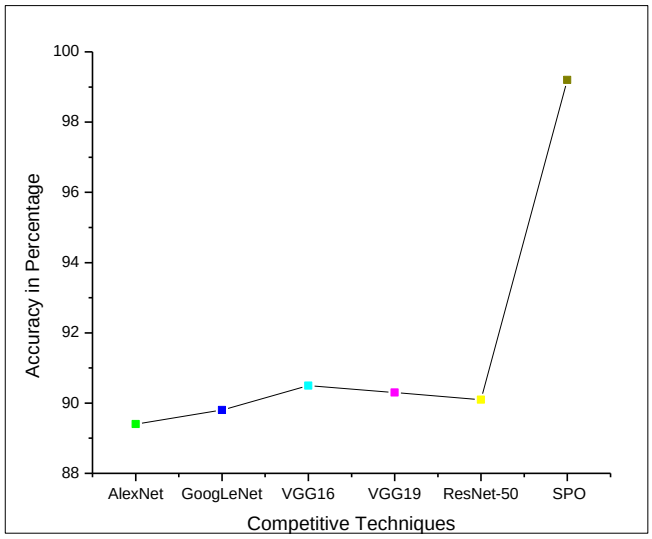

Fig.3.Comparision of Accuracy rate (SPO) with Competitive techniques

II. COMPUTATIONAL TIME

In The time required for finding the normal and affected in guava fruits is measured in terms of seconds. Proposed Spiral Optimization (SPO) technique is compared with the state- of-art-of technologies and is shown in Fig.4. The suggested technique requires 0.1601 seconds for performing the segmentation task in terms of detecting the affected and normal region of fruits, which is much better than the conventional techniques [11].

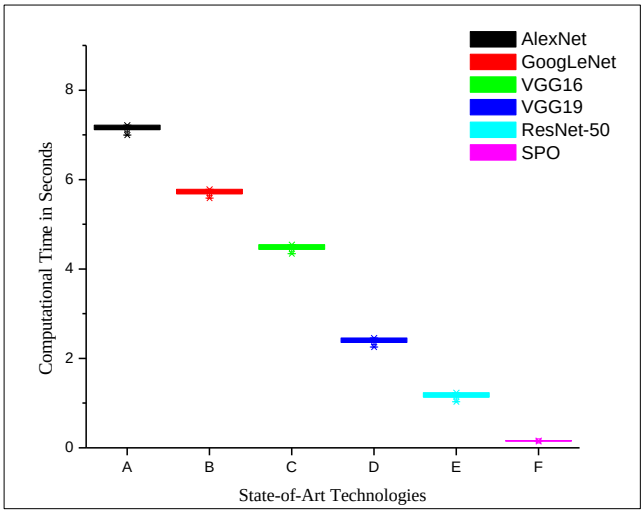

Fig.4.Comparision of computational time with State- of- Art technologies

IV. CONCLUSION

Disease detection for the guava fruit is effectively projected by the proposed Spiral Optimization (SPO) technique. The input image is initially pre-processed, then optimal cluster position is determined and clustering task is performed by the Spiral Optimization (SPO) technique. Experimental results of proposed techniques clearly show the results of finding the different anthracnose affected fruit disease and the accuracy level and computational time of proposed technique is compared with the state-of-art technologies. Different levels of diseases affected fruit images have been considered for the validation of proposed techniques. The suggested technique deliberated better results for detection of affected and normal region. This method takes one step towards and helps the farmers for their better farming, and helps to find the various types of diseases affected by fruits that can be detected in the early stages. In future, increase of dataset size will be used to improve the performance of the proposed system, and other features will be incorporated to boost the classification performance of the system with more noticeable diseases.

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