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Mobile Vision System for Plant Leaf Disease Identification

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Abstract — **Identification of the plant diseases is the key to preventing the losses in the yield and quantity of the agricultural product. The studies of the plant diseases mean the studies of visually observable patterns seen on the plant. Health monitoring and disease detection on plant is very critical for sustainable agriculture. It is very difficult to monitor the plant diseases manually. It requires tremendous amount of work, expertize in the plant diseases, and also require the excessive processing time. Hence, image processing is used for the detection of plant diseases. Disease detection involves the steps like image acquisition, image pre-processing, image segmentation, feature extraction and classification. This paper discussed the methods used for the detection of plant diseases using their leaves images. This paper also discussed some segmentation and feature extraction algorithm used in the plant disease detection.**

Key Words — **Image acquisition, Segmentation, feature Extraction.**

I. INTRODUCTION

At the beginning of this century, there is a tremendous technological revolution in the field of wireless communication and mobile technology. However, this revolution is still absent in agriculture despite advances in technology making it possible to build and deploy wireless sensor and control networks in agricultural field that would radically improve farm efficiencies. This is because the current wireless technologies are too expensive and complicated for use in the farm. Nevertheless, it will be wrong to say that wireless applications have not penetrated the agricultural sector at all. 2-way radios have long been used by farmers in many developed countries with large farmlands to contact their employees, farm suppliers, equipment dealers, agents and buyers from anywhere at any time. Today, with the wide spread availability of mobile phones and cellular networks, the use of mobile phones in agricultural sector is becoming popular replacing the use of 2-way radios. The advantage of using 2-way radios and mobile phones is that they are wireless tools that are relatively cheap and very simple to use. Additionally, mobile phones have one more important advantage that is that all brands of mobile phones are generally compatible.

II. LITERATURE REVIEW

Earlier papers are describing to diagnosis the cotton leaves using various approaches suggesting the various implementation ways as illustrated and discussed below. Cotton Diseases Control has been developed in a BP neural network as a decision-making system. Cotton foliar diseases presented a method for automatic classification of cotton diseases used Wavelet transform energy has been used for feature Earlier papers are describing to diagnosis the cotton leaves using various approaches suggesting the various extraction while Support Vector Machine has been used for classification. Existing the research work described in the features could be extracted using a self-organizing feature map with a back-propagation neural network is used to recognize the color of the image. Earlier paper the fuzzy feature selection approach fuzzy curves (FC) and surfaces (FS) - is proposed to select features of cotton disease leaf the image. Presented work carried out RPM and Dis Bin and compared with the classical PCA based technique. The cotton leaf disease segmentation is performed using modified self-organizing feature map with genetic algorithms for optimization and support vector machines for classification. Proposed use this techniques to extract Eigen feature from cotton leaf. Presently, in the recent agricultural system, advance computation techniques have been developed to help farmers (or) agricultures to monitor the proper development of their crops. In our early agricultural system, during the harvesting process of the crops, the exposed eye observation of farmers or experts is the main approach adopted in practice for the detection and identification of crop diseases under microscopic conditions in the laboratory. However, this requires continuous monitoring of experts which might be prohibitively expensive in large farms. Further, in some developing countries, farmers

May have to go long distances to contact experts, this makes consulting experts too expensive and time consuming. The basic problems regarding with crop is on the field, a fast and accurate recognition and classification of the diseases is required by inspecting the infected leaf spot images also identify the severity of the diseases. There are two main characteristics of plant-disease detection machine-learning methods that must be achieved, they are: performance and accuracy. In this seminar we will describe the process of Advance computing techniques for recognition of leaf spot diseases as this can give much benefit in monitoring large fields of crops and discover the symptoms of diseases. In this work we have to find out the computer systems which analyze the input images using the RGB pixel counting values feature used and identify (each and every disease) wise and next using homogenization techniques Sobel and canny using edge detection to identify the affected parts of the leaf spot to recognize the diseases boundary is white lightning and then result (recognition of the diseases and pest recommended) is given as output to the farmers.

III. PROPOSED METHODOLOGY

1. Leaf image segmentation

In image, video and vision applications image segmentation is a fundamental step to separate homogeneous regions. For image analysis and image understanding, proper segmentation is a necessary condition. Features such as color histogram, texture or edge based methods are used for finding homogeneous regions in an image. Image segmentation methods are classified as supervised or unsupervised. The supervised segmentation approach predefines the characteristics of different regions in an image whereas in unsupervised segmentation there is no such prior information. Unsupervised algorithms includes splitting merging method , local and multi resolution features , Markov random field model and many others which are computationally complex and memory consuming. The advantage of such algorithms is that no comparison is required against the manually segmented ground-truth. Unsupervised image segmentation is very useful in real time systems where large variety of natural images need to be segmented. Plant leaf image is a natural image full of challenges and hence needs a dynamic adjustment of segmentation parameters for better results. For this, cluster-based unsupervised image segmentation methods prove to be useful. In Puzicha et al. proposed an efficient novel mixture model to cluster histogram data with multi-scale formulation. In Bong and Lam proposed multi-objective scatter for image segmentation using concepts of Pareto dominance on gray images (CT scan and SAR).
The four necessary criteria for unsupervised image segmentation given by Haralick and Shapiro are :

1. Uniform and homogeneous regions with respect to some common characteristic(s).
2. Significant difference between adjacent regions with respect to the characteristic(s).
3. Absence of any hole in a region.
4. Simple and spatially accurate region boundaries. In our work, we propose to use *k*-means clustering approach for color leaf image segmentation. An image is composed of foreground and background. In our work, we assume that the leaf image is available with simple and uniform background. The leaf again is composed of two different n regions – the normal green part and the disease patch. Accordingly, we apply *k*-means clustering for segmentation with $k = 3$ corresponding to the three regions in the leaf image – background, normal green leafy part and the disease patch n region. The RGB leaf image captured by the mobile device is first converted into

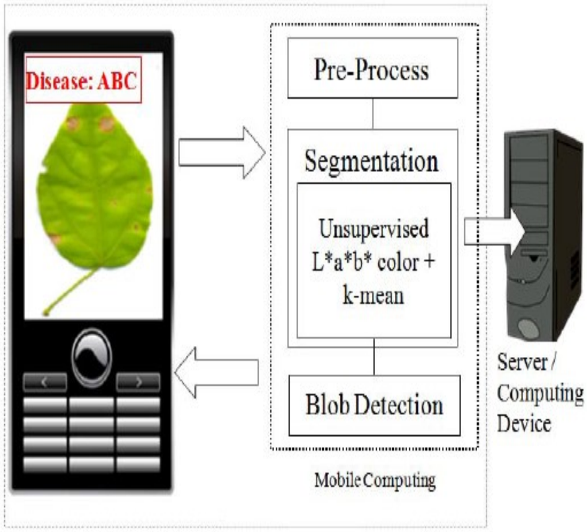

Figure1: Proposed system model

CIE (Comission Internationale de l'Eclairage) L*a*b color model so as to make the input image device independent. The CIE L*a*b color space is n specified by the International Commission on Illumination for use as a reference color model since it is close to the color model visible to human eye. A 5 × 5 averaging filter mask is applied over the L*a*b image to remove unwanted noise. Following this, the clustering algorithm is applied to identify and segment out the three different regions from the input image. Fig. 2 shows all the three clusters in a leaf image where the first cluster is the background with constant intensity value, the second cluster is the green non-diseased portion in the leaf and the third cluster is the region of interest (ROI), i.e. the disease patch in the leaf.

2. Selection of diseased patch

The image of the diseased leaf captured by the mobile device in the field needs to be transmitted to some central server present in the pathology laboratory. In , White et al. captured and transmitted the complete image to a tablet PC located nearby. However, this requires a proper connection and a high speed Internet connectivity. Indian telecommunication technology is still in the developing stage and except in urban places such high speed connectivity is not available. Whereas, the application under consideration is mainly based in rural areas. Thus, transferring a complete image to a server needs a high bandwidth. This is taken care of to some extent by the image cropping step. Among all the diseased patch obtained in a

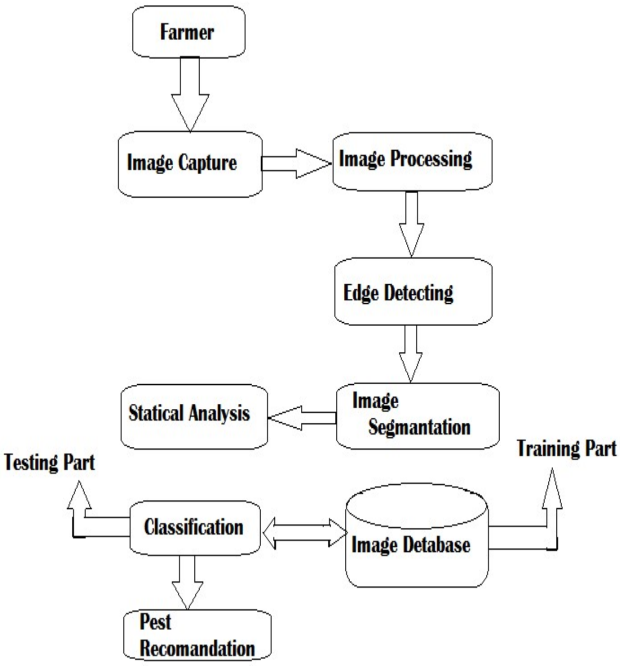

Figure2: Diseases identification System Architecture

Leaf image, the largest size patch is identified, cropped and transmitted. By this, only the relevant part of the leaf image is transmitted while discarding unnecessary portions of the image. Fig. 3 shows a disease patch cropped out of a leaf image. Since the computational requirement of these two steps, viz. segmentation and cropping, is generally not high, the energy consumed in the mobile device is small enough to support the application.

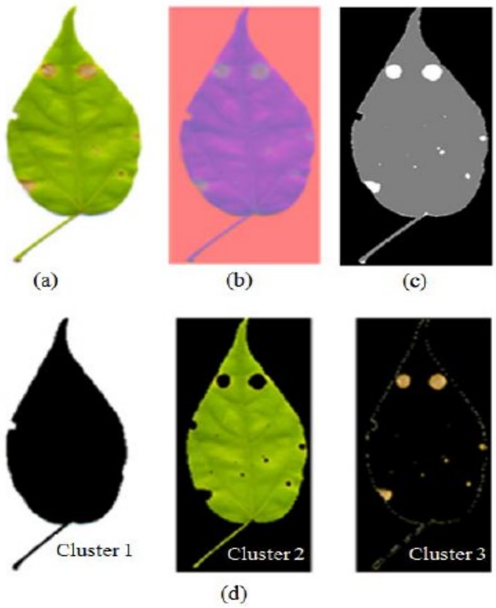

Figure3: Results of leaf image segmentation

3. *Transmission of the cropped image*

Finally, the cropped image is easily transferred to a high processing server or computing device located at the pathology laboratory through a wireless communication channel. The transmission method can be any of the available networks, Fig. 3. The largest disease patch in the leaf image of Fig. 2 cropped out. e.g. 2G, 3G, 4G, Wi-Fi and so on. In order to achieve high transmission efficiency, only the blob corresponding to the largest disease patch is transmitted in color format.

This ensures that no information regarding the disease symptoms is lost. Other than the ROI, all other regions in the cropped leaf image, viz. background and the non-diseased leaf portion, as identified via the clustering process, are of no use for the purpose of disease diagnosis.

Accordingly, we propose to encode every pixel in these regions with a single zero bit thereby reducing the transmission cost both in terms of bandwidth and power.

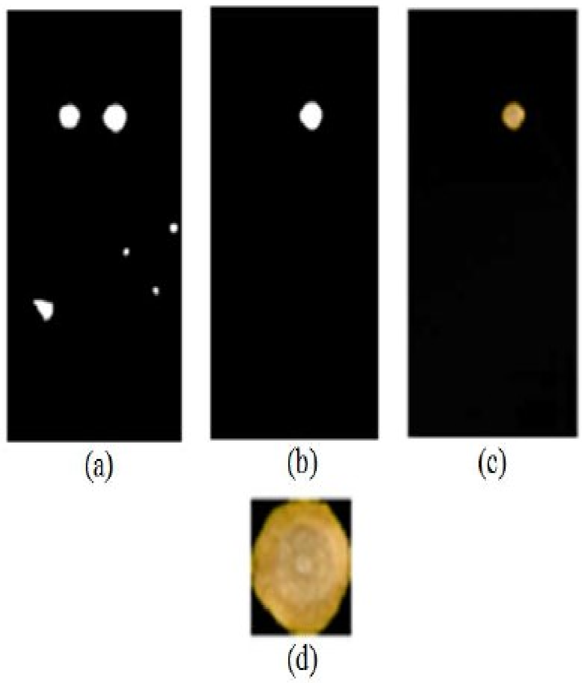

Figure 4. The largest disease patch in the leaf image of Figure 3 cropped out

4. *Energy consideration*

Since mobile devices are battery operated, the energy in both computation and transmission should be conserved. There are three possibilities through which this architecture can reduce the computation and communication cost. They are

1. Compute every operation on the server,
2. Compute feature extraction on the mobile device and analyze it on server using machine learning algorithm,
3. Perform low-level image processing operations such as pre-processing on the mobile device and the rest of the algorithm on the server.

In all of these approaches, transmission media is very much required and a constant connection is important. In respect of power consumption, the first approach will consume less energy but bandwidth requirement will be high. This option requires to transmit the whole image captured by the mobile phone. Hence, a high-speed broad-band connection is required. In India, transmission media is generally very low and thus second approach will be more preferable. Nonetheless, this approach consumes huge battery power. Therefore, the third approach provides a better trade-off between the two. Suppose that the total process of leaf image analysis and disease diagnosis requires C instructions. Also, suppose that the size of the leaf image is D bytes. Let the power consumed by the mobile system be Pc for computing and Pt for transmitting data. If the mobile system performs the total procedure, the energy consumption is

$$Ec = Pc \times \frac{\mathbf{C}}{\mathbf{M}} \quad . \ . \ . \ . \ . \ . \ (1)$$

Where M is the processing speed of the mobile device in terms of instructions per second. If the total procedure is computed in the central server, then the energy consumed in transmitting the whole leaf image is

$$Et = Pt \times \frac{\mathbf{D} \times \mathbf{8}}{\mathbf{B}} \quad . \ . \ . \ . \ . \ (2)$$

Where B is the network bandwidth in bits/sec. Therefore, computing every operation on the server (first option above) is beneficial only when $Ec > Et$.

This requires $\frac{D}{B}$ sufficiently small compared to $\boldsymbol{C}$. Accordingly, offloading is preferred when the available bandwidth B is very large. As proposed in our method, we perform only the segmentation and cropping in the mobile device. Let, the number of instructions involved in doing this is αC, where α < 1. That is, α is the fraction of total computation involved in the segmentation process. Also, let the total data size of the segmented image that is transmitted is βD bytes, where β < 1 is the fraction of the total data after cropping. Then the total energy consumed by the mobile system in our proposed scheme is

$$E_{total} = Pc \times \alpha \frac{\mathbf{C}}{\mathbf{M}} + \mathrm{P_t} \times_{\beta} \frac{\mathbf{D} \times \mathbf{8}}{\mathbf{B}} \quad . \ . \ . \ . \ . \ . \ (3)$$

Partial offloading, as proposed in our scheme, will be beneficial when E_{total} is less than both Ec and Et. Given the parameters M, Pc and Pt of the mobile device and the network bandwidth B, the system requires to calculate Ec, Et and E_{total} and then decide for complete offloading with all computations in the central server (Et minimum), no offloading with all computations in the mobile device (Ec minimum), or partial offloading, as per our proposed scheme (E_{total} minimum). It may be noted from (2) that the channel bandwidth directly affects the energy consumption of a device. The higher the bandwidth, the lower the energy consumption while transferring the image. If the bandwidth is low the energy consumption to transmit the same image is more. Therefore, there is a need to reduce the image size by some means. Accordingly, segmentation plus image cropping is performed, In as described above

Initially, the digital images are acquired from the circumstances using a digital mobile camera. Then image processing techniques are applied to the acquired images to extract RGB Pixel counting features that are necessary for further analysis. After that, some analytical perceptive techniques are used to classify the images according to the specific problem at hand. In this work farmers can take decision immediately at the time. They want to get the best solution to diseases and pest recommendation. Production can be improved, the yield loss can be reduced, they minimum cost of ultimate system very useful to farmers and we can increase the economics of the country. Main farmer's life protects and reduces their burden. Users acquire images of the leaves from the field using sensors and pass it to the computer system which analyze the input images using the homogenous edge detection algorithms and diseases wise the pixels call function logic used for diseases wise detect the affected parts of the leaves to recognize the diseases and then result (recognition of the diseases and pest recommended) is given as output to the farmers in three languages.

5. *Proposed Homogeneous Pixel Counting technique for Cotton Diseases Detection (HPCCDD)*

- RGB image acquisition
- Create the color transformation structure
- Convert the color values in RGB to the space specified in the color transformation structure.
- Apply Color Filtering
- Masking green-pixels
- Remove the masked cells inside the boundaries of the infected clusters
- Find Edge detection (using Sobel and Canny with Homogenous operator techniques)
- Calling the pixel Ranging function to calculate the RGB features (each and every disease)
- Texture Statistics Computation
- Configuring Disease Reorganization and Pest Recommendation.

6. *Evaluation of the Existing Algorithms*

The presented work has taken cotton diseases and control system, WEB-based Intelligent Diagnosis System for Cotton Diseases Control has been developed in BP neural network as a decision-making system to establish an intelligent diagnosis model is 89.5%, and another related work was Thai Herb leaf Image Recognition System used KNN and accuracy is 76%62, next related study Fast and Accurate Detection and classification of plant Diseases used in k-means and NN and found results is 94%.and k-means and ANN is better than other related research studies.

IV. ADVANTAGES

- Protect the crops from the maximum damage.
- Get the real time solution for the plant diseases.
- Save the more time.
- Proper identification leads towards the minimum expanse over the usage of chemicals on the crops.

CONCLUSION

In order to achieve maximum output from the agriculture in minimum time period, so that farmers get proper solution on the time for the particular diseases before the damage to the crop. Introduction of technology in the field of agriculture will surely help to the farmers as well as to the government as the quality of the crop yields will become better and better. The accurately detection and classification of the plant disease is very important for the successful cultivation of crop and this can be done using image processing. Plant leaf identification through the mobile will update farmers with the era of technology. This will surely help to enhance the life style of the farmers.

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