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# WEED DETECTION USING DEEP LEARNING TECHNIQUES: A Review

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*Abstract:- In recent years weeds are responsible for agriculture losses. To overcome this, the farmers have uniformly spray whole field with herbicides. But, the process of spraying herbicides affects the environment. The identification and classification of weeds are of major technical and economical importance in the agriculture industry. To control and prevent specific weeds, deep learning techniques are used. The classification is done by fully connect layers of CNN model. The main aim is improving accuracy of weed detection by applying deep learning techniques.*

***Key Words:*** *Weed detection, Deep learning,, Convolution neural network, Agriculture.*

## I. INTRODUCTION

As the world population increases, so does the demand for food. India accounts for 7.68 percentage of total agriculture output. One of the problems faced by Indian agriculture is not been able to use right amount of herbicides to eliminate weeds. Crops are considered one of the nutrient dense-food all around the world due to its sufficient vitamins, minerals and antioxidants. Weeds compete with crops for water, sunlight and nutrients, leaving them to insect and disease. A considerable amount of research has been conducted on various machine vision techniques for weed detection. One of the machine vision techniques is Support Vector Machine (SVM). Deep learning is one of the newest and most studied technologies nowadays. It is a tool used to build intelligent systems as close to human brain as possible.

Weed considered one of the most destructive constraints for production of crops, and efficient weed control will increase crop yield and food production. The organic products of vegetables requires non-chemical weed control. Thus, hand weeding is primary option for weed control. With the labour cost is increased, development of a visual method of discriminating between crop and weed is an important and necessary step towards ecologically sustainable weed management

## II. LITERATURE SURVEY

This paper uses Site-specific weed management (SSWM). Site-specific weed management is the part of precision agriculture (PA) that tries to effectively control weed infestations with the least economical and environmental burdens. This can be achieved with the aid of ground-based or near-range sensors in combination with decision rules and precise application technologies. These technologies focus on identifying plants and measuring their physiological status with the aid of their spectral and morphological characteristics. Cameras, spectrometers and distance sensors are the most prominent sensors for PA applications. The objective of this article is to describe-ground based sensors that have the potential to be used for weed detection and measurement of weed infestation level. An overview of current sensor systems is presented, describing their concepts, results that have been achieved, already utilized commercial systems and problems that persist. [1]

In this paper Weed can be detected by using machine vision techniques. Machine vision uses special image processing techniques. Weeds in agricultural field can be detected by its properties such as Size, Shape, Spectral Reflectance, Texture

features. Here we are demonstrating weed detection by its Size features. After the image acquisition Excessive green algorithm is developed to remove soil and other unnecessary objects from the image. Image enhancement techniques are used to remove Noise from the images, By using Labeling algorithm each components in the Image were extracted, then size based features like Area, Perimeter, longest chord and longest perpendicular chord are calculated for each label and by selecting appropriate threshold value Weed and Crop segmentation is done . Result of all features is compared to get the best result. [2]

In this weed is detected from crops by using image processing. Then we will give the inputs of the weed areas to an automatic spray pesticide only in those areas. For this, we need to take a photograph of the field with good clarity to detect the weeds with more accuracy. Taking a photograph can be done by attaching a camera to a tractor or taking them manually. Then we will apply image processing to that image using MATLAB to detect the weed. We can detect and separate out weed affected area from the crop plants. The reason for developing such system is to identify and reuse weed affected area for more seeding. This specific area can be considered for further weed control operations, resulting in more production. [3]

In this paper, we describe different classification techniques like SVM, NN, DA and methods like Otsu's, 2G-R-B which are used to differentiate weeds and crops. We analyze all the features of these methods and techniques. After study all the characteristics of classification techniques we have decided to go with Artificial Neural Network because ANN is robust and suited for complex as well as incomplete data. Thus, we can conclude that image processing is non-invasive and effective tool which can be applied in the domain of agriculture with great accuracy for analyzing agronomic parameters. [4]

This paper shows an application for computer vision to detect unwanted weed in crops from one region with more agricultural impact in Colombia. We took images in different crops, wanting estimate population degree from species. An Image processing was developed to obtain regions of interest were finally processed through neural networks. It is important that the images taken are crops that are in early stage in order to generate a possibility of detecting possible for weed control. The feed-forward neural network had an acceptable behavior, compared to the analysis of neurons in the hidden layer that allowed for significant percentage of success for classification among plant species. [5]

This paper intends to focus on the survey of weed detection using image processing in agriculture field. This paper proposes two methods: crop row detection in images from agriculture fields with high weed pressure and to further distinguish between weed and crop. Firstly, for crop row detection the image processing consists of three main processes: image filtering, image segmentation using Otsu's method, and crop row detection. Secondly, further classification between weed and crop, is carried out by using box plotting technique. The prototype can be developed as a system implemented via web interface and android technology with more accuracy in the coming years of research in this topic. [6]

The objective of this work was use Convolutional Neural Networks (ConvNets or CNNs) to perform weed detection in soybean crop images and classify these weeds among grass or broadleaf, aiming to specific herbicide to weed detected. The large number of group images are captured by drone. With this photographs, an image database was created containing over fifteen thousand images of the soil, soybean, broadleaf and grass weeds. The CNN used in this work represent a Deep learning architecture that achieve remarkable success in image recognition. For the training neural network the CaffeNet architecture was used. A software was developed, through which the use of the superpixel segmentation algorithm SLIC, was used to build a robudt image dataset and classify images using the model trained by Caffe software. As a result, this work achieved above 98% accuracy using ConvNets in the detection of broadleaf and grass weeds in relation to soil and soybean, with an accuracy average between all images above 99%. [7]

Unmanned aerial vehicles (UAVs) are becoming an interesting acquisition system for weed localization and management due to their ability to obtain images of the entire agricultural field with a very high spatial resolution and at a low cost. However, despite significant advances in UAV acquisition systems, the automatic detection of weeds remains a challenging problem because of their strong similarity to the crops. A deep learning approach has shown impressive results in different complex classification problems. However, this approach needs a certain amount of training data, and creating large agricultural datasets by an expert is an extremely time-consuming task. In this paper, a novel fully automatic learning method using Convolution neuronal networks (CNNs) with an unsupervised training dataset collection for weed detection from UAV images. These method comprises three main phases. First, we automatically detect the crop rows and use them to identify the inter-row weeds. In the second phase, inter-row weeds are used to constitute the training dataset. Finally, we perform CNNs on this dataset to build a model able to detect the crop and the weeds in the

images. The results obtained are comparable to those of traditional supervised training data labeling, with differences in accuracy of 1.5% in the spinach field and 6% in the bean field. [8]

Several deep convolutional neural networks (DCNN) were constructed for detection of different variety of weeds growing in perennial ryegrass. When the networks were trained using a dataset containing a total of 15,486 negative (images contained perennial ryegrass with no target weeds) and 17,600 positive images (images contained target weeds), VGGNet achieved high F1 scores (≥0.9278), with high recall values (≥0.9952) for detection of weeds growing in perennial ryegrass. The F1 scores of AlexNet ranged from 0.8437 to 0.9418 and were generally lower than VGGNet at detecting weeds. GoogleNet is not an effective DCNN at detecting these weed species mainly due to the low precision values. Thus, VGGNet had the highest Matthews correlation coefficient (MCC) values, while GoogleNet had the lowest MCC values. Overall, the approach of training DCNN, particularly VGGNet and DetectNet, presents a clear path toward developing a machine vision-based decision system in smart sprayers for precision weed control in perennial ryegrass. [9]

In this paper a method called CRowNet which uses a convolutional neural network (CNN) and the Hough transform to detect crop rows in images taken by an unmanned aerial vehicle (UAV). The method consists of a model formed with SegNet (S-SegNet) and a CNN based Hough transform (HoughCNet). The performance of the proposed method was quantitatively compared to traditional approaches and it showed the best and most robust result. A good crop row detection rate of 93.58% was obtained with an IoU score per crop row above 70%. Moreover the model trained on a given crop field is able to detect rows in images of different types of crops. [10]

This paper presents three methods for weed estimation based on deep learning image processing in lettuce crops, and we compared them to visual estimations by experts. One method is based on support vector machines (SVM) using histograms of oriented gradients (HOG) as feature descriptor. The second was based in YOLOV3 (you only look once V3), taking advantage of its robust architecture for object detection, and the third one was based on Mask R-CNN (region based convolutional neural network) in order to instance segmentation for each individual. This method are completed with a NVDI index (normalized difference vegetation index) as a background subtractor for removing non photosynthetic objects. Once the weed image was obtained, the coverage percentage of weed was calculated by classical image processing methods. Finally, these performance were compared with the estimations of a set from weed experts through a Bland-Altman plot, and Dunn's test to obtain statistical measurements between every estimation, we found that these methods improve accuracy on weed coverage estimation and minimize subjectivity in human-estimated data. [10]

This paper develops to classify the malignant melanoma and benign classification by using back propagation neural network .the initial stage is image acquisition pre-processing. The feature extracted by advanced image of symmetry recognition, border detection, shading and dimension discovery. Neural network can give the multi classification result. Here the back propagation is the hidden layer. In this section they examine the ABCD dermoscopy innovation for early prediction. [11]

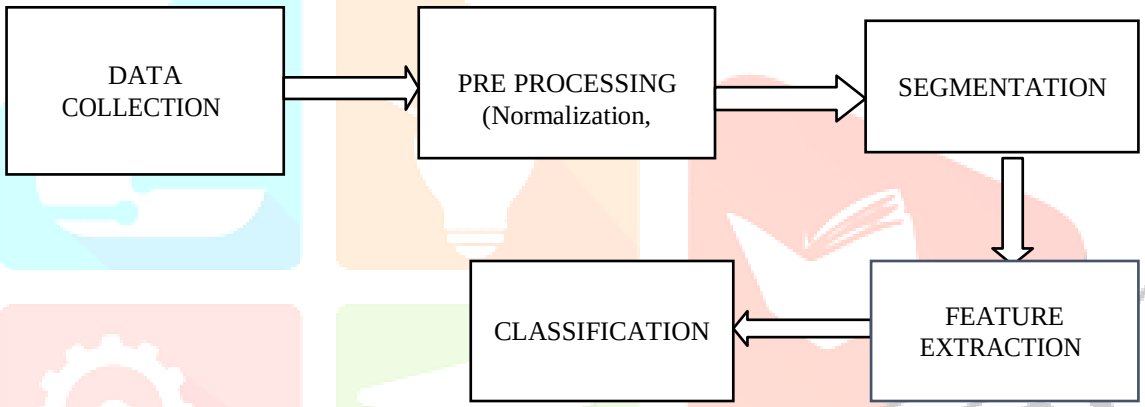
To control and prevent specific weeds, a method of detecting the weed is presented in this paper. By collecting plants and weed dataset which are grayscale images, data is divided into training, validation, and testing datasets and then transported to the covolutional neural network. Based on knowledge gained by the model, it can detect the weeds among plants. Utilization of a pre-trained VGG16 model for weed detection in dense cultures demonstrated improved performance compared to state of the art without the need for large datasets and high computational power for training. [12]

This paper proposes a new method, which combines deep learning and image processing technology. Firstly, a trained CenterNet model was used to detect vegetables and draw bounding boxes around them. Afterwards, the remaining green objects falling out of bounding boxes were considered as weeds. In this way, the model focuses on identifying only the vegetables and thus avoid handling various weed species. Furthermore, this strategy can largely reduce the size of training image dataset as well as the complexity of weed detection, thereby enhancing the weed identification performance and accuracy. To extract weeds from the background, a color index-based segmentation was performed utilizing image processing. The employed color index was determined and evaluated through Genetic Algorithms (GAs) according to Bayesian classification error. During the field test, the trained CenterNet model achieved a precision of 95.6%, a recall of 95.0%, and a F1 score of 0.953, respectively. These method yields high segmentation quality with a much lower computational cost compared to the wildly used ExG index. These experiment results demonstrate the feasibility of using the proposed method for the ground-based weed identification in vegetable plantation. [13]

In this paper detection of weeds in the sugar beet crop, using air-borne multispectral camera sensors, which is considered as an alternative crop to sugarcane to obtain sugar in Pakistan. We developed a new framework for weed identification; a patch-based classification approach as appose to semantic segmentation. Our approach converts 3-class pixel classification problem into a 2-class crop-weed patch classification problem which in turns improves crop and weed classification accuracy. For classification, we developed a new VGG-Beet convolutional neural network (CNN), which is based on generic VGG16 (visual graphics group) CNN model with 11 convolutional layers. For experiments, we captured a sugar beet dataset with 3-channel multispectral sensor. We observed that patch-based method is more robust to different lighting conditions. To produce low cost weed detection system usage of Agrocam sensor is recommended, for higher accuracy Red Edge and Sequoia multispectral sensors with more channels should be deployed. We observed higher crop-weed accuracy and lower testing time for our patch-based approach as compared to U-Net and Deeplab based semantic segmentation networks. [14]

This paper assesses the growth rate of weeds due to macronutrients (nitrogen, phosphorus and potassium) absorbed from various soils (fertile, clay and loamy) in the rabi crop field. The weed image data have been collected from three different places in Madhya Pradesh, India with 10 different rabi crops (Maize, Lucerne, Cumin, Coriander, Wheat, Fenugreek, Gram, Onion, Mustard and Tomato) and 10 different weeds. Intel Real Sense LiDAR digital camera L515 and Canon digital SLR DIGICAM EOS 850 D 18-55IS STM cameras were mounted over the wheat crop in 10 × 10 square feet area of land and 3670 different weed images have been collected. The 2936 weed images were used for training and 734 images for testing and validation. The Efficient NetB7 and Inception V4 architectures have been used to train the model that has provided accuracy of 97% and 94% respectively. The Image classification using Inspection V4 was unsuccessful with less accurate results as compared to EfficientNet-B7. [15]

## III. METHODOLOGY




My proposed work to do weed detection and classification using deep learning techniques. The work is implemented in python platform. Online dataset of weed is used here. Various noises and unwanted background objects or images are suppressed using filtering techniques. Weed features are properly analyzed and extracted using feature extraction process and groups the weed and crops separately in classification procedure. Convolutional Neural Network technique is used for feature extraction. Several texture features know as energy, entropy, size, shape, red, green and blue color features are used to analyze the weed features. Classifiers are trained first, then validated and finally tested for many images using convolutional neural network.

## IV. CONCLUSION

In this article, we introduced a survey of some papers and their classification and detection of weeds in varies method. The different papers conclude that early detection of weed making increasing productivity in agriculture field. Here we can see there are lot papers represent different types of algorithm for classify the weeds and also some advanced technology gives more accurate values. The automated weed detection of research work are also be seen. We are expecting that our work gives more accuracy and better result in future work.

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