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# Detection of Weed and Wheat Using Image Processing

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***Abstract*—** As the increase in the world population the demand of the wheat is also increases. In order to increase the growth wheat in the wheat crop it is necessary to detect the weed in the wheat crop and the barren land to minimize the growth of weed so that the growth of the wheat can be increased. Weed detection is the important factor to be analyzed. Unmanned Air Vehicle (UAV) is used for data acquisition of wheat crop in different phases so that high quality of RGB images can be captured. The proposed method facilitates the extraction of weed, wheat, and barren land in the wheat crop field using background subtraction. The result shows that background subtraction method is good for detection the weed, barren land, and wheat.

**Keywords**: Agriculture, computer vision, Automation, Weed detection, Barren land detection, Wheat detection.

## I.ⁿ INTRODUCTION

Scientists, researchers and government organizations are contributing a lot in the field of precision agriculture. This is only possible when the agricultural lands give a quality output in the form of quality crops. Since Pakistan have a large amount agriculture area and Pakistan is engage in cultivating various crop in these areas. That is why agriculture sector plays an important role in Pakistan's economy. Quality food can only be obtained by analyzing the crop quality, new methods to be adapted for the purpose of growth betterment like vertical farming etc. good quality in crop can be achieved by doing proper research and implement various technique that could improve the quality of crop and as well as its growth. Several researches have been done in this regard on different crops to improve their quality and its growth in this regard. In this research the study was done on the wheat crop. The research was done on a crop field which is located in Gharo, Sindh, Pakistan. The reason behind to choose the wheat crop is that, wheat crop takes around 6 months to get mature. The area of wheat crop was of 5 acres in which certain amount of area was focused for the research study. Several pictures were taken at different time to analyze the growth of wheat and weed. Weed is basically a byproduct of wheat crop that grows simultaneously with the wheat. Weed is undesirable product and it also consume water and plant's nutrients which ultimately decreases the growth of wheat that is essential and prime product of the crop. In order to overcome this problem detection of weed and wheat has been done in this research. The detection of wheat and weed has been done in this research by using image processing. In this regard background subtraction method has been used to detect the wheat and weed area. One of the factors in increasing the crop growth is the barren land i.e. the land in between the crop where crop did not grow. Proper sowing of seed could overcome this problem. To analyze the above stated problems several pictures have been taken from the unmanned guided vehicle (UAV) in different span of time. The first primary goal of the research was to detect the barren land in the focused area of wheat crop field in the initial stage which is checked when the growth of the wheat crop was at 50%. In The second stage, main focus of the research was to detect the difference between wheat and weed. This phase was very crucial because the research was done at the time when the crop was at its 75% growth. The problem that was faced at this stage was of the same color as the color of weed and wheat are of the same color i.e. green color. In the third phase when the wheat crop is quiet mature enough i.e. wheat color turns in to yellow. The further section of the paper is organized as follows. Section II, present the literature review of the previous work related to the image processing techniques used to detect weed in crops. Section III, discussed the proposed methodology of the proposed technique that is used in this research study. Section IV, discussed the results of the research and finally, in section V, conclusion and future work of the research have been discussed.

## *II. LITERATURE REVIEW*

The main topic of this research paper is the detection of the weed in the soybean crop using the Convolutional Neural Network. Weeds are the unwanted plants in any crop which damages the crops. The weed plants compete for the water and other nutrients during the growth of the crop, causing losses to the crops yields.[1] The Phantom DJI 3 drone was used for

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capturing the images. An image database was created which consisted of total number fifteen (15) thousand images of weed plants, soybean and soil. The Neural Network was trained The Convolution Neural Network are used to perform the detection of weed plants. The CaffeNet architecture was used for training neural network.[2] A Five step approach is used for the detection of weed. UAVs capturing the images are the first stage in the five stage process. Through the Pynovisão software, using SLIC algorithm, the images were segmented. The segments are then used in construction of an image database of soybean, soil and weed plants. The next step is dedicated to classifiers which will be used in the comparison to the ConvNets performance, training the classifier is fourth stage in the process, this action is performed by the ConvNets by using the image database segments and other classifiers uses the features matrix. The last stage consists of classification and segmentation of the soybean plantation and returning the visual classification of weed plants presence in the image. [3]

In [4] the main topic the authors have focused in this research paper is the detection of weeds in the cultivating field (Rice) using neural networks. The weed plants in any field are the root cause for destroying the crops, which results in the reduction of the production. The crops do not get the required water and nutrients in the presence of weed plants. The main issue discussed in this paper is weed plants detection in the crop using aerial images taken by a drone. Neural network has been used on the aerial images to detect the weed among the plants in the rice crop. Training the NN Grey-Level Co-occurrence Matrix with the Haralicks Descriptors was used for texture classification and also for Normalized Difference Index that was used for the color classification. The images were captured from drone at the height of 50m over the ground. The Neural network technique which was used for the pattern classification and recognition was implemented to detect the weed in the rice crop.

The authors captured the aerial images using Phantom FX-61. The images were captured at 50m height from the ground level. For building knowledge database the color and texture descriptors are introduced. GCLM with was used for texture description and NDI was used for color descriptor. In total nine descriptors for texture and one descriptor for color was used to train the Neural Network. The neural network was trained with dividing the samples into three parts, 70% for the purpose of training, 15% for the purpose of testing and 15% for the purpose of validation. The output shows 99% accuracy of the weed plants detection.

In [5], The main idea of this paper is to detect the weed in the images captured by a UAV using the SLIC and HOUGH transform. The method was based on the skeleton of vegetation, the spatial relationship of super pixels developed by the simple linear iterative clustering (SLIC) and the Hough transform. The authors in this paper have proposed a new method which discriminate between the crop and weed plants using the images captured by the UAV.

In the proposed method the RGB images are taken by using UAV. The method consists of three main step to detect the weeds. Through robust processing the soil and the other residues are eliminated. The color vegetation indices are used in this paper to differentiate between the background and vegetation. A morphological operation was applied after the preprocessing to get a better structure representation, which helped in the detection of the weed. Figure 1 shows the algorithm of classifying the crop lines and then the weed detection. [6]

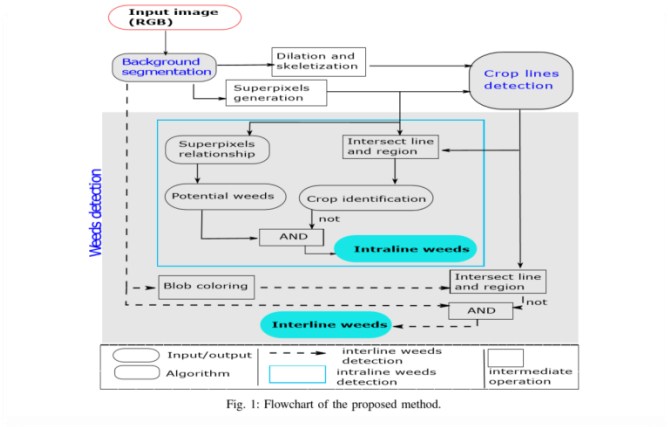

Fig. 1: Flowchart of the proposed method.

Fig 1 Flowchart of proposed method

In [7], the main topic of the research article is detection of weed in rice fields using aerial image acquisition and Neural networks. The main issues that author discussed in the research paper are detection of weed plants. Weed plant's detection is important because these plants normally consume water and nutrients up to 70% which is supplied to the crop. According to the author previously images were gathered through quadcopter using multispectral camera for the detection of weed in a field of sunflower crop. In the initial stages the results were up to the mark. In one of the research paper, researcher compares the images taken from drone camera and the images taken from the satellite to detect the weed on soybean field. The focus was on the detection of weed issue, the idea that proposed in this research was to capture aerial images from the Unmanned Aerial Vehicle (UAV'S). The images were taken from the distance of 50 meters over the field of the ground. And then Artificial Neural Network (ANN) is applied to detect the weeds plants in the rice field. In this research rice field is chosen to do perform research on that. The research was done somewhere on Colombia on a rice field of around 10 hectares. The rice is field was of around 60 days. As at that time it is suitable to detect the weed in plant because the weed plants at that time would be enough grown to be detected by the image acquisition techniques. To pursue the research 5 hectares was under consideration. In this area different kinds of weed were available. The images were captured from a 50-meter height. Then after that image processing techniques applied to detect

the weed plant and mark them with yellow circle. After that this data is analyzed through neural network plot the output result. Then the result shows that the accuracy of the system was found 99%. Because there some areas where weed was not detected by the image processing techniques, by using neural network those areas were also detected. One the major limitation of using neural network approach was it took almost 27 hours to for 12 mega pixel image to survey the whole image. There as a future work it was proposed that parallelized algorithm should be built to reduce the processing time.

## *III. METHODOLOGY*

In order to conduct research work, the crop field for research was chosen which is located in GADAP. The crop that is under consideration was wheat. The reason behind to choose the wheat crop is that, wheat crop takes around 6 months to get mature. The area of wheat crop was of 5 acres in which certain amount of area was focused for the research study. Several pictures were taken at different time to analyze the growth of wheat and weed. The first primary goal of the research was to detect the barren land in the focused area of wheat crop field in the initial stage which is checked when the growth of the wheat crop was at 50%. In The second stage, main focus of the research was to detect the difference between wheat and weed. This phase was very crucial because the research was done at the time when the crop was at its 70% growth. The problem that was faced at this stage was of the same color as the color of weed and wheat are of the same color i.e. green color. In the third face when the wheat crop is quiet mature enough i.e. wheat color turns in to yellow. At this part, it was easy to apply image processing technique to detect the weed and wheat crop.

To obtain image Unmanned Guided Vehicle (UHV) was used to take the aerial images of the wheat crop of certain area that was focused under research. The UAV that was selected for the image acquisition was Phantom 4. The specification of phantom 4 was as follows. The total weight of the drone along with its propellers and batteries was 1380 grams. The diagonal size of the phantom 4 was 350mm. the size of propeller was not in included in that. The rated maximum ascent speed in S-mode of the drone was 6 meters per second. The rated maximum Descent speed in S-mode of the UAV was 4 meters per second. The maximum rated speed of the aerial drone was 20 meter per second in the S-mode. The rated maximum angular speed of drone in s-mode was 200 degrees per second and rated maximum angular speed in a- mode was 150 degrees per second. The maximum tilt angle of the drone that is being selected was 42 degrees per in s-mode, 35 degrees in a-mode, and in p-mode the maximum tilt angle was 15 degrees. The maximum service ceiling above the sea level was 19685 feet which equals in meters is 6000 meters. The maximum resistance from the wind speed of the drone that was used, was 10 meters per second. The maximum rated flight time in the controlled environment was 28 minutes. Any temperature beyond the above mention temperature range flight would be critical. Phantom 4 could behave differently. In phantom 4, gimbal was attached for image stabilization during the flight. It has 3-axis stabilization i.e. pitch, roll, yaw. The controllable range was -90 degrees to +30 degrees. The maximum rated controllable angular speed was 90 degrees per seconds. The angular vibration range is ±0.02 degrees. The camera specifications of the above mentioned drone are as follows. The sensor in the camera is 1/3 inches CMOS with effective pixel 12.4 M. the Field of View (FOV) 94 degrees. ISO is called image sensor sensitivity. The ISO range of the phantom 4 for photos is 100 to 1600 and for video is 100 to 3200. The size of the image that was captured by this drone was 4000 by 3000 pixels. The format in which it captures the photos can be in JPEG or in DNG which is a raw format. The format that was selected for image acquisition was JPEG. [5] The charger that was used to charge the batteries of the drone was of 17.4 volts and the rated output power was 100 watts. The remote controller or the flight controller that was used to operate the drone and its camera was working on a frequency which is a free band i.e. 2.400 to 2.483 Giga Hertz (GHZ). The maximum rated transmission distance of the drone was 5 Km. [8]

Data which is captured by drone is fed into the MATLAB code for pre-processing. The overall experiment is divided in to three phases with respect to its growth. First phase will be initial growth when the growth of the crop was almost 50%. At this stage crop was around 50% matured i.e. the image acquisition was done using drone when the crop growth was in $12^{th}$ week. At this stage, we can be able to detect the barren land among the crop. It was necessary in order to determine the output efficiency of the crop. First of all, it is necessary to understand about the detail of edge detection theory. When the Edge is occurring, at that point there will be a change in shadow or change in color texture is appear through which edge detection technique detect the edges of any shape. Discontinuity of intensities in the image can be step, Roof, Ramp, and Spike There are different edge detection techniques normally that can be used for detection of edges.

The purpose of finding the barren land is to determine that how much area of the cultivated land is not used in the cultivation. This information would be useful for the next time to take care of that so that maximum area would be covered for the cultivation. That would increase the final output of the crop growth.

In the next step, the prime focus of the research study was to detect the weed and wheat in focused area of the crop. It is necessary to find out that the amount of weed produced in any crop because weed is bi-product of any crop and it is normally unwanted product among any crop. Weed utilized the nutrition and water supply to the crop and because of this reason any crop among which weed found did not produce maximum efficient crop. Therefore, it is necessary to detect the production weed in any crop. Here in this research study wheat crop was chosen to detect the presence of weed in the mentioned crop. At this stage the analysis was done crop was around 75% matured i.e. the image acquisition was done using drone when the crop growth was in 18$^{th}$ week.

This process was done by using the background detection technique. In background subtraction technique for moving object the technique used is take a snap of target image with the background and an image with the background only in the absence of that targeted image. Here for the detection of wheat in the crop, image acquired from the crop was analyzed first using preprocessing techniques and then applied Hue, Saturation and Value (HSV). After that separate the shade of green color this was done because this stage weed and wheat were both in green color with different shade. Once the shade was separated after that apply the threshold value to detect the weed crop in the focused area of the overall crop. Applying threshold value was hit and trial method until the desired output was obtained through this process. In the third phase, which was quiet easy relatively from the second phase because at this stage crop was reasonably matured enough that wheat and weed can easily be differentiate in terms of color i.e. weed remained in green color and wheat is in yellow and color with some golden shade. At this stage crop was around 85% matured i.e. the image acquisition was done using drone when the crop growth was in 22$^{nd}$ week. The system flow in the form of flow chart is shown below. In the first step image acquisition is done by the phantom 4 quadcopters in the wheat crop field. Once the image acquisition done by the drone camera the acquired image is then fed in to the MATLAB code for the image processing. For the first phase data acquisition from the drone which was done when the crop was matured around 50% of its overall growth. In the next step drone is used again to acquire the status of the crop that was done in the 18$^{th}$ week of the growth of the wheat crop. The acquired image fed in to the MATLAB code and using background subtraction the desired output would be obtained with some trial and error method. In the next step which was the third and the last one i.e. to obtain the image with the help of drone camera in the 22$^{nd}$ week of the crop growth when the crop was matured around 85%. In this phase the detection weed and wheat is relatively easier than the second phase when the crop was at 75% of its growth because the color of weed and wheat was almost same i.e. the green color. So in the third phase the detection in the acquired image was done using background subtraction. Here color of weed is remained green and the color of wheat changed from green to yellow. The diagram given below shows the overall flow of the system.

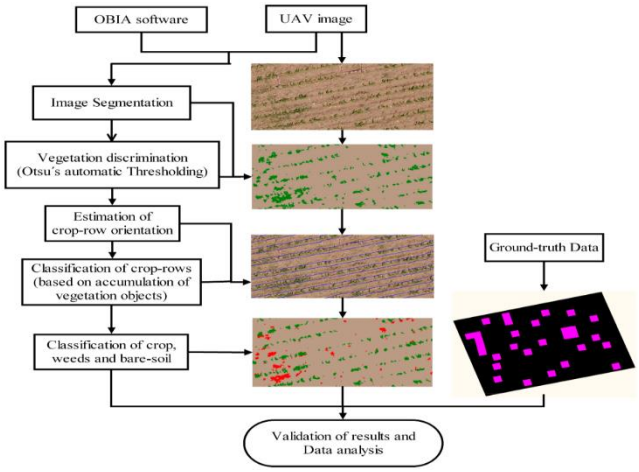


Fig 2 System flow diagram of the overall system

## *IV. RESULTS AND DISCUSSION*

The result of phase 1 is shown in the figure 3 below. The results show that area other than edges is barren land and edges show the presence of crops in that area.

Before

After

Fig 3 Detection of barren land

The result of the phase 2 is shown in the figure 4 below. The results show that the darker or black color area in the output after applying the background subtraction is weed while the other remaining area is the area where the wheat id found.

Before

After

Fig 4 Detection weed and wheat in phase 2 when the crop is mature around 75%.

The result of the phase 3 is shown in the figure 5 below. This result is quiet good and there is clear difference in the wheat and weed, which can easily be seen.

Before

After

Fig. 5. Detection of weed and Wheat in phase 3 when the crop is matured around 85%

## *V. CONCLUSION AND FUTURE WORK*

Although the detection was good enough but still there exist a room for the improvement in the result. Convolution Neural Network (CNN) can be applied in the future research for better result. In stage when the weed and wheat color are same convolution network (CNN) can be produced much better result. The limitation in the above proposed research that was faced was sunlight light intensity issue because of the variation in the captured image was quiet high. This can be overcome when the similar research was done in a very controlled environment. Better camera can be used in order to capture much better image with different sensor in order to overcome the problem that arise due to sunlight variation and shadows.

*Table 1 Quantitative Analysis of Weed and wheat present in Crop*

| *Image* | *Weed* | *Wheat* |
|---|---|---|
| *1* | *64.69%* | *35.31%* |
| *2* | *61.45%* | *38.55%* |
| *3* | *67.30%* | *32.70%* |

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