A Review on Weed Identification using Image Processing Techniques

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***Abstract*—Agriculture always has a chief role in economy as well as it is also considered to be the backbone of economic system for developing countries. It is the important source for food and fabrics. Weeds are also plants but they are unwanted. Weeds compete with crop plants and take away nutrients and various factors. This can lead to the reduction in production of crop plant, land value will also get reduced. Previously, weed removal was done manually. Lot of time was needed for identification and removal of weeds. With the advancement in technology new methodologies where image processing was done in order to reduce human intervention was proposed. Accuracy of this systems was the major issue faced. In this review paper, different image processing techniques for weed detection is discussed.**

Keywords- Image Processing, Feature Extraction, Segmentation.

I. INTRODUCTION

Any plant considered to be unwanted in a particular place is called as a weed. Weed is also familiar for its aggressive growth rate. For some extent weeds can be beneficial but in major cases they are considered to be unwanted. Weeds compete with crop plants for resources like sunlight,water,soil nutrients etc. Weeds are also a big shelter for animal pests. This all factors leads to the degradation of yield of the desired plant.

Weed control methods vary according to the growth habit and their context. Different types of weeds are shown in fig.1.That is,different methods of weed control may be used on a food crop versus a fiber crop. Weeds can be categorized by their life period. They can be grouped as annuals or perennials.

Different weed species are also there, they can be identified based on different parameters like shape,color,size,native livelihood etc.

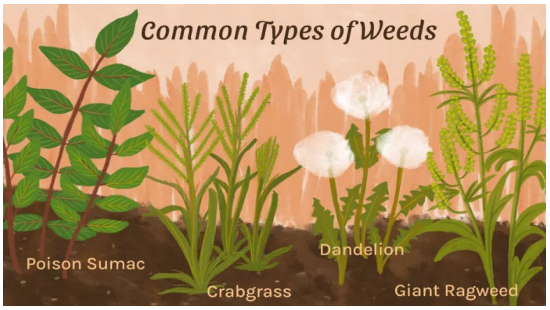

Fig. 1: Different Types of Weeds

II.METHODS

In Fig. 2 shows the different methods used for weed identification using image processing:

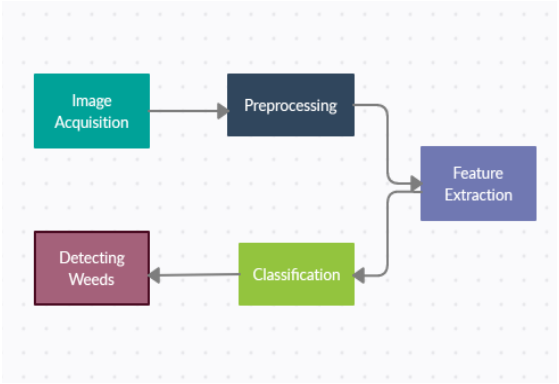

Fig. 2: Block Diagram

A. Image Acquisition

This is the first step of an image processing system. The aim is to transform an optical image (real-world data) into an array of numerical data which can be later manipulated on a computer. Images can be achieved by the help of suitable cameras. Images can be collected from online sites(GitHub).Obtained images are stored in respective size and in jpg format.

B. Image Pre-Processing

This phase is used to remove the unwanted factors that can affect the image like noise, lightning conditions, unnecessary objects etc. This process includes resizing,color corrections and orienting but not limited to it. Gray-scaling can be applied here, this helps to analyze more model performance in a timely manner.

C. Feature Extraction

This step is done in order to make the data set more manageable. Most important part of that particular image is captured more effectively. Shape parameters, contour and skeleton features are calculated. This can be used for classification.

D. Classification

For the classification of weeds. Input to the classifier are feature vectors. Different attributes can be verified. The classifiers are trained, validated and tested using images of different weed. Artificial neural network, probabilistic neural network genetic algorithm etc. are some commonly used classifiers.

III. LITERATURE REVIEW

In 2017, Alessandro dos Santos Ferreira et.al.[1] proposes a developed software that performs the detection of weeds in soybean crop images. The SLIC algorithm can be an efficient segmentation tool for images, in addition to the optimizing time spent in the construction of the image data set. The data set built is composed of more than fifteen thousand images of soil, soybean and weeds. The ConvNets achieved excellent results, with accuracy higher than 98% in the classification of all classes. The NN advantage is that their results are not dependent on the choice of good feature extractors. The use of ConvNets can count on the recent benefits of the rapid increase in processing power and memory. Future works can be to address the evaluation with a image data set covering a greater range of variables. The Convolutional Neural Networks used in this work represent a Deep Learning architecture that has achieved remarkable success in image recognition. For the training of Neural Network the CaffeNet architecture was used. Available in Caffe software, it consists of a replication of the well known AlexNet, network which won the ImageNet Large Scale Visual Recognition Challenge 2012 (ILSVRC2012). A software was also developed, Pynovisão, which through the use of the super pixel segmentation algorithm SLIC, was used to build a robust image dataset and classify images using the model trained by Caffe software. In order to compare the results of ConvNets, Support Vector Machines, AdaBoost and Random Forests were used in conjunction with a collection of shape, color and texture feature extraction techniques.

In 2020, Muhammad Hamza Asad et.al [2] proposed a methodology to develop and accelerate manual labeling of pixels using a two-step procedure. The first step is to background and foreground are segmented using maximum likelihood classification, and in the second step, the weed pixels are manually labeled. Then this labeled data is used to train semantic segmentation models, which classify crop and background pixels as one class, and all other vegetation as the second class. This evaluates the proposed methodology on a high-resolution color images of canola fields and makes performance comparison of deep learning meta-architectures like SegNet and UNET and encoder blocks like VGG16 , ResNet-50 etc. Gating a relationship between weed densities and soil characteristics helps to facilitate variable herbicide prescription for different soil zones.

In 2020, Rincy Johnson et.al.[3] proposed an automatic weed detection technique based on image processing and removal of weeds is also done. The entire system for management was a created on a four-wheeled robot. The system is deployed in the field where spinach was cultivated in a proper row wise order. The vehicle can move in the real field for collecting data. Color images with required quality was obtained from the fields using Pi Camera. Images are captured sideways, not from the top portion only. Image processing focused on the plant size and color, than their shape and is done by the Raspberry Pi board. Weeds growing among the crops were detected successfully. This entire process is automated which reduces a lot of manual effort or man power. The main advantage of this system is that weeds are identified and can be selectively removed.

In 2021, Atshaya G. et.al [4] proposed an algorithm for image advanced processing that consist of loading the image from source, color segmentation, and edge detection. Color segmentation is the method used to separate the crop from the background. This helps in separating all the visually distinguishable colors from one another The algorithm used for segmentation is K-Means Clustering, The desired image after color segmentation consists of green color and the remaining part of image black, making the image feasible to the step in the process, edge detection. To detect edges properly we have to convert the color segmented image into the gray scale image. The image after both color segmentation and edge detection is left in white and the remaining part completely Black. Color segmentation, edge detection make the image ready for the next step called filtering. The filter is used for recognizing regions in which edges appear with a frequency in a specific range. Here the image after the edge detection in above step as input. Threshold is a type of image segmentation, where we change the pixels of an image to make the image easier to analyze. Converting an image from color or gray scale into a binary image is done. This 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. Identification is based on their shape, color, texture and size features after image processing. Prior work has documented the high accuracy considering various other parameters such as texture, genes, etc.

In 2021, Xiaojun Jin et.al.[5] proposes a new method which combines deep learning and image processing technology for weed detection. A CenterNet model was used to detect vegetables and for drawing bounding boxes around them. The green objects falling out of bounding boxes are considered as weeds. The model focuses on identifying only the vegetables than weeds. This can largely reduce the size of training image data set and enhance system the weed identification performance and accuracy. To extract weeds from the background, a color index-based segmentation was performed utilizing image processing techniques. This color index was used to determine and evaluate Genetic Algorithms (Gas). The trained CenterNet model achieved a precision 95.6%, a recall 95.0%, and a F1 score 0.953. Future work can be conducted to identify weeds from live or recorded videos.

It would also be interesting to evaluate the accuracy reached in the detection of vegetables by optimizing the deep learning model.

Table 1: Table of Review

Sl.No	Title	Author	Method
1	Weed detection in soybean crops using ConvNets	Alessandro dos Santos Ferreira et.al.	CNN,SLIC,shape, color and texture feature extraction techniques
2	Weed Detection and Removal based on Image Processing	Muhammad Hamza Asad et.al	Segmentation & labeling
3	Weed Detection and Removal based on Image Processing	Rincy Johnson et.al	Color,size,shape,
4	Weed Detection Using Image Processing	Atshaya G. et.al	Color Segmentation
5	Weed Identification Using Deep Learning and Image Processing in Vegetable Plantation	Xiaojun Jin et.al.	Color index-based segmentation ,Genetic Algorithm

IV.CONCLUSION

This paper presents a review on weed detection using image processing techniques used for agricultural context. Processes like segmentation, feature extraction and clustering can be employed. There is a need to select the most appropriate techniques to assist decision-making. The image processing techniques are used across a vast range. The accuracy of classification varies depending on the resolution of images and limitations of image acquisition. Different factors can affect the image quality like lighting condition,noise etc.

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