Identification of Various Diseases And Defects In Plant Leaves With Remedies Using Convolutional Neural Network Algorithm

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Abstract- *Detecting whether the leaf of a specific plant is affected by any kind of disease, identifying the type of diseases and any other defects including damages caused by animals and pests, nutrition deficiency and soil issues and then providing the necessary details and their remedies.*

Keywords- Convolutional Neural Network, Binarization, Colour space conversion, Edge Detection, Parameter Tuning, Artificial Neural Network

I. INTRODUCTION

India is fast developing country and agriculture is the back bone for the countries development in the early stages. Nowadays technology plays important role in all the fields but we are using some old methodologies in agriculture till today. In olden days identification is done by the experienced people manually but due to the so many environmental changes the prediction is becoming tough. So we can use machine learning techniques for identification of plant disease. Generally the symptoms of disease on leafs, stems, flowers etc. can be observed. So here we use leafs for identification of disease affected plants.

II. METHODOLOGY

1. Preprocessing:

The first step is to preprocess the input image of the plant leaf. There are four steps in preprocessing the image.

- Colour Normalization
- Edge Enhancement
- Colour space conversion
- Median filtering

Colour Normalization is used to neutralize the effects due to illumination, various lighting conditions across the images. It is used to reduce the variations.

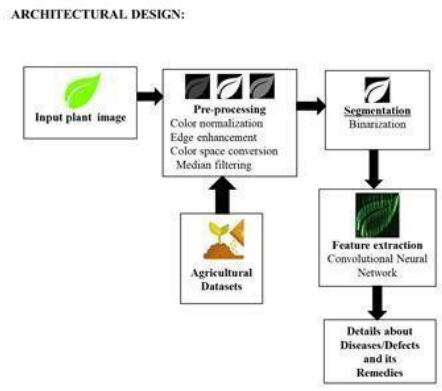
Enhancement is done for detecting the edges in the plant leaf for outlining the leaf object. It is done by using Edge Detection Algorithm.

Space conversion is done to transform the input plant leaf image from RGB to HSV model for efficient detection of affected portions.

Filter method is used in the detection and removal of noises in each and every pixel thus making the filtration process effective, then HAAR wavelet transform is used in extracting the features. Affected crops is identified through Machine learning. Depending upon the severity the classification is done. Convolutional Neural Network Algorithm is used for Predicting the disease. The resulting image is well suitable for further processing.

Before processing the image, agricultural datasets are also given as input along the input plant leaf image.

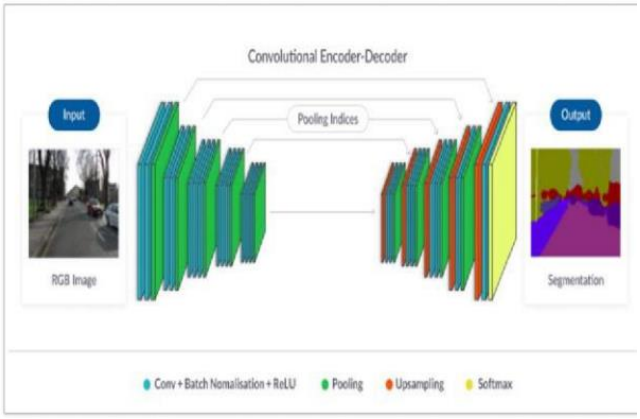
Agricultural datasets include nutrition required in necessary amounts, essential soil type, optimum temperature, humidity and chlorophyll range with respect to given plant leaf. Analysis can be made to check for nutrition deficiency and ensure whether it meets the constraints for optimum temperature and humidity levels, soil usage, chlorophyll range to detect the defects in plant irrespective of infections due to any kind of disease. If the plant leaf meets all the criterias for a healthy plant, then analysis can be made for detecting whether the plant is infected with disease and identifying the type of disease and providing remedies to recover and protect the plants.



Architectural design for plant leaf disease analysis

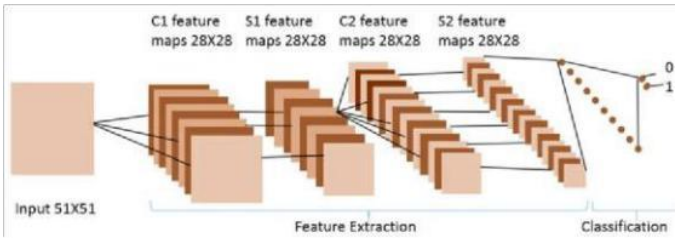
2. Segmentation:

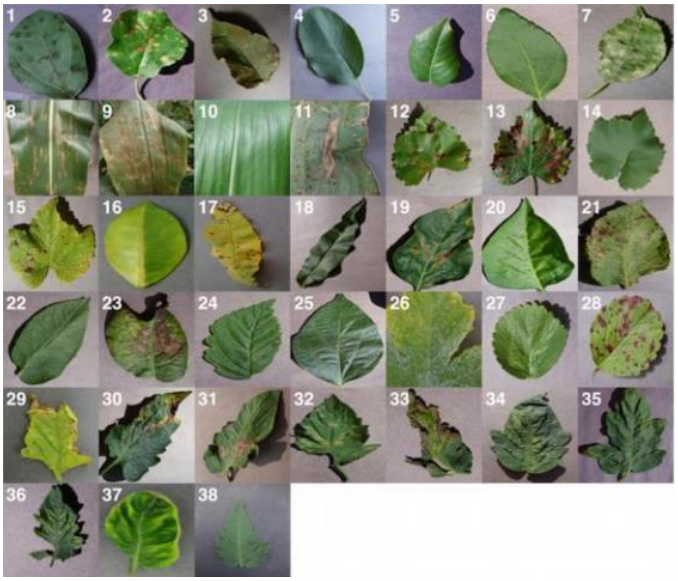
Binarization is done for the pre-processed image. The image is converted to grey-scale with black and white tones. The pixel values less than 167 are made 0 (white) and the pixel values greater than 167 are made 1 (black). The black and white images are suitable for analysing the image for affected areas.



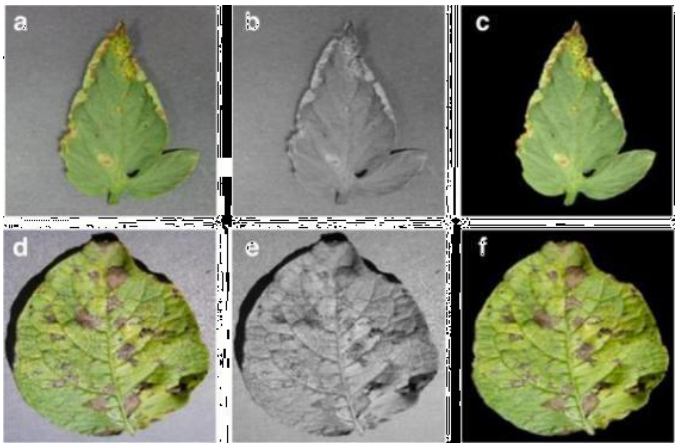
3. Feature extraction:

Feature extraction and classification is done natively by convolutional neural network (CNN) algorithm. The CNN algorithm takes the processed image as input and then transformed into array of pixel values in the convolutional layer and sent to activation layer. In the activation layer, relu activation function is used to replace negative values with 0 values since negative values is not processed. In the pooling layer, max-pooling is used where maximum value is considered from each 2x2 matrix in the batch of entire set of matrix values.





Different leaf samples used



Processing images using segmentation

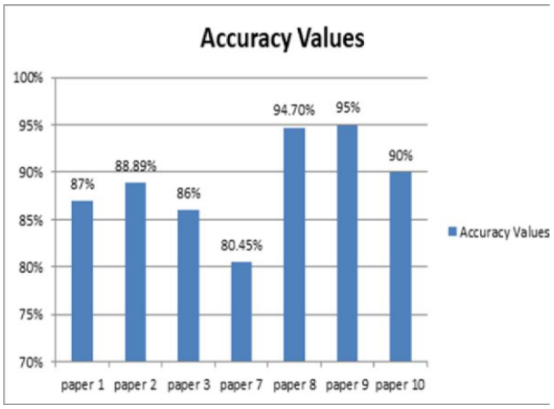
Image (a and d) showing the actual colour image of the leaf. Image (b and e) shows grey-scaled image of the leaf. Image (c and f) shows the segmented leaf.

Analysing images of affected leaf in plants

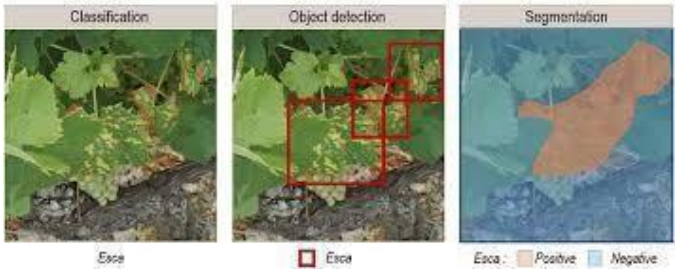
The affected portions in the image are recognized by and detects whether the plant leaf is infected with disease. If the plant leaf is affected, then the type of disease is identified and remedies are provided with respect to disease. It also provides information about the defects in the plant such as nutrition deficiency, temperature, humidity, chlorophyll levels and soil usage.

III. RESULTS AND DISCUSSIONS

The accuracy for this method is estimated as 99% compared to other methodologies. The previous paper makes mainly rely on image processing whereas in this method, machine learning is purely involves. Mainly Deep learning is implemented with CNN algorithm. Deep CNN supports huge amount of datasets for training but depends hugely on GPU resources. The GPU acceleration enables higher efficiency and processing huge datasets at faster rate.



Accuracy graph



Recognition of affected areas in plant leaf

CNN makes use of better classification and recognizes effectively. Median filtering algorithm is used in pre-processing to remove noises and grains in images to improve quality of the image. Results confirmed that this method works well by recognizing diseases even with blurry images and low light images with higher accuracy.

1V. CONCLUSION

This method is very scalable. It is extensible to use with huge amount of datasets in the future. The image datasets for various diseases for wide variety of plants can be included and only trained enough to be used to recognize in the future.

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