Automated Weed Removal System Using Convolutional Neural Network

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Abstract : Weed removal process is a vital part in the agricultural fields. The usual way to remove the weed is time-consuming and also requires more manual labor work. The aim is to remove the weeds in agriculture fields automatically. The proposed work is used to detect the weed which is grown between crops using a deep learning technique and remove the weeds by an automatic cutter. The deep learning is used to analyze the relevant features from the agricultural images. The dataset is trained for the classification of weed and crop. In deep learning Convolutional Neural Network(CNN) uses the convolutional layer with a ReLU function for extracting the features of an image and uses a max-pooling and fully connected layer with ReLU to classify the weed from the crop. The pre-processed image is applied to the CNN network. From the resultant image, Region Of Interest(ROI) is extracted and also extract some features for training. After training, the classification is done. Thus the weed is detected using a deep learning network. In this,100 images are trained to improve accuracy.

Keywords: Weed Classification, Shape Features, Contour property, Convolutional Neural Network.

I. INTRODUCTION

Agriculture is the backbone of India and the village people depend on agriculture and the profit of plants and vegetables will depend on the yield production. One way to get more profit, to remove the weed from the crop. The conventional way of weed removal is a time-consuming process and also requires more labor for removing weed from the crop. The use of herbicides affects the plant, soil. So, it is proposed to use an automated method to remove the weed in the crop. In automated method, the image is captured by the camera. Once the images are captured, preprocessing of images are done and the features are extracted. Based on the features, the network is trained for classification. Once the weed is identified, the controller operates the motor to cut the weed. The rest of this paper describes the existing work, methodology, classification and experimental results.

II. RELATED WORKS

An automated method is used to remove the weed with the help of image processing[1]. Here ragi plant is used for classification. The morphological operation like erosion and dilation method is used to extract the Region of Interest (ROI) [2]. It is converted into a binary image to calculate the number of white pixels to differentiate the weed. The drawback of this paper the robot is placed only for good light conditions to capture the images. To use the machine vision algorithm to classify the weed and crop[3]. Here the cornfield is used to classification. The corn leaves are broad than the weed leaves, it is extracted using the wavelet transform techniques [4].

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But in the different light conditions, it cannot be able to classify. To use the morphological operation to extract the textural characteristics like mean, standard deviation, uniformity. Based on that feature to use support vector machine (SVM) to classify the maize crop to get an accuracy of 82%[5]. To identify the weed in the cornfield using a probabilistic neural network (PNN)[6].To apply the excess green method to distinguishing the plant and soil. Shape features like area ratio, aspect ratio, etc., for classification. The weed and crop image are recognized using an Artificial neural network (ANN) [7]. Here to apply the morphological operation for extracting the feature. To use the support vector machine(SVM) is used to classify the different leaves[8]. Here to use contour property for extracting features from an image. The different leaves have a different contour property for classification. The existing method only trained for specific crops and weed with several assumptions and fail to identify some of the real-time images. The objective of this paper, Collecting the data for different crops and weeds which includes data variability and helps to detect weeds irrespective of soil and illumination conditions. In this work, the dataset is collected in a real-time.

III. METHODOLOGY

The data is collected in different illumination conditions and the images with only weed and images with only crop are collected. Also, the single frame images have both crop and weed images are collected. First the network is trained using the single weed and single crop image. And testing the data. Once it is correctly classified, the image like both weed and crop is given to predict that which is weed or crop.

A. Data Preparation

The image is resized into 250x250. The resized image is given to the contrast enhancement that is to multiply each pixel value by 0.9 factor. After that, Gaussian noise is added to the image. Then, noise is removed using a Gaussian filter[9]. Applied the excess green method to extract the green part of an image using equation 1. With the help of green part, the soil and plants are recognized. Then it is converted into a binary image using otsu's thresholding [10][11]. It tries to find a threshold value t that

minimizes the weighted within-class variance given in equations 2 and 3.

$$Y = 2G - R - B \quad (1)$$

Where R, G, B represent the color of an image.

$$\alpha_w^2(t) = q1(t)\alpha_1^2(t) + q2(t)\alpha_1^2(t) \quad (2)$$

$$q1(t) = \sum_{i=1}^{t} p(i) \;\&\; q1(t) = \sum_{i=t+1}^{I} p(i) \quad (3)$$

Where q1(t) and q2(t) are the weights that are separated by threshold t.α_1&α_2 represent the variance of the two classes. t represents the number of bins in the histogram.

B. Feature Extraction

The shape characters are different for different kinds of crops. Based on the shape features the weed is differentiated from the crop. Here to extract the features, area, perimeter, Eccentricity are calculated[12]. The area is considered for finding the number of white pixels in a binary image. With the help of counter feature, the bounding box is drawn to find perimeter, eccentricity. Here the monocotyledon weed is similar to some of the crops. It is differentiated using the AreaRatio, AspectRatio in Equations(4) & (5).

$$AreaRatio = \frac{area}{Maximumdiameter * Minimumdiameter} \quad (1)$$

$$AspectRatio = \frac{Maximumdiasmeter}{Minimumdiameter} \quad (2)$$

C. CNN Classifier

The convolutional neural network is the one way to do image recognition, image classification, and detection. Four main layers are used for classification. In CNN, the trained images and test image are given as input to the convolutional layer. Here, the image features are extracted with the help of the kernel matrix. The different filters are used like to find edge detection, blurring of image. Each pixel of an image is multiplied by the filter matrix with the given stride number. The stride is used for a number of shifts over the input matrix. Then a ReLU function is used to introduce the Non-Linearity of an image. It used to convert the negative value to zero for reducing the over-fitting problem. After that, a pooling layer is used to reduce the dimensionality of the matrix. Here, max-pooling is used to take the largest element in the matrix to rectify the feature map. Finally, a fully connected layer with some activation function like sigmoid and softmax is used,to give some probability value for an image. Based on that probability the classification is done. In this work, the CNN is used with convolutional layer with ReLU function to extract the features from an image. Max pooling is used to reduce the size of the matrix to avoid an over-fitting problem. Finally, the fully connected layer is used to multiply the input matrix to the sigmoid function for the classification. Fig 1 shows

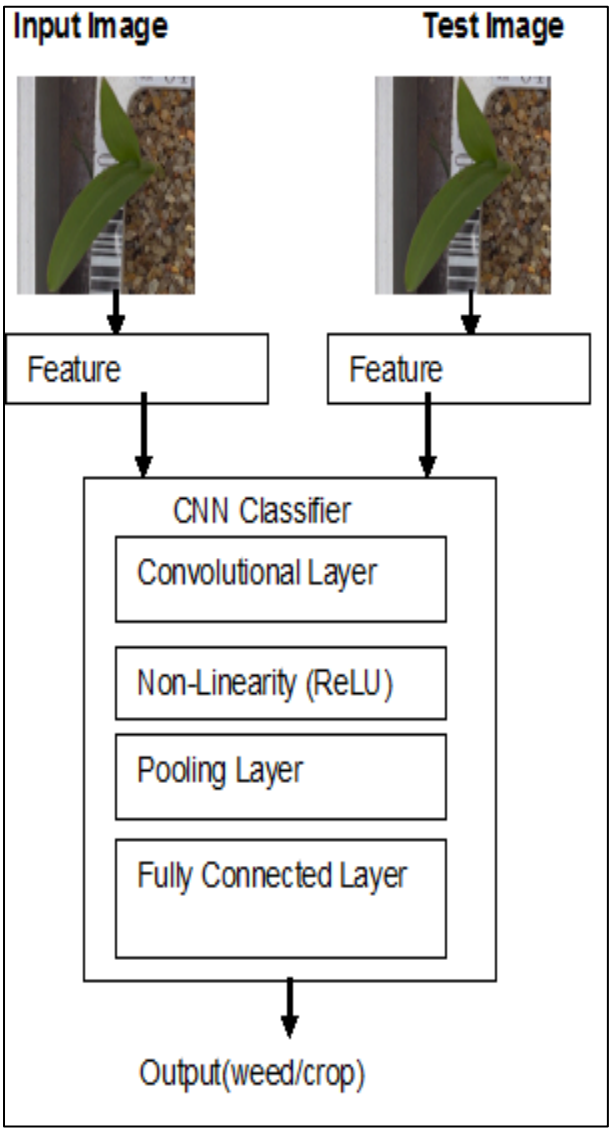

Fig 1: *Classification Model*

IV. EXPERIMENTAL RESULTS

This section describes the experiment results on CNN.

A. Experiments

Python programming language is a used for implementation of this work. The experiment is run by Jupyter notebook with the help of OpenCV, Keras and TensorFlow packages. The Jupyter is an opensource web application to create and edit the document in three different languages that are R, Julia, and python. Keras and TensorFlow is an important package to create a neural network and help to develop this framework in deep learning.

B. CNN

The input size 250x250x3, is given to CNN. Here, 250x250 is the size of the image and 3 is a dimension. With the help of OpenCV, images are imported. The data augmentation is done in this work. Fig 2 shows the data augmentation.

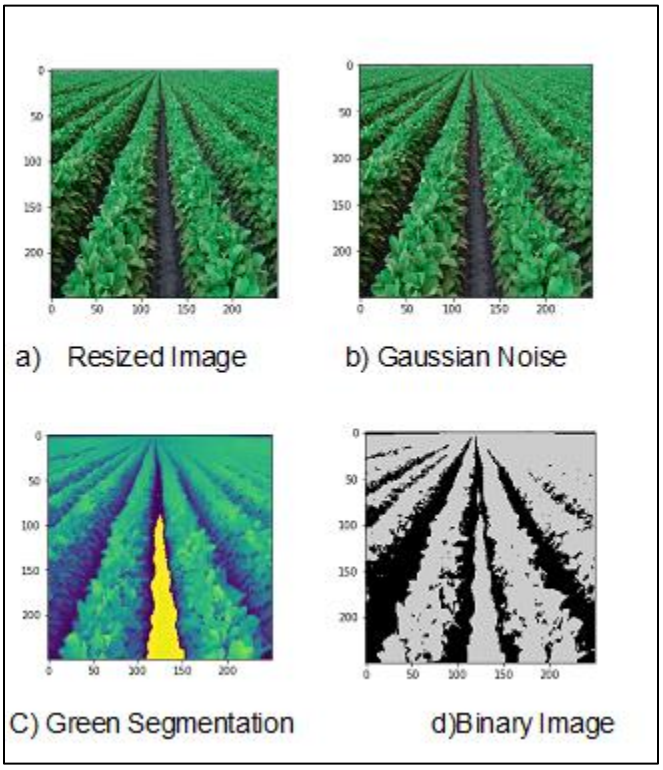

Fig 2: *Data Augmentation*

After converting intothe binary image, the area is calculated. The area is considered for finding, number of white pixel values. The perimeter and eccentricity are calculated with the help of contour property.

V. ANALYSIS OF RESULT

Weed and crop are classified based on the features only. In this work, the area, perimeter and eccentricity values are calculated. The values are differed for crop and weed. Based on this value the classification is done.

VI. CONCLUSION:

The classification of weed and crop is used to detect the weed and remove it by using automated cutter to improve the productivity of the crop. CNN is used to extract the more relevant features of an image. The future work is to develop an automatic process.

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