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Detection of Pest and Disease in Banana Leaf using Convolution Random Forest

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Abstract:
In crop production, pest and disease detection is considered as one of the difficult tasks for the farmers. This paper aims to design a real time pest and disease detection system to recognize the pests in early stage by integrating Image processing techniques with Internet of Things (IoT) in banana plant. In this approach, the images are segmented using K-Mean clustering technique that identifies the pests. Subsequently, the category of pest is identified and is classified using convolution random forest. The various features of the pest and disease are used to train the convolution random forest to classify the pest pixel and disease pixels. Based on disease the organic pesticide is suggested using intelligent system of chatbot. The proposed methodology improvises accuracy and it assist the farmers in safeguarding the crop from damage by sending an alert message.

Keywords:*Pest detection, Internet of Things, Convolution random forest*

I INTRODUCTION

The most important source for human livelihood on earth is crop production. It plays a major vital role in the country's economy. Farmer's economic growth relies upon at the nice of the products that they produce, which relies on the plant's boom and the yield they get. One of the foremost threats to the growth of the crops are the pests. They affect the healthy yield of crops and there by minimize the production. It is a matter of concern to protect these crops as agriculture is essential part of the country.

Detection of pests in plants plays an instrumental function. Pest management is tedious and a hectic process which needs continuous monitoring of the crops. Manual revealing of pest need more manpower and is also time consuming. Hence, it is essential to develop automated computational methods which will make the progression of disease detection and classification easier.

Figure 1. Pest affected leaf samples

Internet of Things (IoT) is a network of interconnected gadgets that can transfer statistics efficiently without human involvement. IoT plays a vital role in increasing the productivity, obtaining the global market, idea about recent trends of crops. With the recent advancements in the technology, it can be used with agriculture to

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make the work easier for the farmers; early stage of recognition the pest is a vital point for crop management. Improved strategies in safe-guarding the crops can prevent such loss and damage, can increase production and make a considerable effect to food security.

In this paper, we focus on emergence of pest in plants. This implies to continuous observation of the plants. Images are acquired using cameras. Then the acquired images are sent to the raspberry-pi. Then the image processing techniques are apply to elucidate the contents of the image.

II RELATEDWORK

Crop safety is a bought as agriculture due to the fact there has continually been a want to maintain the plants free from attack a good way to growth the yield of the healthy plant life. There are number of method proposed so far for pest control in agriculture. In this part of the paper we can evaluate the distinct varieties of proposed strategies and methodology presently used for the early detection of pests and compares their relative execs and cons.

Paul Boissard et.al [3] described the method of using static images for the reason of pest detection. In this method the images are captured with the assistance of scanner. After image acquisition, the advance step is to perform image processing on the acquired image to detect the pests. This method has good accurate results but the main disadvantage of this technique is to use scanner for image acquisition. Also, this technique is time consuming; it requires time in hours to generate the results. Since pests do not remain static, while the images are scanned there is a possibility for the pests to fly away which leads to the blurring of the image. Also, there is a chance of attractive to certain pests. This is a peculiar way to reduce pests, it will not help in detecting those pests which cannot fly. The downside of this method can be overcome by using a pan tilt camera with whiz. The camera is constantly moving as it captures the image. Since the digital camera is flying there is no problem with the pests in motion and subsequently there are no false records.

Tapping [4] is a sampling method. This technique uses a soap solution or oil with water to gather arthropods at the base and stalk of the rice when the rice is tapped. After tapping, the contents in the collecting pan are analyzed arthropods are identified and counted immediately in order to find the pest population. The naked-eye including and data recording can be done on field but it subjects to human error and leads to high labor cost and is time consuming.

According to the survey by Saeed Azfar [6] there are many sensors available for pest detection namely Acoustic Sensors, Low-power Image Sensors etc., The low-power image sensor is a wireless automated monitoring system that is used for pest detection. Placed in a single trap, the wireless sensor captures images of the catch contents from time to time and sends them remotely to a control station .Sent images are then used for determination of the number of pests found at each trap. Based on insect population number, a farmer can plan when to start with crop protection and in which field areas.

Johnny L. Miranda et.al [4] proposed an innovative technique to detect the pests at the early stage. This concept was very efficient towards the finding of pests in crops, but it detects only the whiteflies, a specific pest on paddy plants. It is not applicable for other type of pest.

III PROPOSED SYSTEM

Automatic detection of pest and disease is a very effective way which uses image processing techniques for the detection of pests from the crops and using the different properties of the

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images the pest is classified

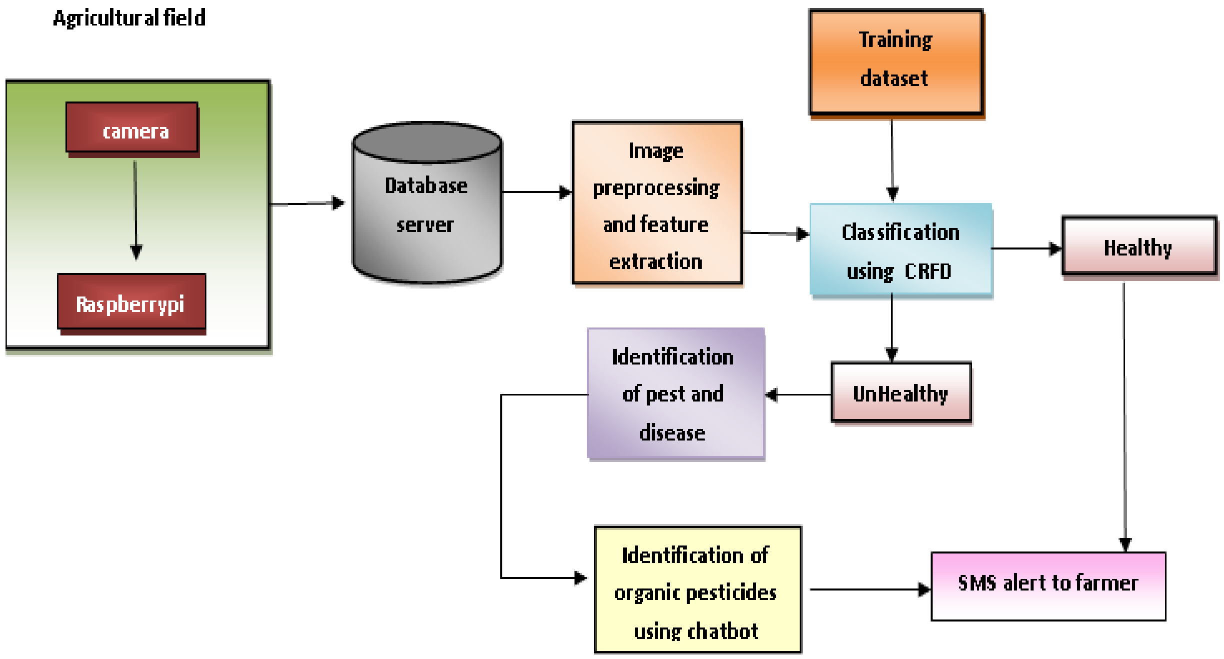

Figure 2. Block diagram of proposed system

Table 1
Rules for cluster formation

Category of the pest	**Rule**	**Cluster 1(Small)**	**Cluster 2(Medium)**	**Cluster 3(large)**
White Fly	Rule1	ROI	healthy region	healthy region
Aphids	Rule2	ROI with disease region	healthy region	healthy region
Beetle	Rule3	ROI with disease region	healthy region	disease region
Weevils	Rule4	ROI with disease region	disease region	healthy region
Thrips	Rule5	ROI with disease region	disease region	healthy region
Caterpillar	Rule6	ROI with disease region	healthy region	disease region
Moth	Rule7	ROI with disease region	healthy region	healthy region

using Convolution Random Forest Detection (CRFD).In this methodology the images of leaves from the crop fields are taken from the agriculture field and then transferred to machine using Raspberry-pi and stored in the database. The image is preprocessed and segmented into various clusters stand on the rule. Table 1 demonstrates the rules to form the clusters. Features are extort from each cluster which forms trained dataset. Input image is preprocessed and feature is extracted. Based on the key image Trained dataset consist of two stage of classification. In first stage

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the input image is classified as healthy and unhealthy. If the output is healthy there is no pest in the leaf and no chance to infect the plant. If the output unhealthy system is to find the category of pest using the CRFD. With the aid of pest identification the possibility of the disease to spread in the banana leaf is identified. Both pest and disease identification is send to the cultivator as a SMS message through GSM Module. By identifying the category of pest, the disease to be affected to the plant is predicted and a message is sent to the farmers which help them in taking appropriate measures and thereby protecting the crops. The overall methodology is described through a brief block diagram given in fig 2

The proposed system works on the basis of some rules framed in table1.Each pest is classed into three clusters support on the size as small, medium and large. The cluster1 represent small size pest up to 1mm, cluster2 represent medium size from 1mm to 2mm and cluster3 represent large more than 2.5mm.The sub region of images are processed by using ROI.

A. Image acquisition

Image acquisition is the foremost step of image processing. The images are capture using a high resolution camera with equal illumination to the object. The captured images are saved in the same format such as JPEG, TIF, BMP, PNG etc. The digital camera is interfaced with the Raspberry- pi which makes use of the captured photo as an enter to the system.

B. Image pre-processing

Image preprocessing is done to improve the image facts that contains unwanted in torsion and to enhance the features of the image for further processing. Image preprocessing creates an enhanced photo that is more useful for buying a clean remark. Whenever the camera captures a cluster of leaves, background image (excluding the pestiferous leaf) will be blurred as the foremost step. Then the image of the pestiferous leaf will be cropped out. Finally the RGB image will be converted into gray image for the identification of pest and disease.

The steps involved in this system are:

1)Conversion of RGB image to gray image

2) Resizing of the image

3) Filtering of the image.

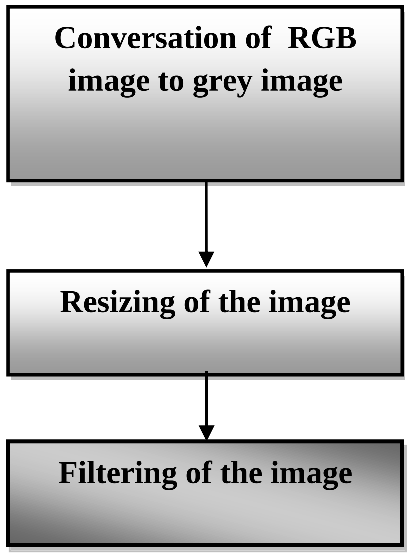

Figure 3. Steps involved in image pre –processing

1) *Conversion of RGB to gray image.*

In RGB color model, pixel color is combination of three colors Red, Green, and Blue (RGB). The RGB image is a 24-bit color image that supports around 16,777,216 different colors, whereas a grey scale image is of 8 bits. The pixel value ranges from 0 to 244.To find the edges based on luminance and chrominance, the conversion to grey scale image is an essential step. The formula to convert RGB to gray is given in equation (1).

$$(x, y) = 0.2989*R + 0.4870*G + 0.1140*1)$$

The information possessed by gray scale image is enough for our methodology so we convert RGB image to gray scale image because the RGB

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image requires more memory space.

2) Resizing of the image

The image obtained is resized according to the need of the system. There are numerous methods available for picture resizing, Nearest-neighbor interpolation, bilinear, and bicubic. In Nearest-neighbor interpolation the factor that falls in the cost of the pixel is assigned to the output pixel. No different pixels are considered. In bilinear interpolation the output pixel fee is a weighted common of pixels in thennearest - by way of-two neighbourhood. In bicubic interpolation the output pixel price is a weighted average of pixels in the nearest 4 by means of four neighborhoods. Hence we're the use of bicubic interpolation in our gadget because it generates greater correct results than any other approach.

3) Filtering of the image

Filtering in image processing is a system of removing the unwanted data or noise. It also allows scrupulous highlighting of particular records. There are numerous strategies to be had to clear out the picture and the first-class alternative depends at the photo and the way it is used. Both the analog and virtual photo processing calls for filtering to yield ausable and appealing cease result. There are extraordinary styles of filters such as low bypass filters, excessive bypass filters, suggest filters and many others. In our system we are using smoothening filter out that is to reduce noise and improve the visible best of the photo. Spatial filters are carried out to both static and dynamic photos, wherein as temporal pics are implemented best to dynamic snap shots. Here we use an average clear out, it's miles used for smoothing the photograph as well as to lessen the noise within the photo. In this type of filter out every pixel price is calculated with the suggest price of its 8 neighborhood pixels.

4) Image Segmentation

Image segmentation is the procedure of conversion of digital image into several segments and furnishes an image into something for easier analysis. It is used for identifying the objects and bounding line of that image .we have used K-means clustering method for segmenting the image, where the images are partitioned into clusters in which at least one part of cluster contain image with major area of diseased part.

The Algorithm step is given below

1. Identify the amount of cluster k

2. Initialize centroids by first reorder the dataset and then arbitrarily selecting K data points for the centroids without

alternate.

3. Repeat till there is no alternate to the centroids i.e. challenge of information factors to clusters isn't converting.

- Calculate the sum of the squared distance between information factors and all centroids.
- Allocate each data point to the closest cluster (centroid).
- Compute the centroids for the clusters by taking the common of the all facts points that belong to every cluster.

A. Feature extraction

Highlight extraction is the procedure where the ideal component vectors; for example, shading, surface, morphology and structure are separated. After division the district of intrigue (Region of interest) chosen which having better picture information utilizing highlight extraction systems. Number of properties, as an example, assessment, correlation, suggest, eccentricity, general deviation, homogeneity and so forth are obtained by using Gray level co-occasion framework (GLCM) for texture analysis and texture functions are calculated from statistical distribution of

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located depth mixtures at a particular role relative to others.

B. Convolution random forest for

Classification

It is a supervised algorithm, create a forest with N number of decision tree by some way and make it random. Initially the algorithm checks the leaf is healthy or not. Features are extracted from the each cluster as ST.

$$ST=\begin{pmatrix} f01 & f02\cdots & t1 \\ \vdots & \vdots & \vdots \\ fm1 & fmn & tmn \end{pmatrix}$$

N number of the random sub-tree is created and the outcome of the each sub-tree is mapped into convolution matrix. Based on the class label each output is mapped with the matrix. The output is converted into n*n matrix based on the number of label. The Maximum value in the output is used to identify the pest. Depend on the size of the pest the disease is identified which is detail described in the algorithm. The input of the pest and disease are passed into the intelligent system to know about the organic pesticide.

$$\begin{matrix} 0 & D1 & 0 & 0 \\ D2 & 0 & 0 & 0 \\ 0 & 0 & D3 & 0 \\ .. & .. & .. & .. \\ 0 & 0 & 0 & Dn \end{matrix} \quad * \quad \begin{matrix} 1 & O1 \\ 1 & O2 \\ 1 \rightarrow & O3 \rightarrow \\ .. & ... \\ 1 & On \end{matrix}$$

$$\begin{matrix} O1 & O2 & O3 & O4 \\ O5 & .. & .. & .. \\ ... & .. & .. & .. \\ .. & ... & ... & On \end{matrix}$$

N=Total number of decision tree

C=Total number of class label

O=output of decision tree*class labels

O= N*N (covert the output matrix into n*n based on number of class labels)

Accuracy=Max ($\sum_{i=1}^{n}\sum_{j=1}^{n}.Yij$)/(Number of rows*100)

Algorithm

For N=1….do

Label=createtree(s,f)

C<-Group the output into Convolution Matrix

End For

P<-predict(C)

Return the result

Repeat the process for disease identification

Function createtree(s,f)

C<-find the class label based on sample and feature

return class

End function

Function predict(C)

R<-FIND THE HIGHEST NUMBER OF LABEL USING CONVOLUTION METHOD

Return R

End Function

IV EXPERIMENT AND RESULT

The main aim of the model is to develop a system which recognizes banana leaf pest and disease .Based on that the intelligence system of Chabot suggest the organic pesticides due to the TP.CRFD improves the accuracy of the pest detection and identification when compare to the classifiers of SVM, Random Forest And Neural Network. TheFigure.4 and Fig.5 Shows the detection of the pest and disease.

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Table 2
Experimental results

Insect	SVM	Random Forest	Neural Network	CRFD
White Fly	0.7593	0.7618	0.7601	0.7801
Aphids	0.8123	0.8217	0.8299	0.8311
Beetle	0.8298	0.8312	0.8423	0.8511
Weevils	0.8399	0.83123	0.83	0.8623
Thrips	0.8411	0.8567	0.8512	0.8645
Caterpillar	0.8526	0.8589	0.8678	0.873
Moth	0.8823	0.8791	0.8534	0.8791

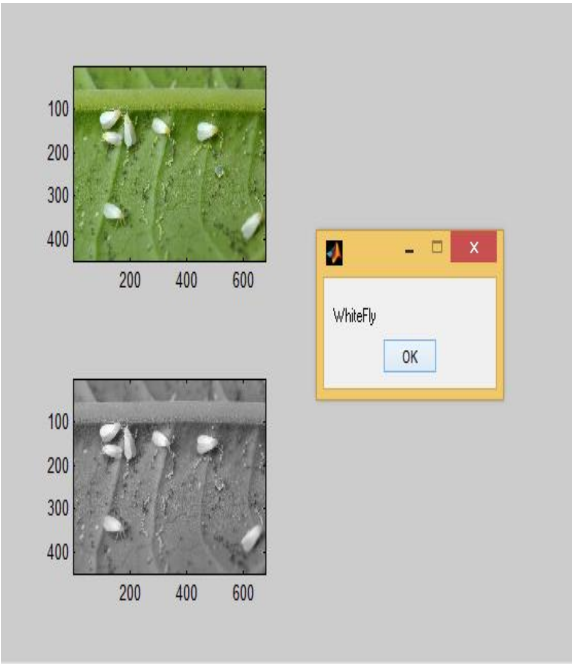

Figure 4.Pest Detection

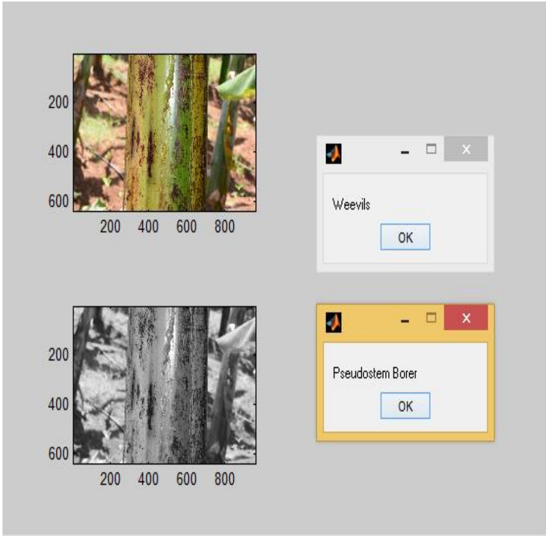

Figure 5. Pest Detection and Disease identification

This methodology is applied to various Pest and we have determined the level of accuracy of the system in each pest which the represented in the form of graph in Fig.5

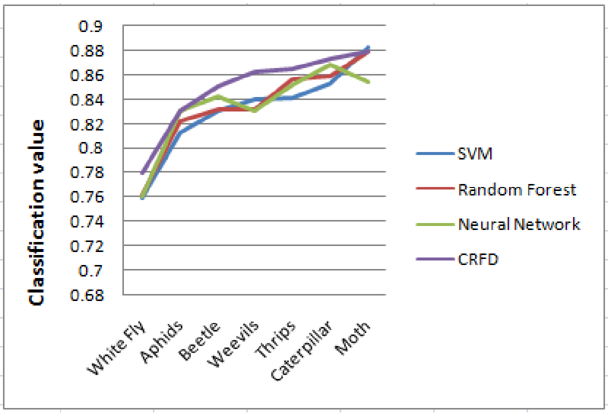

Figure 6. Experimental result of the CRFD

V CONCLUSION AND FUTURE WORK

The proposed methodology is based on image-processing with IoT and convolution random forest algorithm for banana plant. The result presented in this paper is promising. From the results we inferred that, wider the plant surface larger is the accuracy of pest detection. The results obtained are as expected but few improvements need to be made on both materials and methods in order to achieve the requirements of fully automated pest management system, which involves pest detection, extraction and identification. In future an automated spraying

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system will be designed and integrated along with this system that is after the detection of the pest, the appropriate pesticide will be chosen and sprayed on the affected part of the plant. The enhanced algorithm provides the better result comparing to the remaining existing algorithms.

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