Harvester Cum Destroyer Robot using Fire Bird V Robot

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Abstract— Robotics and automation plays a vital role in the society meeting 2050 agricultural production needs. Robots have played a fundamental role in increasing the efficiency and reducing the cost of industrial production and products. More recently, farmers have started to experiment with autonomous systems that automate such as digging, planting, harvesting, spraying, and weed removal. Many gardeners still remove weeds by manually pulling them out of the ground, making sure to include the roots that would otherwise allow them to re-sprout. Similarly traditional harvesting methods accounted for more of hard work to be put by the farmer. In order to overcome, we are going to a see a harvester and destroyer robot which is used to harvest the ripened crops and remove the unwanted weeds in the field. By using this robot we could be aware that when the crops are in the right stage for harvesting or not. This could be done by using the IR sensors that are used to find the height of the crops by image processing technique.

Key words: Fire Bird, Gripper, IR Sensor, Camera Module

I. INTRODUCTION

Today the environmental impact of agriculture production is very much in focus and the demands to the industry is increasing. The production of agricultural products is growing and the competition is getting bigger, therefore the farmer has to be very efficient to be able to complete. The harvesting robot will have the advantages of being able to work around the clock (24/7) and improve food safety by reducing human-plant contact. It will also be possible to increase the heat and humidity in the greenhouses, which would normally result in impossible working conditions for humans, to increase plant growth.

Agriculture is humankind's oldest and still its most important economic activity, providing the food, feed, fiber, and fuel necessary for our survival. With the global population expected to reach 9 billion by 2050, agricultural production must double if it is to meet the increasing demands for food and bio-energy. Given limited land, water and labor resources, it is estimated that the efficiency of agricultural productivity must increase by 25% to meet that goal, while limiting the growing pressure that agriculture puts on the environment. Agricultural robots or robotic devices aid farmers in the care of crops and livestock, increasing farm productivity. Utilized in greenhouses or in open fields, agricultural robots can be used for harvesting, fruit picking, weeding, planting and pest control. Agricultural robots and robotic devices are becoming increasingly important as industry awareness of sustainability and environmental preservation grows. The goal is to create robots that can replace human labor in agriculture, reducing costs while increasing profits and crop production. It will enable countries without a tropical climate the ability to complete better in the world market. Harvest is the process of gathering ripe crops from the fields. The process of cutting and gathering of the ripened crop is called harvesting. In India, most of the harvesting is done manually and sickle is the only tool that is used for this purpose. Harvested crop is then threshed to separate the grain from its outer covering called chaff. The time for harvesting fluctuates with climate, the reason, the variety and the crop involved. The nutritional value, freshness and flavor of fresh produce depend on the stage of maturity and the time of day at which they are harvested. If a product is harvested at a too early stage of maturity, it may not mature at all, where on the other hand, if the same product is harvested when it exceeded the stage of maturity, it will be stringy and coarse. The quality of a product and the shelf-life dependents on the way it is harvested and handled thereafter. The harvesting method used depends on the biological characteristics of the crop, climatic conditions, and the technical equipment available. The processing of harvested crops includes cleaning, drying, and other tasks, depending on the crop.

Weeds compete with crops for space, nutrients, water and light. Smaller, slower growing seedlings are more susceptible than those that are larger and more vigorous. Weeds also vary in their competitive abilities and according to conditions and season. The presence of weeds does not necessarily mean that they are damaging a crop, especially during the early growth stages when both weeds and crops can grow without interference. However, as growth proceeds they each begin to require greater amounts of water and nutrients. Weeds can also host pests and diseases that can spread to cultivated crops.

II. TASK OF THE ROBOT

A. Harvester:

The process of cutting and gathering of crop after it is matured, is called harvesting. In agriculture, the harvest is the process of gathering mature crops from the fields. Reaping is the cutting of grain or pulse for harvest, typically using a scythe, sickle, or reaper. The harvest marks the end of the growing season, or the growing cycle for a particular crop, and this is the focus of seasonal celebrations of many religions. On smaller farms with minimal mechanization, harvesting is the most labor-intensive activity of the growing season. On large, mechanized farms, harvesting utilizes the most expensive and sophisticated farm machinery, like the combine harvester. Harvesting in general usage includes an immediate post-harvest handling, all of the actions taken immediately after removing the crops-cooling, sorting, cleaning, packing-up to the point of further on-farm processing, or shipping to the wholesale or consumer market.

B. Destroyer/ Weed Controller:

The process of removing the unwanted weeds/crops in the field is called destroyer or remover. A plant is often termed

a "weed" when it has one or more of the following characteristics:

- Little or no recognized value (as in medicinal, material, nutritional or energy)
- Rapid growth and/or ease of germination
- Competitive with crops for space, light, water and nutrients

Weed management decisions vary according to plant life cycles, infestation size, environmental parameters and management objectives. The traditional methods used for controlling weeds are as follows:

- Cultural method
- Physical method
- Chemical method
- Biological method

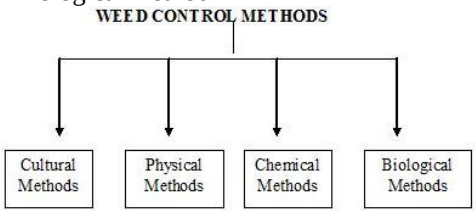

Fig. 1: Weed control method in traditional agriculture

In our paper we are going to remove the unwanted crops by using an autonomous robot which has a camera module which identifies the unwanted weeds by comparing with the image processed in the robot.

III. ROBOT DESIGN

Here the robot is a Fire Bird V robot. It is an Atmega2560 based microcontroller that is used along with Atmega 8 microcontroller. This microcontroller acts as a master and slave control device. Here this robot is based upon the "Open source philosophy software" so that it could be used with any type of other software for programming which includes MATLAB, Keil, Scilab, MRDS etc. The basic components in this robot is that it has IR sensors, proximity sensors, white line sensors, SHARP IR sensors, buzzers, LCD and LED along with Ni-MH battery.

If we need we could also additionally add other features to this robot that includes camera, gyroscope, ultrasonic sensor, accelerometer, motion sensor, GPS etc.

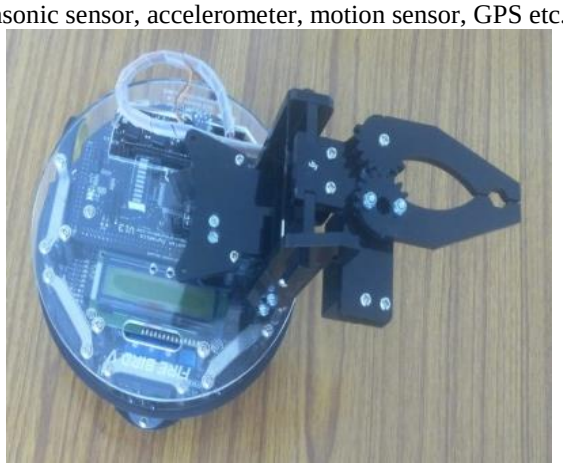

Fig. 2: Firebird V robot with Gripper attachment

A. *Components in the Module:*

- 12V DC Motor
- 8- IR Proximity Sensor
- 5-IR Sharp Sensor
- White line sensor
- Buzzer
- LED
- LCD
- Ni MH Battery
- Position Encoder
- Camera Module
- Gripper Module

IV. SENSORS FOR HARVESTING AND DESTROYING ROBOT

A. *Infrared Sensors:*

In this paper, three infrared sensors are utilized for distance measurements. The IR sensor consists of a LED emitting the infrared light and a photodiode. This sensor enables to detect objects without any influence on the color of reflective objects, reflectivity, and the lights of surroundings. It generates an analog voltage that is a function of range. The output voltage can be measured by an analog-to-digital (ADC) input line. Infrared proximity sensors are used to detect proximity of any crops in the short range. IR proximity sensors have about 10cm sensing range. These sensors sense the presence of the crops in the blind spot region of the sharp IR sensors. Firebird V robot has 8 IR proximity sensors. In the absence of the obstacle, there is no reflected light hence no leakage current will flow through the photodiode and output voltage of the photodiode will be around 3.3V. As obstacle comes closer, more light gets reflected and falls on the photodiode and leakage current flowing through the photodiode starts to increase which causes voltage across the diode to fall.

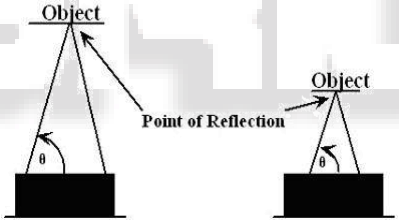

Fig. 3: Principle of IR sensor

B. *White Line Sensors:*

Line sensors are used for sensing white line on dark surface. It can even detect nodes and move on the maze of the white or black lines. It consists of high intensity red LED for illumination and highly directional photo transistor for line sensing. Phototransistor consists of a photo transistor and convex lens. Because of precise alignment between lines and photo transistor it has very narrow viewing angle of 5 degrees. Due to the directional nature of the photo diode, it does not get affected with ambient light unless it is very bright. When the robot is on a white line, more lights get reflected resulting in considerable increase in the leakage current which causes voltage across the sensor to fall between 2 to 0.1V. When the robot is not on a white line, amount of light reflected is less, hence less leakage current flow through the photo transistor. In this case, the line sensor gives an output in the range of 2V to 3.3V.

C. *Buzzer:*

In this project, buzzer is used to make sound when the robot is approaching the crops. When the robot is a bit far from the crop then it makes a less pitch sound, as it approaches

the crop further, the sound of the buzzer increases drastically. When the crop is the required one then the buzzer is indicated by 'n' times. When the crop approached is unwanted one that has to be removed then the buzzer gives a sound for only one time.

1) Block Diagram:

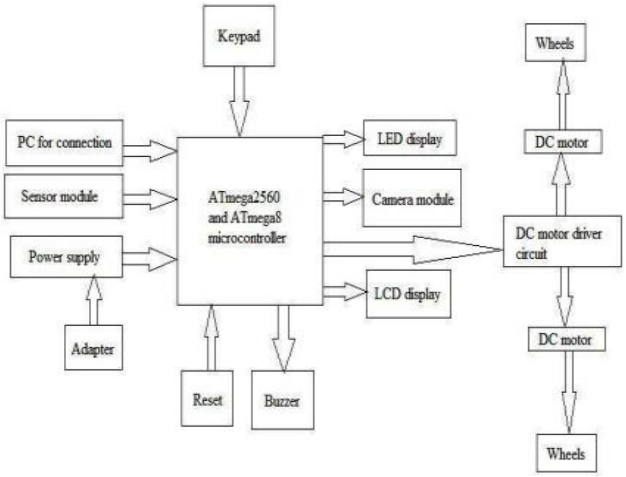

Fig. 4: Block diagram for harvester cum destroyer robot.

2) Working:

This IR range sensor produces voltage signal when the photo diode conducts due to reflection of IR rays. The emitter emits a pulse of IR light. This result travels out in the field of view and either hits an object or just keeps on going. In the case of no object, the light is never reflected and the reading shows no object. If the light is reflect off an object, it turns to the detector and create a triangle between the point of reflection, the emitter and the detector. The angles in this triangle vary based on the distance to the object. The triangle described above. It is an analog infrared proximity sensor. This sensor has a LED that emits infrared light. Infrared light has the interesting property that it bounces on objects. On the front of the sensor, beside the LED that emits infrareds, there is a photodiode that is sensible to infrared light. It will vary the output voltage based on the amount of infrared light that bounces back to the sensor. The more infrared light it sees, the closer is the object and the higher output voltage generated by the photodiode. The sensor will provide an analog output voltage that is promotional to the distance of the object it senses. Its analog output will then be fed into analog-to-digital converter of the microcontroller. This value can be used to determine whether or not there are objects close to the sensor and how far these objects are present.

The camera module interfaced with the Fire Bird is used to identify whether the crops are grown or not and detection of weed takes place. This is done by pre determination of the crops which is being inserted as data from the PC. The images of weed and the type of crop being grown are compared with the data from the camera and sensor module. It compares both the images and the sensor compares the data being displayed in the LCD along with the programmed data. If both the values from the camera and sensor are similar then robot decides the action to be taken place.

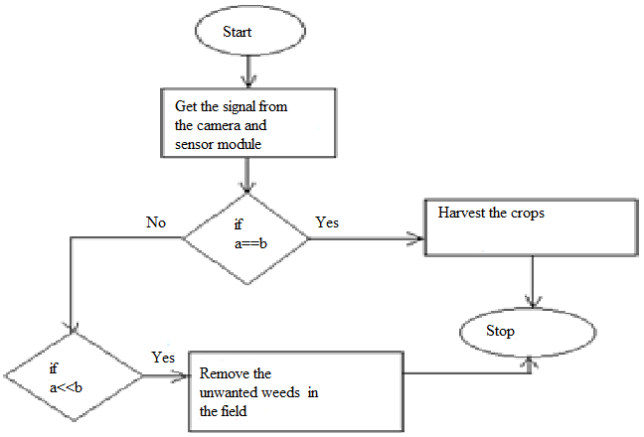

Fig. 5: Flowchart of the harvester cum destroyer model

According to the flowchart, the signal from the sensor and the value in the program are same then the robot has to harvest the crops. If the value of the signal from the sensor is less than the program value then the robot identifies that it is an unwanted weed. Therefore, the robot has to remove the unwanted weeds in the field. These unwanted weeds are removed with the help of gripper circuit.

D. Advantages of Harvesting:

- Less costly, but high capital costs.
- 24 hour harvest possible.
- Less labor management problems.
- Higher wages for workers.
- Stabilizes work force size.

E. Advantages of Weed Control:

Weeding is an important control method practiced in many crops. The removal of weeds is useful because of these unwanted plants compete with the crop for space, water and nutrients. Besides helping to get a healthier crop, weeding has some other advantages. It helps to alter the microclimate below the plants. Sun and wind can penetrate deeper in a weeded crop and reduce the humidity. This can have a positive impact on pest populations and some diseases. Weeding also helps to loosen the soil. Water can infiltrate more rapidly and roots of the cultivated plants can develop in a better way. While weeding is important, keeping a few spots of weeds as a refuge will help to conserve the eco-system. The growth of weeds can be prevented or delayed by using mulch. Weeds can be controlled mechanically or by using chemicals (herbicides). However, the use of chemicals can have adverse side effects on the environment and it involves risks for the farmers who have to handle the dangerous substances.

V. FUTURE SCOPE

For future implementation, agriculture is human kinds oldest and still its most important economic activity, providing the food, feed, fiber, and fuel necessary for our survival. With the increasing global population expected to reach 9 billion by 2050, agricultural production must double, if it is to meet the increasing demands for food and bio-energy. Given limited land, water and labor resources, it is estimated that the efficiency of agricultural productivity must increase by 25% to meet that goal, while limiting the growing pressure that agriculture puts on the environment.

In future the sensing range can be increased by increasing the sensor quality with the help of the IR signal spread all over the provided area. Hence the robots may navigate easily and find which are the crops that are used for harvesting and which are to be destroyed.

VI. CONCLUSION

Thus in this paper we have implemented harvester cum destroyer robot which is used to harvest the ripened crops and remove the unwanted weeds in the field. By using this robot we could be aware that when the crops are in the right stage for harvesting or not. By using this robot we could harvest and destroy the plants from a remote monitoring station.

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