DETECTION OF WEED IN AGRICULTURAL FIELD USING FLOOD FILL ALGORITHM

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***Abstract*:** Management of weed is one of the main factors that increase the production cost of crops. They do a reduction in yield, inefficient utilization of machinery can cause a psychological disorder in agriculture. Thus weeds need to be controlled in an efficient manner. In this paper, an image processing approach is used for detection of weed. There are two primary sections of the proposed system segmentation and specialization. Segmentation is used thresholding and for differentiation flood fill algorithm is used. The developed algorithm based on flood-fill method has been tested on various sample images and an efficient result is obtained. The overall procedure is implemented in OpenCV python.

***Index Terms*—- Agriculture, Weed Detection, Crop Row, Image processing, Segmentation, Flood Fill Algorithm**

I. INTRODUCTION

Agriculture plays one of the most important role in the economy of countries. For this reason government, researchers and farmers are looking for new techniques towards lowering the production cost [1]. One of the most significant and the costliest labour in agriculture area is weed controlling [6]. Weeds are unwanted plants that compete with the main crop yield for water and soil nutrient. Weeds are distributed non-uniformly within a field and they bring more loss to farmer than other natural factors. According to a study, India loses agricultural harvest of over $11 billion annually. Thus weed management is most important in any crop production system [9].

Usually, farmers remove weeds by spraying weedicides or herbicides uniformly to whole field. Consistently a lot of herbicides are utilized for expelling weeds from fields. Herbicides have side-effects on the environment and bring risk to human health. Thus weed must be handled in an appropriate manner. Today, software and hardware technologies are quickly growing with the increase in production, research and designing etc. [11]. Various technologies like image processing, computer vision, artificial intelligence etc. are used for detection of weed.

There are various detection algorithms in image processing like edge detection, color detection, wavelets classification etc. The vast majority of the weed identification approaches have three primary stages- 1) image acquisition and segmentation 2) image smoothening and other operations 3) feature extraction to differentiate weeds and crops [6].

Usually in an agricultural field one basic type of weed classification is done physically by size of weed leaf. Weeds with wide leaves like Clover, Coltsfoot, Galinsoga and weeds having narrow leaves like Toadrush, FieldWoodrush, Pearlwrot and many more
In agriculture research, two types of weed detection algorithm is developed. [13]

1. Inter-row weed detection- this method is applied where weed is present in between the rows of the crop.
2. Interplant weed detection- this method is applied where weed is present in between the plants in the row.

In this paper, we proposed an image processing inter-row weed detection method which uses flood fill algorithm to separate weeds and crops.

Through this project our main objectives are-

- To efficiently detect weed in crop field using image processing.
- To decrease the utilization of herbicides by showering them just in the influenced region where weed is available.
- To reduce labour and production cost by using chemicals only in affected area.

The rest of this paper is structured as follows - Section III describes the proposed image processing approach in detail. Section IV discusses the result obtained and in the last Section V conclusion and future work is presented.

II. RELATED WORK

Various Research work have been applied to solve this problem. Artizzu et al. [1] presents a computer vision system for classification of weed patches and crop row. The whole system is divided into two-phase, a fast image processing (FIP) phase for real-time implementation and robust crop row detection (RCRD) phase for accurate processing. Firstly, RCRD phase occurs which performs all the operations needed for correct detection of weeds and produces a binary image as output which works as input for next FIP phase. FIP extract crop row from the input image and weed pixel is successfully determined.

Hossein Nejati et al. [6] proposed a method which uses a Fast Fourier Transform and leaf edge density for weed detection. The system is made to classify weeds from crops on the basis of specific structure of leaf. The method is applied on corn field and achieved 92% accuracy.

Su Hnin Hlaing et al. [5] developed an image processing approach for weed detection based on area. The whole system is mainly divided into three parts : segmentation, classification and error calculation. The developed algorithm is based on area thresholding and tested on various location. This system has 33 % error rate.

In Varalakshmi R et al. [4] a weed detection approach is offered in which weed is identified by looking at the circular convoluted weed image and preloaded test set images of weed. Here, video of the farm is recorded and then this video is segmented into frames. Each frame obtained is sharpened, made to undergo gray scale conversion then vegetative region is segmented. After that obtained gray image and weed sample image is circular convoluted with a unit matrix. Finally convoluted images are compared and if 85% of the value matched then the presence of weed is confermed.

Shubham lavanial et al. [7] developed an image processing method for detection of weed in maize field using Otsu and PCA implementation. The main idea of this method is double thresholding. The whole system works in two step. Firstly, crop row is detected and then distinction between weed and crop is carried out .In this paper first thresholding is done for identification of crop row and then second thresholding is applied for distinction between weed and crop. There may be chances that presence of weed is more than the threshold value so in that case PCA is applied for further classification.

Manisha Joshi et al. [11] proposed an algorithm for automatic weed detection and developed an herbicide sprayer robot using CATIA. The system tested on field where weeds have narrow leaves and crops have broad leaves. The whole process is done using machine vision approach. Wavelet transform has been used for image compression and classification of weed and crop are based on morphological size base techniques.

In Ashitosh K Shinde [9] a machine vision approach is used for weed detection. Here weed is detected on basis of size. Labelling algorithm is used for extracting components from the image, then for each label feature like perimeter, area, longest chord etc. are determined and then weeds are identified.

III. PROPOSED SYSTEM

The proposed system includes the following four steps.

i. Image Acquisition
ii. Segmentation,
iii. Filtering and Masking
iv. Detection of weed using Flood Fill Algorithm.

The whole system can be shown with the help of block diagram –

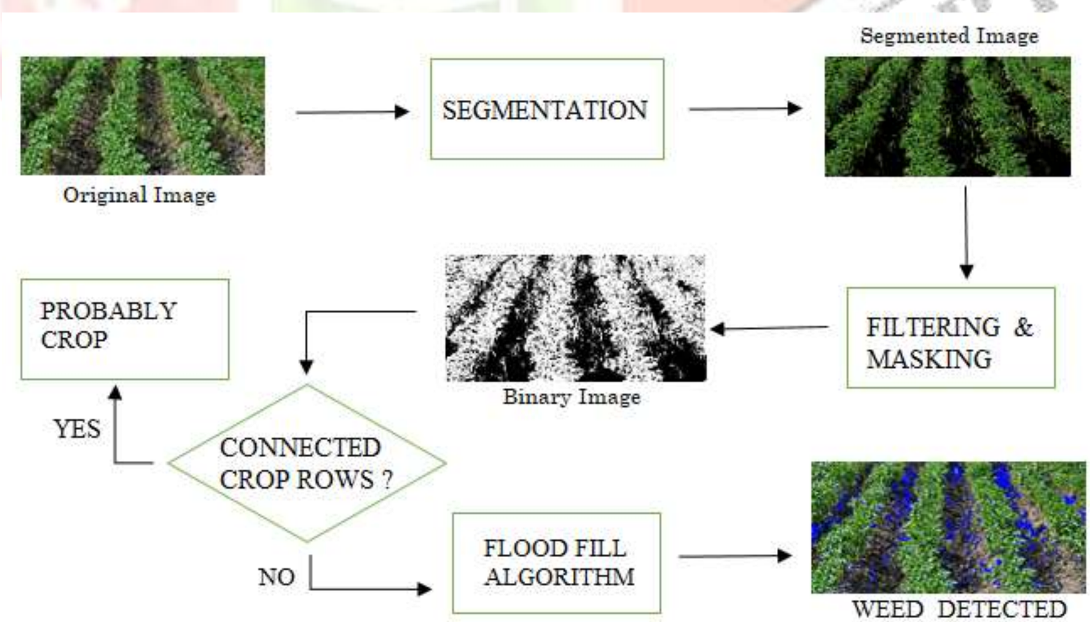

Fig 1: Flow Diagram of Proposal

3.1 Image Acquisition

In this Research, the initial step is to get the image of the farm. These images are utilized as the contribution to the framework. The weed and crop images are captured with the help of a digital camera. The sample images are caught in the field with a resolution of 5MP and stored in 24 bit JPG format in RGB color space. Images are obtained at different times of a daytime. The images were processed with OpenCV Python on Window 10 Operating system and Intel i3 CPU, 1.70 GHz processor.

3.2 Segmentation

After image acquisition, it is important to remove the redundant information from the captured image and segment the image into vegetation and non-vegetation region. Different methods are available for segmentation like threshold-based segmentation, region-based segmentation, edge-based segmentation, etc. For our project, we choose threshold-based segmentation because it is simple, does not require preprocessing and it also takes less time for execution. Upper and Lower threshold for vegetative green region is found to be RGB [40,80,33] and RGB [255,255,102]. Any pixel having intensity within this specified threshold range is segmented. Only the segmented green vegetative pixels are produced in the image. Pixels that do not have intensity in the specified range are made to have zero intensity in segmented image.

In segmentation, excess green color is extracted. For this following method is developed [9]-

$$Outimg(x,y,c) = \begin{cases} inimg(x,y,c), & inimg(x,y,r) < inimg(x,y,g) \text{ and } inimg(x,y,b) < inimg(x,y,g) \\ 0, & Otherwise \end{cases}$$

where outimg(x,y,c) is output image after segmentation, inimg(x,y,c) is input image and x,y are coordinates of the pixel and c is the primary color of the pixel. The result after segmentation is shown below.

Fig.2: Original Image

Fig. 3: Image after Segmentation

3.3 Filtering and Masking

Images are often corrupted by the random variation in intensity, illumination or have poor contrast and can't be used directly. And then for that purpose filtering is performed to get less noisy and sharpened image. A high-pass filter is employed to get an image look sharper. It is observed that filtering also helps in smoothening the edges of the segmented image. Image masking is performed for extracting only the green region of the image. The second reason to mask image is to prevent artifacts arising from dividing the background by background values. Masking of an image makes a binary image where the segmented vegetative green pixels are produced to be binary 1 and the rest is binary 0. The masked result is presented in fig-4 which has pixel intensity value "0" (background) or "1" (green color object).

3.4 Detection Using Flood Fill Algorithm

The final masked image is used as input to the weed detection phase. After masking, binary image is obtained. Now onto this binary image Flood Fill Algorithm is applied to differentiate between weeds and crop. Weeds are detected on the basis of their connectivity with the crop rows.

Flood Fill is an algorithm that determines the area that are connected to a given node in a multi-dimensional array. Usually, flood fill is used to color an entire area of the connected pixel with the same color. Here, a starting pixel is selected which is known as seed and recursively more and more seeds are planted if they possess the right color. Each new seed is responsible for coloring the pixel at its position, and testing for new pixels around it that have to be distorted. Various flood fill algorithms are available, for example 4-way, 8-way, scan line based etc. In this paper 4-way, flood fill algorithm is used. The flood fill algorithm takes three parameters: a start node, a target color, and a replacement color. The algorithm operates in a recursive way. Firstly, starting position is given and a new color is assigned at this position. Then new seeds are planted at its 4 neighbors to continue the recursion. Each of these new seed again repeat the whole procedure if they satisfy following condition-

- The pixel is inside the screen.
- The pixel has old color.
- The pixel does not receive the new color.

Masked image contains pixels of both crop and weed having intensity one. We start our procedure with the topmost pixel row of the image. On scanning the topmost row from left to right as soon as we find the white pixel we call the flood fill algorithm that recursively set all 4-connected pixel to intensity 0. As the Flood Fill procedure stops, we resume our hunt of white pixel in the topmost row in the same left to right manner and repeats the same process. This finally halts and sets all the connected parts of the crop rows to zero intensity, leaving the white part that is disconnected to the crop rows is considered to be weeds.

ALGORITHM FOR WEED DETECTION

Step1: Take a masked image (800p x 400p) as input
Step2: For each pixel in mask [0, j] repeat from
  Step3 to Step 4
Step3: If a pixel is white then
  Call FloodFill (0, j) Method
Step4: j = j +1
Step5: For each pixel in the mask [i, j] repeat step 6
Step6: If mask[i,j] = white then
  Set colorpix[i,j] = blue
Step7: Exit

FloodFill(i,j) Method

Step1: Repeat till pix[i,j] is black
Step2: Set colorpix[i,j] = black
Step3: Call FloodFill(i-1,j)
Step4: Call FloodFill(i+1,j)
Step5: Call FloodFill(i,j-1)
Step6: Call FloodFill(i,j+1)

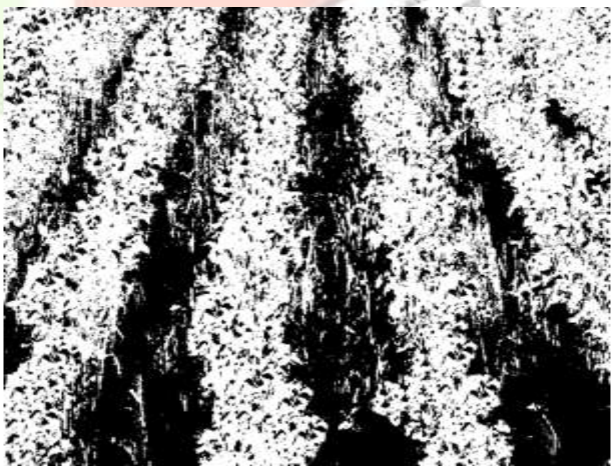

Fig. 4 : After Filtering and Masking

IV. OUTPUT HIGHLIGHTED WEED IMAGE

Image from last step is now processed taking into consideration that the white pixels in this image are vegetative region that is weed. White pixels are traced from the top-left to bottom-right are the same are highlighted in the original image as weeds.

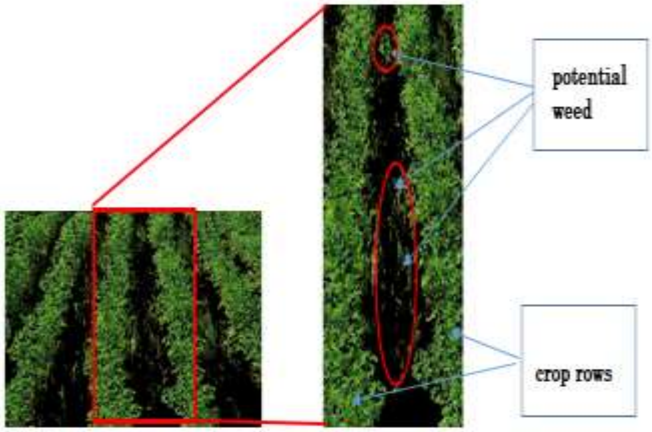

Fig. 5: Crop Rows and areas marked as potentially weed.

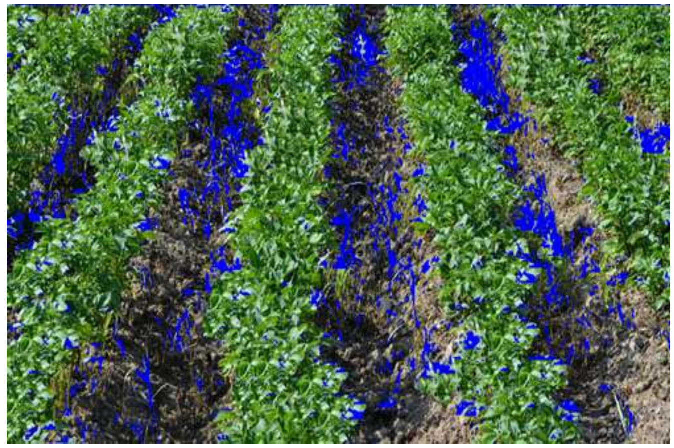

Fig.6: Weed highlighted image as output.

V. RESULT AND DISCUSSION

This method has been implemented using python and OpenCV images on 64 bit windows 10 operating system. After processing the image on our Flood Fill Algorithm, results are shown in images containing weed in an 800x400 RGB image. The final output of few other images is also included in this paper in fig 7, 8, 9 along with their BGR plot diagrams in Fig 10, 11, 12.

BGR plot is the graphical representation that tells us the number of pixels of specific intensity in the image. Red, Green and Blue plot lines show the red blue green content of the image. In our detection step we chose R=0, G=0, B=175 to highlight weed areas in an image. In BGR plot of Fig.7 peak can be seen to reach 13000 pixels at intensity value 175. Similarly for Fig.8 and Fig.9 blue hike reaches 15000 pixel and 27000 pixels.

Percentage of weed pixel detected on image is calculated utilizing the rule

% weed = $\frac{w}{w+c}$ *100, where c is number crop pixels detected in the image and w is number of weed pixels detected in image.

Similarly, % crop = $\frac{c}{w+c} * 100$, where c is number of crop pixels detected in image and w is number of weed pixels detected in the image.

Representing data from the BGR plot of all three images into the table.

Table 1: Table for representing % of weed and % of crop detected.

Test Image	**% Weed**	**% Crop**
Fig 7	4.06%	95.94%
Fig 8	4.68%	95.32%
Fig 9	8.43%	91.57%

In paper [1] width and height of vegetation was measured and if it had >3/4 of height and 5% width was taken as crop, this means if any weed patch satisfies the condition it was also taken as a crop. Weed that is large in size are taken to be crop. One similar error was also observed when the edges of crop rows are measured the leaves end does not satisfy the height and width condition and are taken as a weed. Both above situations is shown in fig13. But in Flood fill algorithm approach overcomes both these errors as it does not rely on the width and height computation it only checks the connectivity of vegetation this means if the vegetation is connected with the crop row it is taken as crop and if not then as a weed.

Fig.7: Original Image 1

Fig.8: Original Image 2

Fig.9: Original Image 3

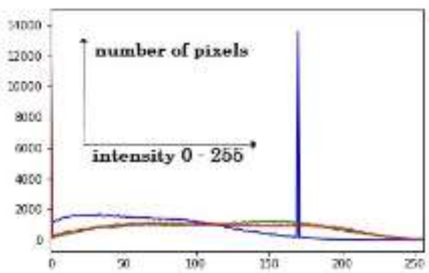

Fig. 10. BGR plot of Image1

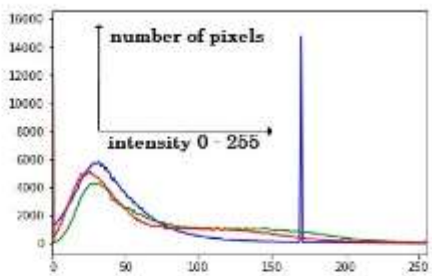

Fig.11: BGR plot of Image2

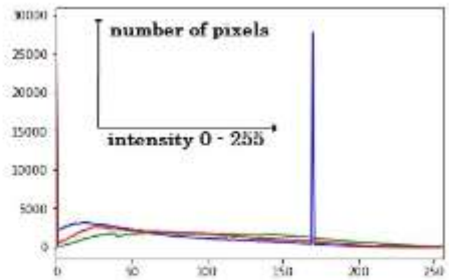

Fig.12 : BGR plot of Image3

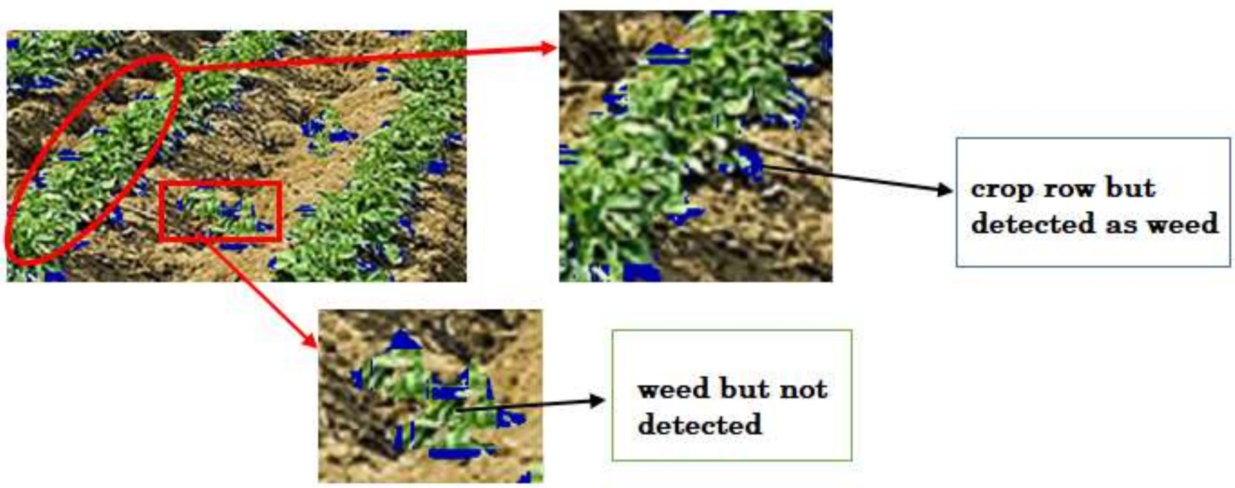

Fig 13: Error that Flood Fill Approach overcomes.

VI. CONCLUSION

In our proposed system, a new approach has been made to help farmers reduce labor cost and improve productivity by creating an algorithm in Image Processing. After segmenting vegetative region from the image, it is processed and enhanced further for better outcomes in the computation. Filtering is done to get rid of the interference. Crop and weed are differentiated with the aid of the flood fill algorithm. The time complexity of this algorithm is less. Thus through this system, we try to obtain maximum accuracy in minimum time.

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