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AI Enabled Weed Detection AND Farmer Aiding System

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Abstract: Agriculture is the mainstay of human food in this world. Today with a growing population, we need to increase the productivity of agriculture a lot to meet the requirements. (Hodgson JM. The nature, n.d., p. 1) In the old days they used regular methods to increase production, such as using cow dung as fertilizer in fields. This has resulted in increased productivity sufficient to meet the needs of the population. But later, people started thinking of getting more profit by getting more results. Then came a revolt, dubbed the "Green Revolution". After this ancient use of a toxic, lethal herbicide has risen to an extreme level. In doing so, we achieve success in productivity growth, but we have forgotten the damage to the environment that will raise questions about our livelihoods in this beautiful land. So in this project, we implemented some methods to reduce the use of herbicides by only spraying them in areas where there are weeds. In this article, we implement image processing using MATLAB to define weed areas in an image we capture from fields.

Keywords: image processing, planting, weed detection, spot spraying.

Introduction: Use of natural resources and inputs that include soil, water and fossil fuels, the basis of agricultural production. Therefore, the conservation, optimal use and efficient management of these natural resources is fundamental to facilitate efficient use of resources in agriculture in the Indian scenario. India has a cultivated area of 141.58 million hectares, which accounts for 46% of its total geographical area. The average farming intensity in India is 140.54%, while the net irrigated area is less than half the net cultivated area at 63.6 million hectares. The use of NPK (nitrogen - phosphorus - potassium) per hectare was 128.34 kg in 2012-2013, which is lower than in 2010-11, although there was a massive increase in fertilizers after the Green Revolution period. The total consumption of pesticides increased over the years to reach 56,091 thousand tons in 2012-2013 (Ministry of Agriculture 2013a).

This rapid expansion, combined with the essential role of food in our society, has created an economic area exclusively dedicated to monitoring and predicting trends in the agricultural market landscape. The basic principles of macro and microeconomics apply to agriculture, as well as to the presence of external factors such as climate change and food health.

In this article, our main goal is to detect weeds in the crop using image processing. Then, we will be feeding the inputs from the grassy areas into a robotic fogger to only spray in those areas. For this we need to take a picture of the field with good clarity for more accurate weed detection. A picture can be taken by connecting the camera to the tractor or by taking it manually. We will then apply image processing to that image using MATLAB to detect weeds. In this article we applied two methods to detect weeds. These are: 1. Weed detection between rows 2. Weed detection between plants The final result will contain the weed areas that we will provide as input to the automatic sprayer, which is performed using an "Arduino uno" controller.

Problem Statement: Weed plant detection is a new research problem in agricultural field which want to take help from computational knowledge to distinguish unwanted growth of weed along with other crops/plants. Usually in farming when we farmers grew something due to soil property and pre available micro seeds extra development of weeds is there which spoil the actual outcome of farming as they affect the growth of implanted plants. So weed detection is problem of indeed identifying the area of weeds so that specific areas can be maltreated for squirting with minimum spraying on the other plants of interest. In recent years, as the world population growth, existing land and natural resources decreased, the meticulousness agriculture is increasingly capturing more attention of the researchers. Image processing strategies could be applied to solve this problem.

Background: With the increasing world population, although we have enough but no agricultural products. It is the need for new smart agricultural methods to increase or maintain crop yields while reducing. Environmental impact. Precision farming techniques achieve this through spatial scanning. Key indicators of crop health and treatment application, p. Herbicide and pesticide,Fertilizers, only in related areas. In this case, automated systems can often be used as Effective platforms replace tedious manual procedures. Specifically, a weed remedy is A critical step in independent farming, as it is directly related to crop health and productivity.

Challenges: Reliable and accurate detection of weeds is a prerequisite for effective treatment Because it allows subsequent operations, p. the previous. Selective sealing, spot and mechanical spraying,Plowing, while minimizing damage to surrounding plants. However, marijuana needs. The disclosure presents many challenges. The traditional object-based classification approaches are It will likely fail due to the blurred boundaries between crops and weeds, as shown in the figure below. he is Appearance also prevents naming of manual data required for supervised learning Algorithms.

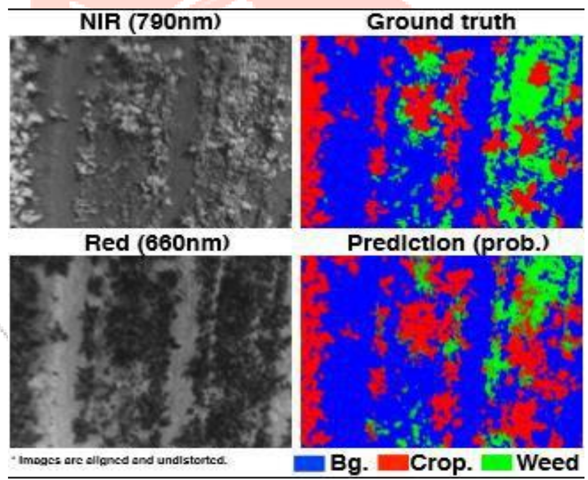

Figure 1;

Methodologies:

I. The literature suggests that the method for detecting weeds can depend on the location and characteristics of the edge.The weeds under the target can be easily, quickly and accurately separated from the target my knowledge. In this way we can solve many technical problems related to micro-pesticides And in the navigation system for agricultural vehicles.Typically, a weed photo has three elements of soil, crops, and weeds. So, A weed detection method, where the proposed literature is divided into three steps, namely soil Bottom segmentation, cropping and weeding.The proposed approach is based on changing the background color of the crop soil, vegetation and weeds Pictures. These images consist of a red, green, and blue component. Three components (RGB) Pictures are merged according to specific combination (2 * G-R-B) to make original picture. If the image turns gray, then the gray intensity of green crops increases And the bottom of the earth is tied. On the other hand, the difference in the intensity of gray is expanded. In this case, an appropriate slide threshold is used. Thresholds are used for segmentation Gray Pictures. The 3-component RGB merging method is shown below:

$$f(i,j)=\begin{cases}0 & 2G(i,j)<R(i,j)+B(i,j)\\ 255 & 2.5G(i,j)-R(i,j)-B(i,j)>255\\ 2.5G(i,j)-R(i,j)-B(i,j) & \text{ot her}\end{cases}$$

In the formula, R(i,j), G(i,j), B(i,j) are distinguished represent the value of RGB 3-component of point (i,j). f(i,j) is the gray value after image changing gray.

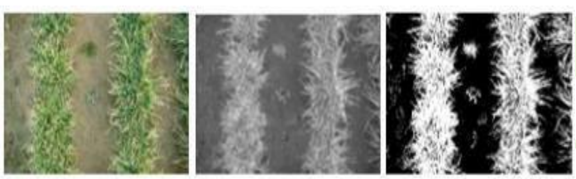

Figure 2;

Once the green plant is separated from the soil bed, the next step is to extract the weeds between the rows of plant pixels. Due to the green color represented by both crops and weeds, it is difficult to separate them by color characteristic. There is a case of folded and topped leaves between crops and weeds between rows, so you also have some difficulty identifying weeds between rows using the property of shape or texture. According to the position feature in which the seed crops are arranged in rows and the edge of the row is essentially fixed, an efficient approach to identifying weeds between the rows of the seed crops is provided.

Weed detection approach based on position and edge characteristics is: First, the pixel graph method to create the centerline of crop rows, through Roberts operators to detect edges, the edge of the crop row is highlighted. Then, from the pixels of the crop centerline, the pixels belonging to the crops or weeds are determined by analyzing according to the characteristic rows on both the left and right, until they reach the edge of the crop row.

II. A new crop and weed classification system based on a complete convolutional network with an_encoded-coded structure and includes spatial information by. Exploitation of the information on crop disposal that can be observed from the image sequence allows our system to strongly estimate the classification of pixel images in crops and weeds, i.e. semantic segmentation. (philipp lottes, p. 3) A FCN-based sequential classification model for the semantic segmentation of pixels for classes (1) of background, i.e. mainly soil, (2) crops (sugar beet) and (3) weeds. The basic idea is to make use of the information on plant,which is provided by the planting process. We let the classification model this information from the image sequences that are part of the cut row and combine the layout information withfeatures.With his new combination,we can improve the performance and generalizability of our ratinsystem. (philipp lottes, p. 3)

III. Through morphological processes, many morphological features of_corn plants and weed species common to the place have been extracted. The effective properties of maize and weeds were analyzed through a discriminant gradient analysis. Of the seven characteristics used in the analysis, four were sufficient to classify the two target groups of grasses and maize. These shape properties were fed to artificial neural networks to differentiate weeds and main crops. 180 images of maize plants and four common weeds were collected under normal field conditions. (s.kiani, A.jafari, p. 4)

IV.

Convolutional neural network is a proprietary algorithm used for deep learning. It is used to detect the fragmentation of objects and images. They learn to extract features from the image without manual help. A convolutional neural network can contain tens or hundreds of layers that learn to discover the various properties of an image. (Mrs. R. Dhayabarani, 2018, p. 4) Filters are applied to each training image with different resolutions and the output of each wrapped image is used as input for the next layer. Filters can start out as very simple features, like brightness and edges, and grow in complexity to features that uniquely define an object as layers progress. The segmented image will be processed with CNN using ReLU and clustering to differentiate the intensity of the segmented portion of the image. Deep learning is easier in MATLAB. A minimum amount of code will be required to generate code in deep learning. You can quickly import pre-trained models. MATLAB allows users to place interactive markers on objects within images and can automate the_tagging of field truth within videos to train and test deep learning models. This interactive and automated approach can produce better results in less time. (Mrs. R. Dhayabarani, 2018) They used CNN's imaging functions to train an SVM multilayer classifier. The Rapid Gradient Descent Solver is used for training by setting the Learners parameter of the function to Linear. This helps speed up training when working with high-dimensional CNN feature vectors.

V.

The proposed approach includes two processes: (1) image extraction and labeling, (2) construction and training of our neural network. (karthik kantipudia, pp. 4-5) In the image extraction process, the sub-images are extracted by cutting the original images into sub-images. Each sub-image is then tagged based on the annotation images provided. In the following process of constructing the network architecture, a convolutional neural network model is implemented using 20 layers consisting of an image input layer, four two-dimensional convolutional layers, six linear-corrected unit (ReLU) layers, four assembly layers with a maximum two-dimensional, three fully connected layers, One-layer softmax, and a final sorting layer. Several sub-sets of images collected by different sizes of sliding windows were passed into this grid to determine the best sliding window size resulting in higher weed detection rate and less crop wastage. After calculating the ratios between the true rate of weed detection and the crop waste values for each size of the sliding window, it was found that the size of the sliding window [80 80] resulted in the maximum ratio with a true rate of detection of weeds and yield. The waste values were 63.28% and 13.33%, respectively.

VI. These results reveal that the size of the sliding window [80 80] was able to predict real weed areas in the crop field images with 63.28% accuracy causing the least damage to crops because the crops were predicted as weeds.

Experimental Design: The pixel removal method introduces a sliding window and by counting the number of black and white pixels in the window to determine whether or not it reaches the edge of the cropping area. Pixels in the window. The process of the algorithm is shown below:

1) Binary image edge detection

2) Create a W window (3 x 3 or 5 x 5, etc.),

3) Adjust distance parameters such as minimum distance, maximum distance (dmax), and scan binary image incrementally with W.

4) Calculate the total number of white pixels in the sliding window.

5) If Sw of W is less than the threshold M and the distance between point C and midline dc> dmin, meanwhile, C is the boundary point detected in step (1), continue to define the current line as it does not reach the edge of the growth region. Repeat steps (4) and (5) until the stopping conditions are met.

Modules:

1). Crop Classification using CNN Model

2). Artificial and Organic Pesticides suggestions

3). GPS module to alert users
4). Farmer – Centric Market Place

1). Crop Classification using CNN Model:
This module will contain a CNN Model for each crop supported by the system. The user can select their crop and then scan their field and run it on our system to find out weeds in their crops. (Zhong, p. 5)

As of now we will be building a model to support 2-3 crops. The models will have a plain CNN architecture so that regular farmers can use it using their existing infrastructure (mobiles, handheld camera) without over-fitting the data. Later the model can be expanded to R-CNN to support drone infrastructure to locate the position of weeds remotely.

2).Artificial and Organic Pesticides Suggestions : This module will suggest the Artificial and Organic Pesticides for the weeds. This module can be selected manually by the user by inputting the desired weed. This system automatically suggests the pesticides after the scanning of the crops using the Crop Classification Module. (Bahlai CA, 2010)

3).GPS module to alert users :

This module stores the GPS location of detected weeds (with user's consent) and then alerts the nearby farmers who are registered with the system about the weeds discovered so that they can take precautions.

4). Farmer Centric Market Place : This module contains a market place where registered farmers can list their agricultural products directly. Any users either registered or not can directly view agricultural products available in their region and can contact the farmer using the details they provided in the Market Place Module. This module only intends to be a place where farmers can list their products, all the transactions following after will take place between the farmer and buyer directly.

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