Design and Development of Automatic Weed Detection and Removal System

Pushpavalli M
Associate Professor, Department of ECE
Bannari Amman Institute of Technology
Sathyamangalam - 638401, India
Email: pushpavallim@bitsathy.ac.in, sowpush@gmail.com

Abstract

Most important approach of plant life is weed handling. Herbicides are used all over the world to control agricultural weeds now a day. Moreover practical weed controlling is done by labors and using these herbicides. In this paper automatic weed detection and removal systems was proposed to avoid the problems like herbicides staying in the agricultural fields, which leads to also an environment problem and livings of human beings. To detect and differentiate the weeds from the crop, machine vision system has been used. Two basic designs of mechanical methods are used to automatically remove weeds from the seedline. That is a mechanical rotary weeder is used to remove weeds from the inter rows and torsion weeder which removes the weeds from the within rows. This system design is based on the design of torsion weeder. The above system is designed to avoid the consumption of herbicides in the agriculture area and to replace the manpower.

Keywords: *Automatic Weed Sway System, Intelligence System, Finger weeder.*

INTRODUCTION

Besides the technological evolutions, robotics is a fast growing field; research and development of producing new robots provide enormous practical grounds whether home like, economically or aggressively. Applying automatic technology to agriculture has a several improvements to the industry which help the farmers to save money and time. In flora, the management of weeds depends on manual weeding and herbicides. In order to control the weeds, herbicide is not a good choice. To vanquish these effects many methods were suggested for removing the weeds that is chemical weed removing, electrical weed removing and mechanical weed removing. One of the three methods is the desired method that is mechanical removing which has a three main techniques which is used most widely in burying weeds and cutting weeds. (Cloutier et al., 2007).N.D.Tillett et al. (2008) developed an experimental machine for inter row and within row weed removal. A hydraulic driven disc which is used to remove weeds within the row and moreover it had an interior section to avoid damaging of crops. This paper describes the detection and removal of weeds based on machine vision in the inter rows and within rows in agriculture field.

Literature Review

Various aspects of automation in agriculture is like detection of fruit, weed, humidity and temperature. There should be an efficient method to do all the above with low cost as a primary criteria. Many methods have been proposed by various authors. Feyaerts and van Gool used a spectrograph camera to identify weeds. They obtained up to 86% classification accuracy, but the scheme was not applicable to in-field purposes. Another approach for weed detection was proposed by Nielsen, M., Andersen. This demonstration is mainly focus on tomato plants. Nielsen analyzed images acquired by a stereoscopic vision system, but

ground irregularities had negative impacts on results. There were some other classifications based on height differences. For identifying broad-leavedpatches in cereal crops, Berge developed a method based on shape parameters and as a result achieved 84 to 90% classification accuracy.

Active shape like height was also used to classify the type of weed species. There is a problem in using the height as an ideal parameter as the heights of the species are not same.
Additionally it can be used only for one type and it is not suitable for all the types of crops. Another type is by using texture information we can classify the weeds and crops and this can be done by machine vision where images can be used to extract information.

Promissory results on automated weed detection were obtained using an image processing method. Another approach for taking images of a field by using CCD camera mounted on a tractor. With the popularity of digital cameras, personal computers, image processing software, and global positioning systems, machine vision systems could be an option to cost reduction in data collection for precision agriculture. Georeferencing the data could be possible to identify spatial variability on weeds distribution and allow site-specific control, using patch spraying where herbicides are applied only on the areas where the weed population economically justify the application. Other options are varying herbicide and data collection through weed maps. In this work an image processing method is followed for identification and data collection.

Automatic Weed Sway System
The automatic weed's way machine has three main systems : Automatic Detection unit, intelligence system and weed

removal system. The System design is shown in the Fig.1. The detection Unit consists of PC and Zigbee, PC is used to make the decisions about the input. The working of the cart in the field is handled by the guidance system with respect to the output from detection unit. The weed removal unit working is also based on the output from the machine vision system and its decision unit. The above two operations are powered by microcontroller unit. The transmission of signals between the units is carried through the zigbee module.

Automatic Recognition Unit
The technology is used here is the digital image processing. In this unit, the image which is captured from the field is the input and is processed using digital image processing techniques. This image will be distinguished with normal plant image and weed image. During this stage the weed image is distinguished and extracted by digital image processing techniques. After a long time the weed is detected and categorized by comparing the input image with classifier section. The presence and absences of the weeds is fed to the intelligence system. The output of the recognition unit is 'weed is detected', if any weed image is found in input. It produces the output 'weed is not detected', if no weed.

Automatic Intelligence System
Automatic intelligence system is guided by microcontroller. The recognition unit input is given to the controller unit. The intelligence system works based on the output from the recognition unit. The signal is received via zigbee from recognition unit. If there is no weed detected there will be no changes in system working and the cart will move in forward direction in the field. If the signal from the recognition unit is said to be '1' the controller will not provide access to the end effectors in weed removal unit. If the signal '0' is received the controller makes

the changes in intelligence system and weed removal system. Intelligence system stops moving in the forward direction when the weed removal system actuates the end effectors. End effecters are used to remove the weeds from the field.
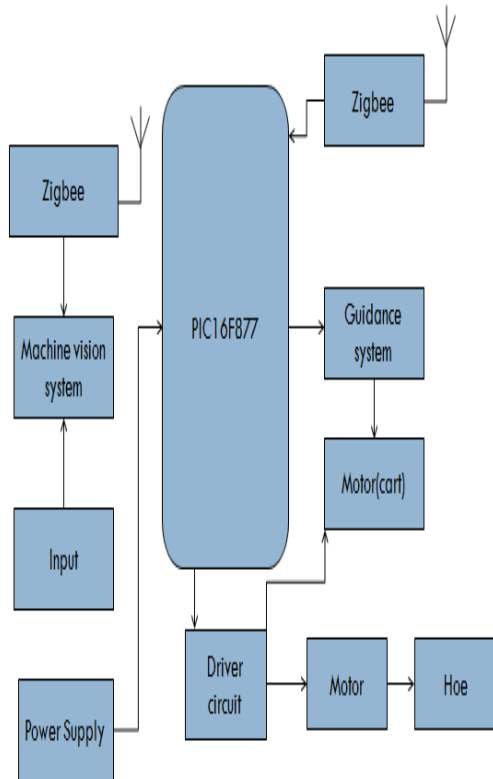

Fig 1. System Design of the System

Fig 2: Steps in Recognition unit

Fig. 3: Finger weeder

Detach System (Finger weeder)
The working of weeder is based on the output from recognition unit and control unit. The input image is normal image and it does not have any weeds, it state is neutral. If the image is abnormal by having the weeds, the motor activates the end effecter i.e. weeders in the system. The weeder used in this system is torsion and finger weeders. The images of the weeders are shown below Fig 3:
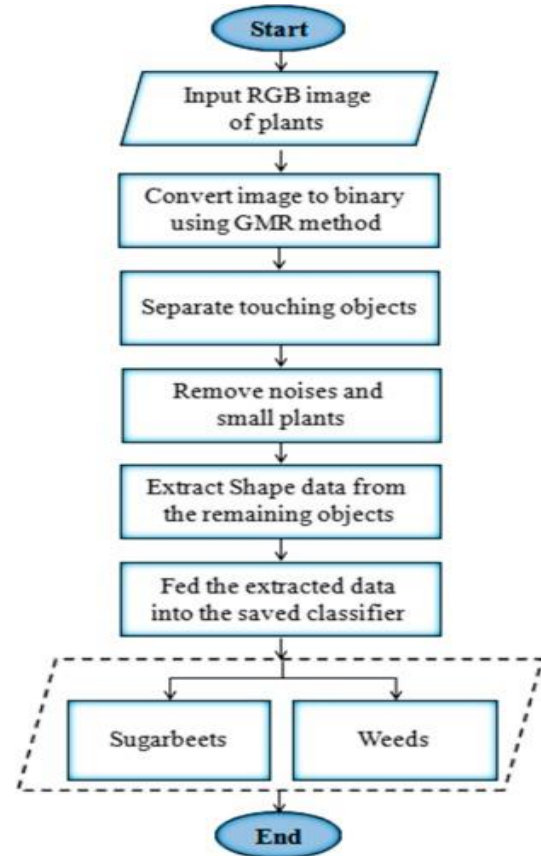
System Prototype
Hardware
PIC 16F877A
PIC16F877A Microcontroller is used as the controller unit. The actions depend on the output from the recognition unit. This controller is programmed for dominating the action in the intelligence system and weed detach system. This unit controls the speediness and other working of the motor.

Gear Motor
Motor type used in the system is gear

motor. In the cart DC motor is used and stepper motor is used in the end effectors. Stepper motor which is a high performance motor in the system because it tends to work with the end effectors, hence to avoid destruction it is controlled carefully by the control unit.

Supply Unit
In order for the power supply to the control unit and intelligence system 9V battery is used. The transmitter is powered by the PC by connecting the setting with the PC by using USB to RS232 cable.

Fixed regulators are three-terminal linear regulators are commonly available to generate fixed voltages of plus 3 V, and plus or minus 5 V, 6V, 9 V, 12 V, or 15 V, when the load is less than 1.5 amperes. The "78xx" series (7805, 7812, etc.) regulate positive voltages while the "79xx" series (7905, 7912, etc.) regulate negative voltages. Often, the last two digits of the device number are the output voltage; e.g., a 7805 is a +5 V regulator, while a 7915 is a -15 V regulator. There are variants on the 78xx series ICs, such as 78L and 78S, some of which can supply up to 1.5 Amps.

Relay Circuit
A relay is an electrically operated switch. Many relays use an electromagnet to mechanically operate a switch, but other operating principles are also used. Relays are used where it is necessary to control a circuit by a separate low-power signal, or where several circuits must be controlled by one signal. Relatively small amount of power is needed to operate the coil .The actuator is the output device which is a motor that is responsible for controlling a system. The actuators are used in many applications .These electrical relays are used to allow low power electronic circuits to switch the high currents and voltages.

Many electronic projects use transistors as their switching device because it can provide fast DC switching(ON-OFF)control of the relay coil.Since the design of relay switching is huge ,here is the some more common ways of switching relays .

Mode of Communication
Zigbee module is used for the high level communication between the recognition unit and controller unit. Here CMOS 2.4GHZ ZIGBEE/ISM TRANSMIT/RECEIVE RFeIC is used. The RFX2401C architecture integrates the PA, LNA, Transmit and Receive switching circuitry, the associated matching network, and the harmonic filter all in a CMOS single-chip device. The RFX2401C is a fully integrated, single-chip, single-die RFeIC (RF Front-end Integrated Circuit) which incorporates all the RF functionality needed for IEEE 802.15.4/ZigBee, wireless sensor network, and any other wireless systems in the 2.4GHz ISM band. Comparing the superior performance, high sensitivity and efficiency, low noise, small form factor, and low cost, RFX2401C is the suitable solution for applications requiring extended range and bandwidth. It has simple and low-voltage CMOS control logic, and requires minimal external components for system implementation.
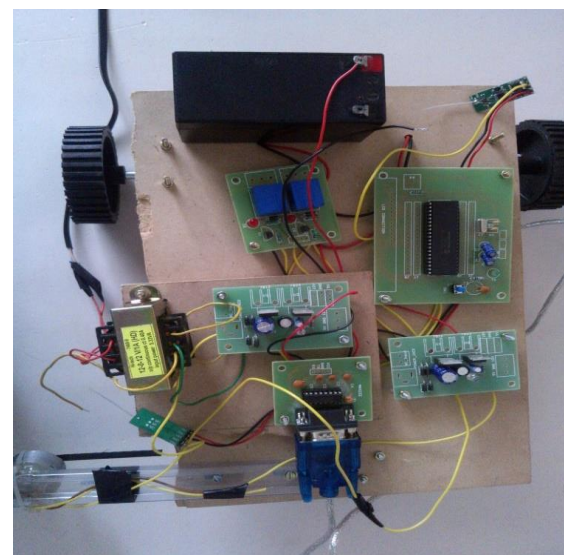
Fig.4 : System Prototype
USB to RS232 Cable

USB to RS232 link is utilized to interconnect the transmitter and PC. The choice unit sent the outcome through the link to the controller unit. Here CMOS 2.4GHZ ZIGBEE/ISM TRANSMIT/RECEIVE RFeIC is utilized. The RFX2401C is a completely coordinated, single-chip, single-bite the dust RFeIC (RF Front-end Integrated Circuit) which joins all the RF usefulness required for IEEE 802.15.4/ZigBee, remote sensor organize, and some other remote frameworks in the 2.4GHz ISM band. The RFX2401C design coordinates the PA, LNA, Transmit and Receive exchanging hardware, the related coordinating system, and the symphonious channel all in a CMOS single-chip gadget. Commonplace high power applications incorporate home and mechanical computerization, savvy power, and RF4CE among others. Consolidating unrivaled execution, high affectability and effectiveness, low clamor, little shape factor, and minimal effort, RFX2401C is the ideal answer for applications requiring expanded range and data transmission. RFX2401C has straightforward and low-voltage CMOS control rationale, and requires negligible outer segments for framework execution.

Software
MATLAB 2014
MATLAB 2014 is the product used to recognize the nearness of weeds in the info picture. MATLAB is an abnormal state dialect and intelligent condition for numerical calculation, perception, and programming. Utilizing MATLAB, you can dissect information, create calculations, and make models and applications. The dialect, devices, and inherent math capacities empower you to investigate numerous methodologies and achieve an answer quicker than with spreadsheets or customary programming dialects, for example, C/C++ or Java. In spite of the fact that MATLAB is expected basically for numerical processing, a discretionary tool compartment utilizes the MuPAD representative motor, enabling access to emblematic figuring capacities. An extra bundle, Simulink, includes graphical multi-space reenactment and Model-Based Design for dynamic and inserted. MATLAB was first embraced by scientists and professionals in control building, Little's claim to fame, yet rapidly spread to numerous different areas. It is currently likewise utilized as a part of instruction, specifically the educating of direct polynomial math and numerical examination, and is prominent among researchers associated with picture preparing.

Results from the detection Unit
Input image has taken and processed to identify the weeds and crops in the image. This has done by using MATLAB.

Input image without weed and its output:
Aftereffect of the picture without weed, shows the message 'weed isn't identified' and furthermore create information '1'. The information has given as contribution to microcontroller. Microcontroller does not roll out any improvements in working of the framework and does not incite the hoe system.
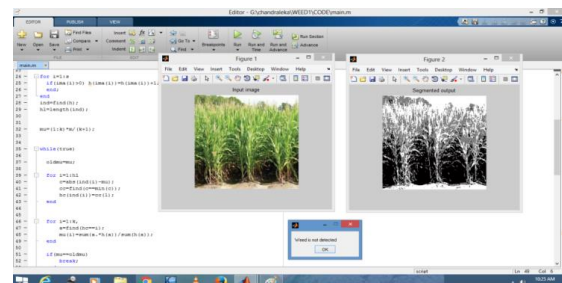

Fig. 5: *Input image without weeds and its output*

Input image with weed and its output:
After effect of the picture with weed, shows the message 'weed is distinguished' and furthermore create information '0'. The information has given as contribution to microcontroller. Microcontroller quits

working of the direction framework and activates the mechanical hoe in the system.
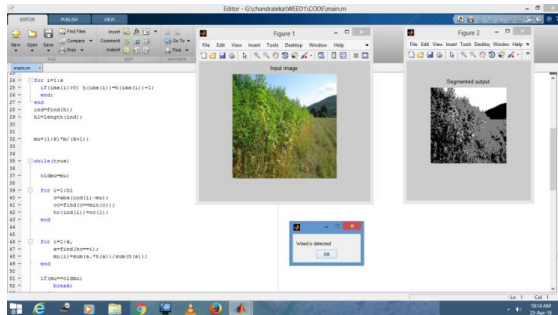

Fig. 6: Input image with weeds and its output

CONCLUSION

This paper allows the thought regarding the programmed discovery and evacuation of weeds in the horticulture field, particularly the evacuation of weeds mechanically. So the use of herbicides in the horticulture field is avoidable. With this paper it is reasoned that in agribusiness field the yields and weeds are separated with picture tests. The got comes about are at that point dissected; from these outcomes weeds are distinguished after it is examined the mechanical cultivator which is controlled by the microcontroller is flagged. Microcontroller gave the flag to engine to activate the mechanical hoe system.

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