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WEEDICIDE SPRAY ROBOT USING IMAGE PROCESSING

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Abstract - *In India, agriculture stands as the conventional occupation. In recent days, the rates of farming are dwindling. Two reasons include manual labor shortage and the growth of unwanted plants like weeds. These weeds hinder the growth of crops by decreasing the water content to the crops and spatial aspects. This results in loss of revenue for the farming community. In India most of the people are farmers. For the purpose of fieldwork, maximum human power is needed, but regarding the present year's need for workers a large man power is necessary but availability of workers is very low. In the emerging era of technology, innovations in the field of agriculture and robotics is increasing. As an addition, the proposed system is a robot which identifies the weeds, differentiates them from the crops and removes them without any harm to the crops. Automation being the current trend in technology, when applied to the cultivating fields makes human life simpler and elegant. The main aim of the project is to identify and discriminate weeds from crops in the field. It uses the image processing technique to detect and remove weeds. It can also be implemented to reduce the usage of chemicals in crop fields. Agricultural automation thus helps the farmers to maintain their crops and optimize usage of resources singlehanded.*

Key Words: Agriculture, Automation, Weed, removal, Farming, Image Processing, Crop Weed Discrimination, Man Power, Robot etc.

1. INTRODUCTION

In India, nearly 60-70% people are farmers. Agricultural land in India was last measured to be 60.5% as of 2013. One basic threat affecting plant growth is the presence of weeds. Generally, a weed is a plant in an undesired place. These weeds consume water, sunlight, space etc. from those of the crops. Weeds not only affect the farm productivity but also can be harmful to livestock. Thus the removal of weeds becomes essential. In modern agriculture, these weeds can be either pulled out from the field or have chemicals sprayed on them. The latter method was found to be more efficient than the former. But these chemicals may be of harm to the actual crops. In order to minimize the volume of chemical sprayed, the practical solution will be spray only in the areas where weeds grow. But manual chemical spraying to particular areas consumes a lot of time and labor. The identification and classification of weeds are of major technical importance in the agricultural industry. Weeds are classified based by shape, color and size features.

2. LITERATURE SURVEY

Application of robotic systems are gradually spreading every day as the chance of swapping human operators with robots to provide active solutions and return on investment. But however robots are needed mainly in situations where the tasks are harmful and dangerous for the farmers. Certain tasks accomplished by robots that are in existence are

2.1 ROBOTIC GANTRY

Robotic gantry has been utilized as a fertilizer spray and was made in such a way that it could synchronize its functions based on the weather conditions. This maintains the balance of the system with a sensor that detects stormy or unfeasible weather conditions and makes sure that it works only if favorable conditions are found.

2.2 BIOLOGICAL MORPHOLOGY TECHNIQUE

In this method form and size options like major axis, minor axis, area ratio, breadth area unit etc. for the detection of the plant existing area. Other unseen options are found with the help of biological morphological technique. The technique uses the color identification method for the proper separation of the soil and plants used. The method achieved almost 72.6% of overall accuracy in other crop types and a 98.9% when the field was restricted to only corn fields.

2.3 SELECTIVE HARVESTER

Selective harvester is one of the machines that harvests only the portion of crop that has reached the specified threshold value or quality like particular size requirements in order to produce minimum waste due to early harvest. However, the selective harvester is mostly based on the accuracy or sensitivity of the sensors used for detection. It performs its tasks on two ground rules. Initially the system checks for the size or color quality factor before harvest which represents the physiological maturity such as ripeness and flavor. Then it ensures that the part of the crop is harvested without any harm to the neighboring crop.

2.4 ROBOTIC IRRIGATION

Irrigation is a vital factor that involves watering of plants intermittently or when the need arises. Robotic systems have been employed for such irrigation purposes. The robotic irrigator is a mechatronic water diffuser that resembles an orbiting rain-gun, and it was developed with a

method to spray flexible rates of water and chemicals over a specified area. Even though these machines are unable to supply the required amount of water to the right proportion of a field, it can still be used for irrigation of small field locations.

3. WEED REMOVAL METHODS

Weeds reduce the quantity and quality of agricultural products, affecting both industry and consumers. It is estimated that weeds cost farmers around $1.5 billion a year in weed control activities and a further $2.5 billion a year in lost agricultural production. Earlier techniques involve manual ways in the removal of weeds. Two features which are being used till date are:

- Mechanical weeding keeps the soil surface loose by producing soil mulch which results in better aeration and moisture conservation. In spite of its advantages, mechanical weeding may at times kindle the growth of more weeds due to the seeds that get spilt during the process.
- Chemical weeding is mostly preferred because the weedicide application is generally more effective, easier and selective.

4. PROPOSED SYSTEM

The project deals with a real-time weed control system using image processing which can reduce the use of herbicides based on the presence of weeds. It thus increases the organic level in plant crops as the herbicide level is controlled.

The objective is to develop an algorithm that can

- ✓ Recognize the presence of weeds
- ✓ Effective spraying of herbicides at the place of weed growth

4.1 IMAGE PROCESSING

Image processing is a process to convert an image into digital form and performing particular functions on it to extract some useful information from it. Two types of methods used for Image Processing. They are Analog and Digital Image Processing.
Analog image processing can be used for the hard copies like printouts and photographs. Image analysts use various fundamentals of interpretation while using these visual techniques. Digital Image Processing techniques help in manipulation of the digital images by using computers.

4.1.1 DIGITAL IMAGE PROCESSING

In digital image processing, an image may be defined as a two dimensional function, f(x,y), where x and y are spatial (plane)coordinates , and the amplitude of f at any pair of coordinates(x,y)is called the intensity of the image at that point. When x,y and the amplitude values of f are all finite, discrete quantities, we call the image as a digital image. A grey level image frequency histogram was made from pixels with values between 5 and 85. Pixels with values outside this interval was of no importance.

Initially the crop field is viewed through a camera fitted to the robot and the information is transferred wirelessly to the system. From this weeds are to be identified and differentiated from the crops using the techniques of image processing. A wireless data about the whereabouts of the weeds is communicated to the robot. This information helps it to spray weedicides to the weeds and not on the crops. This saves and enhances the organic level of the crops.

The field of digital image processing refers to processing digital images by means of a digital computer. Digital image composed of a finite number of elements, each of which has a particular location and value referred as pixel. The pixels with same color have similar pixel values. Using these values, the image is processed.

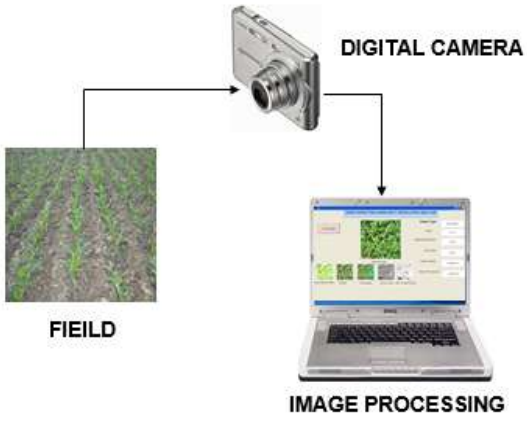

Fig -1: Methodology

4.2 WORKING PROCEDURE

The weedicide spray robot implements a method by which weeds are detected using image processing. This is achieved by giving input of weed blocks as images to the system and similar blocks in the image and differently colored for the robot to be identify the weeds. The data and control signals are sent through wireless communication. This makes the sprayer in the robot to spray herbicides only to the weeds.

The image acquired is such that it captures both the crop and the weeds in the same frame. Weed segmentation requires two stages. First is separation of whole plants from the background. Second stage is separation of weeds from the main plant. Those pixels that are related to plants have different green pixel value than that of the weeds.

Fig -2: Crop and Weed discrimination

Weeds have a different color pattern when compared to crop plant. Weeds can be easily discriminated from crops using their shape features. But since crop and weed occur in the same frame of the image, it is not possible to discriminate them using their shape. Hence a better choice is to use the color analysis method as the basis to segment the weeds from the field image.

Color segmentation is one of the techniques in image processing that is used to separate the crop (which also include weed) from the background. This is done through K means clustering. The difference between two point colors can be measured using the Euclidean distance metric. Clustering is used to group the pixels of same colors into group of objects, thereby making it easy to segment. The part of the image which needs herbicide spraying is changed to a black color and the rest to white color. The output image thus comprises of only two colors.

Now the robot is designed in such a way that the system sprays herbicide only if the image has more than 75% of black color filled in it (i.e) the black color in the images correspond to the ratio of weeds present in it. Thus in this way the crops don't get sprayed on by a large amount of herbicide. Hence the organic quality in the crops or plants is preserved.

Navigation of the robot is controlled by the user as most of the fields in India do not have an inter row cropping. Hence the movement through the crops will be difficult if navigation is automated. For this reason, the navigation is in the hands of the user.

5. OPERATIONS

5.1 OPERATION 1 – FUNCTIONAL ARCHITECTURE

All the components are fixed on a PCB (printed circuit board) and the connections are soldered at the correct place and a mobile phone with DROID CAM app installed in it is required. This is necessary to live video stream the crop field. A RF receiver module suitable for adding the functionality sent from the RF transmitter to an existing microcontroller. The RF receiver module is fixed to the system on the user side.

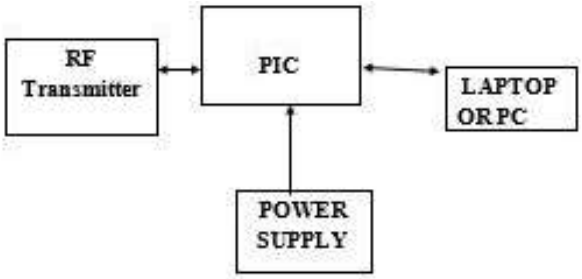

Fig -3: Transmitter

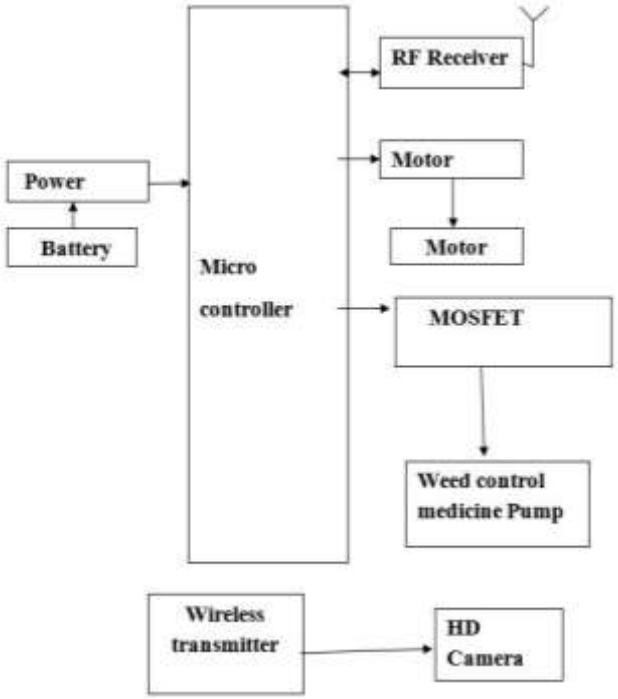

Fig -4: Receiver

5.2 OPERATION 2 – SOFTWARE PHASE

The micro controller works according to the program which the user feeds into it. This is done using a programmer. A C# program is to be written for navigation of the vehicle. The C# code will run on the system to limit the control of navigation for different crop fields. The same C# program will also see to the image processing phase of the system.

5.3 OPERATION 3 – WORKING EXECUTION

The robot is placed at the field and the program is executed for a test process. The robot has to be validated for proper working in different test cases for identification of issues. After proper test runs, the system can be utilized in alternate crop fields and the results are to be verified.

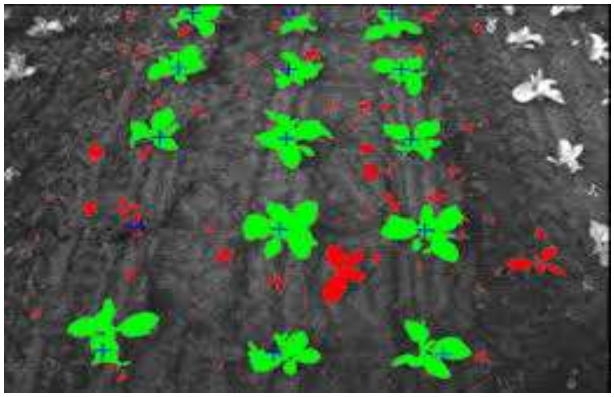

Fig -5: Analysis and Verification

6. CONCLUSIONS

A vision system has been developed using image processing for the detection of weeds in agriculture fields. The weeds are detected and differentiated. Based on the percentage of weeds present, the amount of herbicides sprayed can be reduced which is economically beneficial as well as helps in the reduction of soil pollution.

Agriculture should do its part to conserve the organic capacity of the crops. By applying adequate weedicide to the weeds and not to the crops, with the usage of this system, the organic level in the plants could be conserved to a large extent compared to the conventional manual spraying system. The system serves the aim 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.

An agricultural robot that could be manufactured at a low cost and which aids to implement numerous precision agriculture related processes on a field with very less supervision is developed. This could help in reducing input costs and increase agricultural outputs by maximizing the crop yield of a given land.

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