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Novel Image Processing Technique for Feature Detection of Wheat Crops using Python OpenCV

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***Abstract*— The job of this research is to filter the diseased part of the leaf from the leaf images. The authors proposed and implemented image processing technique using OpenCV for separating the diseased part of the leaf from the image of the leaf. Foreground Extraction, Edge Detection, Color filtering and Combination of Edge Detection with Color Filtering is done for wheat images.This novel technique can facilitate the process of the detection of diseases in wheat plants. The system allows to follow a particular pattern of capturing images of plants so that threats will be analysed quickly. Apart from helping humans to detect the diseases in plants, this research work can automate the process of detection without the need of human resources for feeding dataset to model, which is a much reliable process. This research will ultimately contribute in automation of agriculture processes faster and will make farmers to cultivate more in less amount of time.**

Keywords*— *Image Processing, OpenCV 2, GrabCut, Canny Edge Detection, Pre Processing, Feature Extraction.

I. INTRODUCTION

Agriculture is one of the area which plays an important role in Indian economy. Over 69% of population in India, who are residing in rural areas, are having agriculture as main source of income and are completely dependent on it [1]. Agriculture sector provides an ecosystem where different farmers cultivate and produce different crops. This variety in crops is possible due to different weather and soil conditions. Wheat is one of the most popular cultivation crops. Wheat along with rice makes around two thirds of the food consumed by people in the world. There are many problems faced by farmers who grow wheat like rainfall, improper yield, over fertilization, flood damage. One of the important problems in these is the effect of diseases in the crop. Diseases in wheat accounts for about 10-30% of loss in production of wheat [2]. Diseases are also one of the prime reason of expensive prices of wheat today. 1 kilogram in India in 2018 costs about Rs.23. Poor people who cannot afford end up starving or buying adulterated food. This results in the increase of malnourishment. The farmers are sole affected people due to diseases. Farmers have nothing to do with the diseased plants other than to throw them. Reports have stated that even though 72% of people like farming, 69% of farmers think that doing job in cities is better than agriculture and 62% of farmers are ready to shift from village to city. Looking at some of the reasons behind their thought process, 36% of farmers have claimed that farming does not give them appropriate income for sustaining [3].

Many wheat crops have been affected by the diseases and it results in low productivity of crop yeild. One of important thing to note is that many farmers are unable to detect the diseases in the crop until the severe/irrecoverable state of the disease occurs. There are pesticides and fungicides for many diseases which can be cured when the disease is in the initial state. More interesting thing to notice is that, even after huge advancement of technology in the areas of Computer Vision and Machine Learning, such fundamental problems are still not fixed. Hence the goal is to merge the advanced technologies present in Machine learning to help the field of Agriculture for benefitting farmers. Wheat production in India is the backbone of granary in our country and it serves as the major crop alongside the rice.

The outline of the researcher paper is given as follows: Section II describes the related work on Agriculture for the detection of diseases in agriculture based crops. In Section III, the objective of the current work is defined. Section IV provides the various feature detection techniques which are used in this research for wheat crops. The significance of implemneted work has been discussed in section V. Conclusion of this research work is given in section VI.

II. BACKGROUND

Various research works have been carried out in the field of agriculture. In every work, researchers made an attempt to contribute for the better productivity of agricultural crop and save crops from various kind of diseases. Different kinds of Machine Learning techniques have been discussed for the detection of plant diseases [4]. This research suggested to make use of Convolutional Neural Networks for better accuracy and detection of multiple diseases. An attempt has been carried out for the detection of fungal diseases in maize leaves by using features from Haar Wavelets [5]. This research made use of KNN and SVM for detection of diseases and achieved an accuracy of 88% with SVM and 85% with KNN on neighbor size of 5. Novel Computer Vision Technique has been developed for the detection of aphids in wheat crops [6]. This research claims mean identification rate of 86.81% and quite acceptable in terms of comparison with state-of-art. Automatic wheat system has been developed for the detection of wheat diseases [7]. This research claims that the results achieved in this research outperforms the conventional CNN when tested for same parameters. Imaging technique has been proposed for the weed detection of

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vegetable crops [8]. This research has combined existing methods to develop framework for weed discrimination with the consideration of seeding patterns. Advanced machine learning techniques are discussed for the detection of biotic stress so as to protect the agricultural crops [9]. This research outlines the various techniques which are applied for the early detection of plant diseases. An effiecient imaging technique has been proposed for the periodic identification of wheat grains to detect any kind of germination in them [10]. This research achieved prediction accuracy of 93.57% when using least squares support vector machine. High Resolution based imaging technique has been used for estimating the density of wheat crops [11]. This research achieved good results with an average relative error of 12%. Advanced Neural Network is used for the detection of plant diseases [12]. This research put emphasis on early detection of diseases and also unfolded the current challenges and trends. An attempt is made for the detection of diseases in grape leaves [13]. This research used SVM classifier and successfully achieved an accuracy of 88.89%. Image based technique is used for the detection of fungal diseases in plants [14]. This research put emphasis on the early detection of fungal diseases with various symptions under consideration. Image processing technique is used in combination with genetic algorithm for the early detection of regions which are unhealthy in leaves of plants [15]. This research has proposed an approach and use of genetic algorithm in plant leaves disease detection. Accurate Weed identification for precision agriculture is carried out in trained sets [16]. This research used deep learning architecture of CNN for the extraction of crop weeds and claims quite effective in its approach in comparision to works done in state-of-art. Image processing technique has been proposed for the detection of diseases in plants [17]. This research covers acquisition of crop images, and then performs their pre-processing and segmentation and later uses an approach for their classification of detection of diseases. Fuzzy approach and computer vision technology has been used for the leaf disease detection in plants [18]. In this work, features are extracted earlier and then Artificial Neural Networks are used for the classification of diseases. The classification of wheat grains is done using SVM classifier along with SIFT features [19]. This research has developed an automated system for its classification with an accuracy rate of 83.33%. Image processing techniques are applied for the collection and detection of disease related features in rice crops [20]. This work has given an outline for the identification of rice disease detection in agricultural system.

III. Objective of Work

This research work is to use the image processing techniques to filter the diseased portion from the wheat plant. Image recognition is the preferred choice for the filtering of the diseases as diseases affecting the wheat plant change the physical structure of the leaves. Image processing can hence help filter the diseased portion from the image of leaf of the wheat plant. Image processing role in this research can be referred to as the pre-processing part of the machine learning approach to solving problem where the features(diseased portion) can be extracted from the raw data (image). Devices can be used for collecting the images in a periodic interval of time in various locations of the field.

These images can be processed with the techniques for the extraction of feature from the image. OpenCV 2 is the preferred library for image and video processing as OpenCV library is rich source of image processing algorithms and methods. OpenCV 2 is an advanced library available in several platforms comprising of state of the art computer vision and machine learning image processing techniques. OpenCV 2 is an ideal library tasks like face detection, object detection, tracking movements in video and 3D model extraction. The procedure of collection of the images of the leaves of the wheat crop is extremely crucial for the filtering process of the images as some image processing techniques mentioned require the alignment of leaf in certain order in the image for that technique to work. The preferred image collection is the image of one leaf of one wheat plant with blade surface in the center of the image and with mud as the background of the image. The leaf of the wheat crop must be strictly confined to the center of the image and background must not contain images of leaves for accurate results of the image processing techniques.The outline of sample collected images of leaf of wheat plant is shown in Figure 1 and 2.

Fig. 1 Sample Image of Wheat Plant Leaf.

Fig. 2 Sample Image of Wheat Plant Leaf.

IV. FEATURE DETECTION

The feature detection process is divided into 4 phases in terms of Foreground Extraction, Edge Detection, Color filtering and Combination of two or more techniques

A. Foreground Extraction

Foreground extraction is the first stage in the image processing techniques for the disease extraction phase. Foreground extraction is a process in which the entire leaf in the center is extracted from the image. The end result image is the image that has the same dimensions as that of the original image but with blackground completely black, thus removing the entire background. GrabCut is the technique used for the extraction of the foreground from the background. GrabCut techniques uses a rectangle to separate the foreground from the background. The GrabCut technique assumes that the foreground is strictly inside the rectangle mentioned in the image and performs extraction based on the rectangle. The rectangle can vary based on resolution of the image. The accuracy of the extraction is solely dependent on length and width of the rectangle. If the image of the leaf is strictly at the center of the image, then the rectangle's width is small which increases the accuracy of the extraction of the foreground. The foreground extracted image will act as the input image for the rest of the techniques. Extraction of foreground can help remove the unwanted noise from the background which helps improve the results of the disease extraction from the image. Extraction of foreground can make the disease extraction phase immune to background objects, hand intrusions and other leaves in the background that can hamper the results of the other techniques. The application of GrabCut technique on original image and its results are shown in Figure 3 and 4.

Fig 3. Original Raw Image of Wheat Leaf

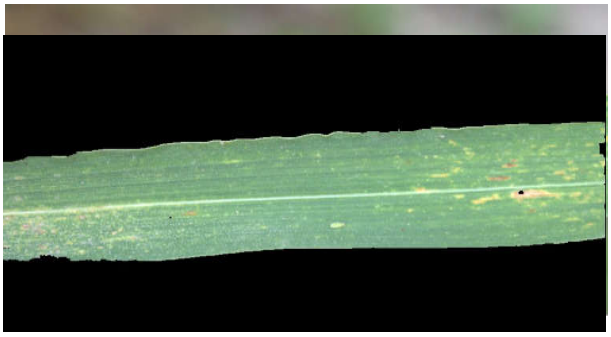

Fig 4. Image after Application of GrabCut Technique

B. Edge Detection

Edge Detection is the stage in the image processing technique in which the textures in the image are extracted in a separate image. The result is a monochrome image of the same dimensions as the original image with white representing the textures in the image and black representing non edges. Edge Detection helps identify the textures inside the leaf, which can help differentiate the healthy leaf with the diseased leaf. A diseased leaf contains more textures in comparison to a healthy leaf. Canny Edge Detection is the technique used for the detection of edges in the image. Canny Edge detection uses threshold values that determine the sensitivity of the edges that are to be detected. The lower and upper threshold values have to be mentioned by the user. Ideal lower and upper threshold values authors suggested for the detection of textures in the leaf image are 250 and 300 respectively.

Edge detection is an extremely useful tool when working with monochrome images which preserves storage and retrive the textures as features for the process of disease extraction. Edge detection is a crucial tool when combined with the next technique that can help differentiate between the diseased part of the image to the textures that are visible due to other factors like dryness or lack of chloroplyll or pesticides. Edge detection does a fantastice work in ignoring the background blurs in the image, which gives good results when GrabCut does not do an ideal job at extracting the foreground. The application of Canny Edge Detection on GrabCut technique resultant image and its results are shown in Figure 5 and 6.

Fig 5. Image after GrabCut Technique

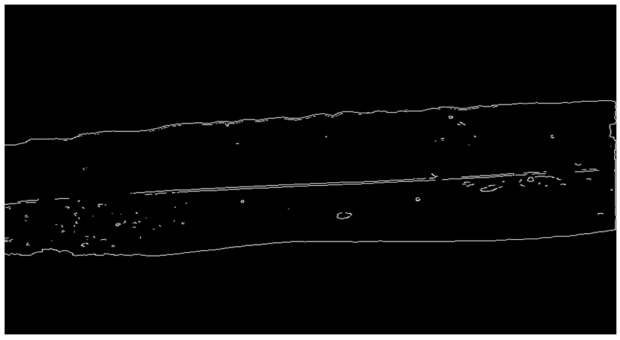

Fig 6. Image after Application of Canny Edge Detection Technique

C. Color Filtering

Color Filtering is a stage in the image processing techniques where the pixels of the image matching a specified color range are extracted from the image. Since all the diseases in wheat plants have a physical appearance on the leaf, capturing that particular color range in by the image can help extract the diseased portions directly from the image.

Each disease requires it's own specific color filteration process. Wheat diseases like Yellow Rust appear as bright orange to red spots on the leaf where as diseases like Powdery Mildew appear as white fungal spots on the leaf of the wheat plant. Methods like inRange function in OpenCV 2 help in color filteration process by mentioning the range of HSV values that help filter the color pixels. InRange function requires the image to be converted to HSV format.

Color Filtering process is crucial for the extraction of diseases from the image of the leaf of a wheat plant. This extraction can help differentiate the diseased portions from the non diseased portions of the leaf. Color filtering can also help identify the possibility of existence of disease in a leaf. The application of color filtering on wheat leaf which is affected with yellow rust is shown in Fig 7 and 8.

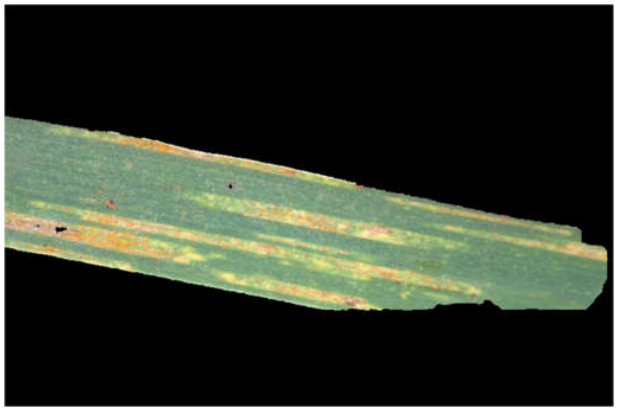

Fig. 7 Leaf Affected with Yellow Rust

Fig 8. Orange and Red Color Filtering applied on the Image

D. Combination of Two or More Techniques:

Combination of two or more techniques can help merge two and more applied techniques into a single image. This method is important for combining several techniques and making a combined useful image. OpenCV 2 considers each image as a matrix of values of each pixel.

Hence combining the results of each technique is pretty much summing the the values of matrices of the results. In extraction of diseases in the images of wheat plant, the combination of results of Canny Edge Detection along with the color filtering results can help differentate the textures of the diseased with that of the textures of non diseased. Texture of diseased portion of the leaf is now filled which determines that the portion of the image is diseased. The result achieved by combining edge detection and color filtering is shown in Fig. 9.

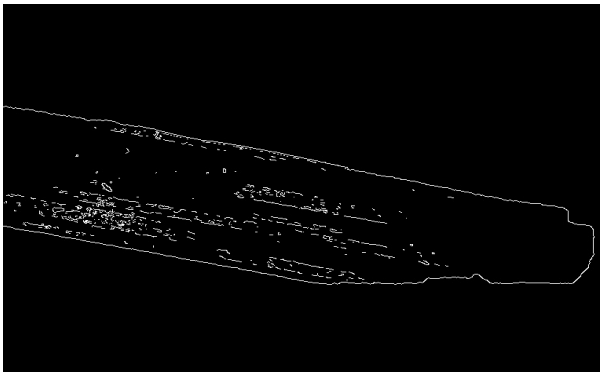

Fig 9. Combination of Edge Detection and Color Filtering.

V. DISCUSSION

Wheat is one of the most important cereal grain in the Indian food market or in fact in the world. A key important issue from a farmer point of view is to continuously improve the yield. From industry point of view or being a researcher one should continue with their effort in improving the quality of the wheat crop. There are number of environmental factors and diseases that affects the wheat crop yield and which results in heavy losses to the farmers as well as to the food industry.

Timely detection of these diseases becomes important from industry as well as from farmer's point of view. With the latest advancements in computer science fields, it is possible to empower the farmers with a technology that helps them in improving their crop yield and monitoring their crop health. In this research work, the major emphasis was drawn on feature detection of leaves of wheat plant so that any uneven changes can be identified for early disease detection. Foreground Extraction, Edge Detection, Color filtering and Combination of Edge Detection with Color Filtering is done for wheat images.

The results in images show marks on the portions where actually images are rusted with diseases. The original images are applied GrabCut techniques which uses a rectangle to separate the foreground from the background. The resultant image is then processed with Canny Edge Detection Technique for identifying the textures inside the leaf, which can help differentiate the healthy leaf with the diseased leaf. Next Color Filtering is applied as all the diseases in wheat plants have a physical appearance on the leaf, so capturing that particular color range in by the image helped in the extraction of the diseased portions directly from the image. Next Canny Edge Detection along with the color filtering is applied to make results in differentating the textures of the diseased with that of the textures of non diseased.

VI. CONCLUSION

In this work, the main aim was to filter the diseased part of the leaf from leaf images. The authors proposed and implemented image processing technique using OpenCV for separating diseased part of the leaf from the image of the leaf.

Foreground Extraction, Edge Detection, Color filtering and Combination of Edge Detection with Color Filtering is done for wheat images. The results in images show marks on the portions where actually images are rusted with diseases. This research work, even with small outcome, will definitely turn handy for certain groups of people to improve their workflow in agriculture sector. This research will help the farmers in early detection of diseases in wheat crop which can help us in the betterment of the crop yield in agriculture.

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