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Automatic Weed Removal System using Machine vision

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***Abstract*-- Herbicides are used worldwide to manage agricultural weeds. Over 95% of herbicides reach a destination other than their target crops, because they are sprayed or spread everywhere in the agricultural fields. This causes many unwanted effects on environment, humans and other living organisms. The automatic weed control systems provide efficient method of weed removing within the rows and inter rows. The machine vision system has been used to detect and differentiate the weeds from the crop. Guidance system has been used to track the rows with accuracy and to control a row cultivator and an autonomous agricultural robot in real-time. Mechanical methods of automatically removing weeds from the seedline two basic designs are used: a mechanical knife removes weeds from the inter rows and rotating hoe are used to remove the weeds from the within rows. The proposed system is helpful to avoid the usage of herbicides in the agriculture field and also replaces the shortage of labor.**

***Key words*-- automatic weed control system, machine vision, autonomous agriculture robot, mechanical hoe.**

I. INTRODUCTION

Today, robotics is a quickly growing field, as technological advances continue; researching, designing, and producing new robots serve numerous practical grounds, whether domestically, commercially, or militarily. Applying automation to agriculture has assist create numerous improvements to the industry while helping farmers save money and time. Agricultural Robots or agribot is a robot employed for agricultural purposes. The main area of application of robots in agriculture is at the harvesting stage. These have many benefits for the agricultural industry, including a higher quality of frozen produce, low production cost, and a smaller need for manual labor. The main purpose of this paper is to design automatic detection and weed removal system using the machine vision to achieve guidance along the field, identification of crops from the captured image by camera and removal of weeds in the agriculture field.

II.PREVIOUS WORKS

Weed control is an important issue in the agriculture field. Automatic weed detection and removing is achieved by the help of the machine vision system. This machine vision system is mainly helpful for the processes such as detection of the weed and guidance of the system.

The detection of the weeds or the classification of weeds from crops was detected by the following methods. Using machine vision the stem positions of all plants (crops and weeds) in the image was captured [12]. In another method the detection of weeds is done with DNA and the characteristics of the plants, where the microcontroller checks the status of the DNA against the plant [11]. Image processing algorithm [6] , crop/weeds discrimination without segmentation [7]and texture based weed classification[9] methods also used to detects the weeds from main crops in the field.

For the guidance of the system the uses the image processing algorithms, visual map, neural network [1] and image capturing techniques [2] to run forward and all over the field. Removing is done with the help of herbicide sprayers and some mechanical system. But it does not cost effective and reach the efficient results in the automatic manner.

III. NEED FOR WEED REMOVING AGRIBOT

Controlling the weeds in the agriculture field is a big deal in agriculture crop production. Maximum 90% of weeds are controlled by using herbicides (chemical weed killer). Reducing herbicide options, fear of ground water contamination, and customer pressure to ignore herbicide use, are all pushing the farmers to away from reliance on herbicides. Hand weeding is also not effective and not suitable for wide range. To overcome these problems in weeding, automatic detection and weed control system detects the weeds in the field and remove it mechanically. This system uses two machine vision systems: one to guide the agriculture robot along the field and another is to identify the crops and weeds by its color and shape parameters. Weed removal is achieved with mechanical hoe. Weeds in the inter row and within row also removed by this hoe and rotating disc. This system is highly useful to replace the usage of herbicide and the shortage of labors.

IV. PROPOSED SYSTEM ANALYSIS

In cooperation of machine vision technology (guidance, detection and identification) with

robotics, an autonomous detection and weed control system can be developed and brings many promising benefits to the agriculture field such as avoidance of herbicides and its impacts on environment and humans, solution to the shortage of labours, helps to save time and money.

The overview conceptual diagram of the automatic weed removing agribot will be,

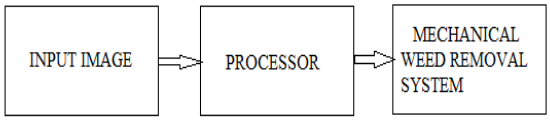

Fig. 1. Conceptual Diagram of Automatic weed removing agribot

Weed removal can be applied for the following purposes:

a) Identifying the crop and weeds in fields.
b) Classifying the weed among crops.
c) Mechanical weed removal in respective areas.

The automatic weed removal system uses two mechanical hoes (knives and circular disc) for the removal of weeds in fields. This system is based on two pistons that are alternately filled with pesticide. The movement of these pistons is at low velocity and is controlled by stepper motors. Stepper motor is the heart of the system. The main precision work of this weed removal system is done by the stepper motor.

V. BLOCK DIAGRAM

The block diagram of automatic detection and removal of weeds system consists three major systems. They are namely:

A. Automation Detection Unit.
B. Spray and Control Processing unit.
C. Output unit

A. Automatic Detection Unit

The computing system is based on a single-board PC with a digital signal processor. This board received images of the field scene from a digital camera from the field through serial interface. Inputs from proximity detectors, encoders and outputs to motors attached with hoe are made through a custom-built interface board. This signal board communicated with the main microcontroller board via RS232 serial interface that performs low-level control algorithms and managed the inputs and outputs. The main controller board and custom-built interface board along with their power supply were fixed within a metal enclosure attached to the implement. The classification of the weeds and crops are done based on the visual texture. The use of visual texture computed from gray scale and color images to identify plant species. We can use color co-occurrence matrices in the hue saturation and intensity color space to obtain an overall classification accuracy of the images. But computation time is an important factor and suggest using a smaller set of texture features. The another way in co-occurrence matrices on a gray scale image to compute texture features such as angular second moment and inertia to classify greenhouse grown grass and broadleaf plants with an accuracy of 93% and 85%, respectively. The texture algorithm used by this method was computationally intensive, requiring 20–30 s/image. To achieve a great result the weeds are divided into grass and broad leaf categories the classification rates were 98 % and 95% respectively. It takes the parameters hue and saturation texture features with neural network.

B. Automatic Guidance Systems

Two popular techniques are commonly used in the guidance system:
one is machine vision system and another is global positioning system. Here machine vision system is used for the guidance and global positioning system is used for the monitoring purpose.

The important requirements of row guidance system are:

• Capability to track rows with an accuracy of a few centimetres.
• Capability to control a row cultivator and an automatic agribot in real-time, which means that both offset and forward of the row structure must be estimated at a sufficient fast rate.
• Capability to work on sow crops which means that the time of appearance and the size of the crops may vary in the agriculture field. This also means that weeds and crops have about the same size in early cultivation(discrimination between crops and weed cannot be made by size only).

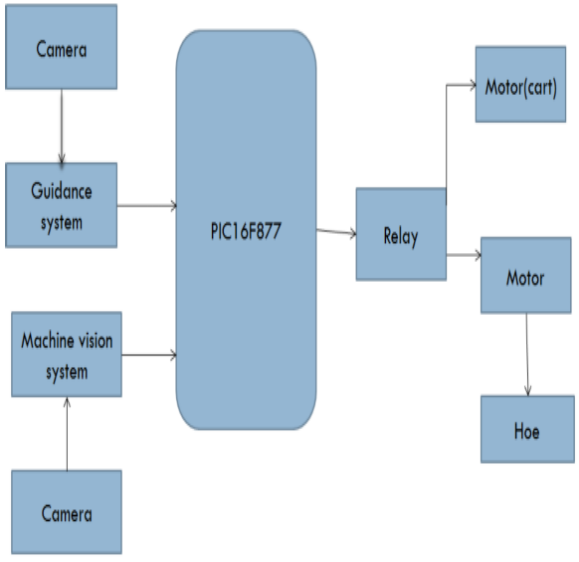

Fig. 2. Block diagram of automatic detection and removal of weed system.

• Capability to work when there is high weed pressure.
• Capability to work when plants are not able to found in the row. This is mostly the case in [organic] fields where coming is about 71%, which is less than in conventional fields, where the coming usually is about 91%.

One of the most widely used machine vision methods for recognizing crop rows is based upon the Hough transform. The Hough transform is a computationally efficient steps for detecting discontinuous lines or curves in images, thus it is suited for situations like those listed by A° strand where the crop stand is incomplete with intervals in the crop rows due to bad germination, insect harm or other factors results in missing crop plants in the row . To make possible row identification for agricultural guidance for automatic guidance of a harvester. In one of the early implementations, the Hough transform for row tracking in real-time and well known that their technique was tolerant to weeds situated away.

A camera was mounted in the middle on the system looking forward and downwards such that the bottom of the agriculture field of view was vertically beneath the camera and the area of the bed was distinctly able to seen. The position of the plants across crop rows and their phase relative to the motor was identified using computer vision. Camera superimposed with graphical guidance information.

C. Weed Removal System

Weed removal system prefers the mechanical weed removing techniques. These are achieved by the use of mechanical knives, hoes and other desired mechanical equipment used for weeding in the agriculture field.

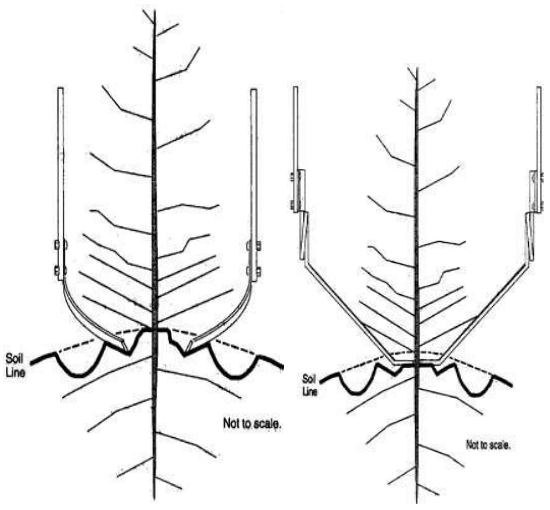

Fig.3. Mechanical knife and hoe

VI. CONCEPTUAL SCHEMATIC DIAGRAM

The PIC16F877A controller will be fed with the input. The controller will be connected with a stepper motor. If there is no weeds are present in the input image, the motor will stay idle, no further action will takes place. Else, the weeds are detected in the captured image the motor will start running; which in turn induce the mechanical hoe system. Proteus ISIS and Micro C software are used for simulating the mechanical hoe system which is connected with the robot's end effectors.

The Fig.3. depicts the simulated output acquired when there is no weeds in the input image. The motor will stop running once the processor detects the normal crops. Motor running represents the actuation of mechanical hoe system. The knives in the hoe system removes the weeds in the inter rows and the circular disc in the hoe system removes the within row weeds.

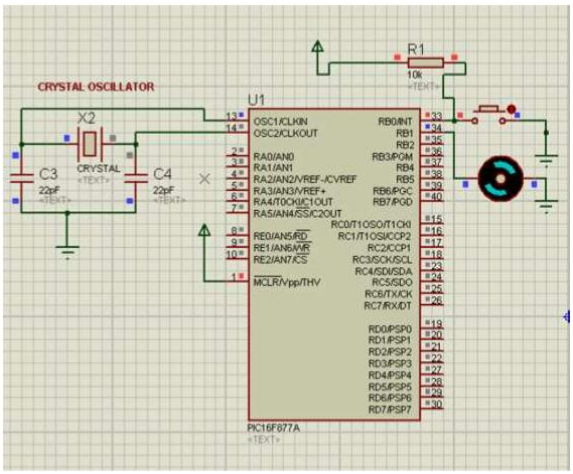

Fig.4. Simulation output

The stepper motor is used to actuate the mechanical hoe system which is highly important in the process of removing the weeds.

VII. CONCLUSION

This paper permits the idea about the automatic detection and removal of weeds in the agriculture field. Especially the removal of weeds mechanically. So the usage of herbicides in the agriculture field is avoidable. With this paper it is concluded that in agriculture field the crops and weeds are differentiated with image samples. The obtained results are then analyzed, from these results weeds are identified after it is analyzed the mechanical hoe which is controlled by the microcontroller is signalled. Microcontroller gave the signal to motor to actuate the mechanical hoe system. The software simulation of the system is done by using MATLAB, VSPE and PROTEUS.

VIII. FUTURE SCOPE

The future work of this paper aims in design and implementation of the automatic mechanical weed control system in agriculture field. Also, try to implement this system for all types of crops. This paper promise that it will surely avoids the shortage of human labours and the usage of herbicides in the agricultural field.

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