Solar Powered Seed Sowing and Pesticide Spraying Farmingbot with Wireless Control

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Abstract— In India, nearly about 70% of people are dependent directly or indirectly upon agriculture. So the agricultural system in India should be advanced to reduce the efforts of farmers. Various types of operations like digging, seed sowing, pesticide spraying etc are performed in the agricultural field. Traditional methods used to perform these operations are time consuming and these operations uses separate equipment for different operations. So there is a need to develop single equipment which performs all the required operations and also to reduce the efforts of farmers. The unique feature of farmingbot is to develop a system which minimizes the working cost and also reduces the time to perform these operations by utilizing solar energy to run the farmingbot. This system introduces a control mechanism which aims to perform digging operation, drop seeds at particular position with specified distance between two seeds and lines while sowing, closing the pit, pesticide spraying and also the wireless control of the farmingbot. The drawbacks of the existing method will be removed successfully in this automatic machine.

Index Terms— Android application, Arduino Uno, Bluetooth HC-05 module, Farmingbot

1 Introduction

The main motive for developing agricultural automation technology is the decrease in manpower, a phenomenon common in the developed country. Also there is a need for improved food quality. Robotics and artificial intelligence achievements offer solutions in precision agriculture to processes, related to seeding, harvesting, weed control, grove supervision etc. to improve productivity and efficiency.

In the current generation most of the countries do not have sufficient skilled man power in agricultural sector and it affects the growth of developing countries [1]. Agriculture plays a vital role in Indian economy. The need for the automation in the field of agricultural sector is mainly due to the increased need of an agricultural product, due to increased population and reduction in the number of labours in the agricultural sector. This paper is mainly concerned with the automation of a partial process involved in the agriculture (like digging, seed sowing, closing the pit, pesticide spraying) using the energy powered by solar panel and controlling these operations wirelesslly. In [2] the author stated how to employ solar panel to meet the power requirement of farmingbot.

The traditional methods of seed sowing includes line sowing, broadcasting, transplanting, putting seeds behind the plow, dibbling i.e. making holes and dropping seeds by hand. Also in traditional method a pair of bullocks is used to carry the heavy equipment of leveling and seed dropping [3]. The use of tractor is most common in the current agricultural trend. Before the seeding process is done it is necessary to properly mix the top layer of the soil with the fertile bottom layer of the soil which is usually done by the tractors or animal driven plough. This requires a lot of energy and human interaction. Due to the heavyweight of the tractors the soil will be compacted, the compacted soil will lose porosity and it becomes difficult for the seeds to germinate. So it's time to automate the sector to overcome this problem. Pollution is also a big problem eliminated by using solar panel.

2 Proposed System

Some of the existing methods for seed sowing are cost effective but require more man power. It is fully automated and hence trying to reduce cost as well as human dependency [4]. The existing seed sowing methods have limitations like non uniformity in the seed distribution, poor control over depth of seed placement so that labour requirement is high and during Kharif sowing, placement of seeds at uneven depth may result in poor emergence. The farmingbot is not only performing various operations related with farming but also monitoring all the actions related with the movement of farmingbot like obstacle detection, battery voltage and panel voltage and compass sensor output. Here renewable source of energy i.e. solar energy is used as a power supply to feed the power requirement of the system in the form of solar panel.

3 Circuit Design and Hardware Components

The block diagram of farmingbot consists of Arduino Uno which is the heart of the whole assembly as shown in Fig. 1 and solar panel is attached with the lead-acid battery for storing energy and further it is given to power supply circuitry which is providing +5V for Arduino board. Optical Compass Sensor HMC5883L is used for compassing and ultrasonic sensor HCSR04 is used for obstacle detection. It requires +12V

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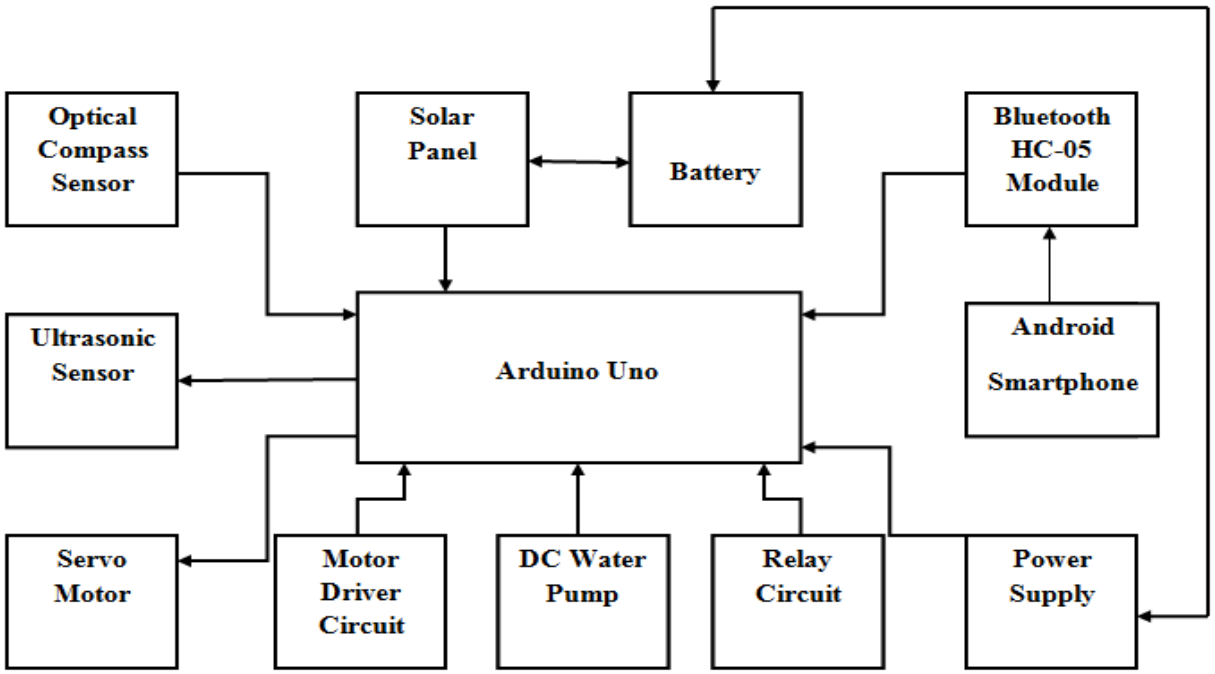

Fig. 1. Block diagram of farmingbot

supply for driving DC motors using l293d. Optical Compass Sensor servomotor is used for seed sowing and Bluetooth HC-05 module is connected with Arduino and wirelessly with android Smartphone to controlling the whole assembly. The hardware of farmingbot is mounted on Chassis which is 28cm long and 22.5 cm wide.

3.1 Arduino Uno Board

Fig. 2 shows Arduino Uno board which is the controller for the whole assembly. It consists of Atmega328 microcontroller. It is a flexible, small, complete, and breadboard friendly. In order to load new code on to the board one can simply use a USB cable. The pin configuration of this board is as shown in table I.

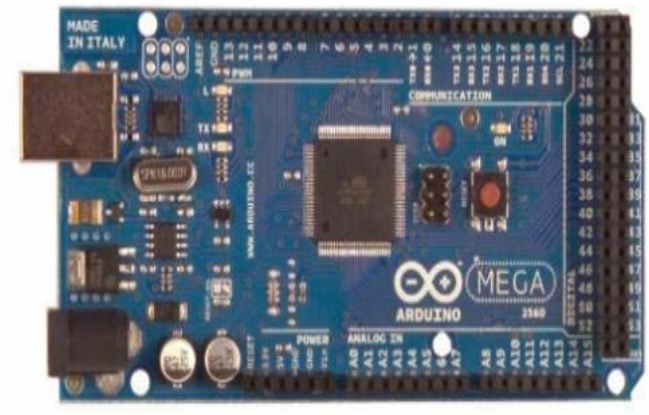

Fig. 2. Arduino Uno Board

3.2 Digital Compassing

Digital compass sensor is used for determining exact 900 rotation of farmingbot if we need to rotate in right or left direction. It includes high-resolution series magneto-resistive sensors plus an ASIC containing amplification, automatic degaussing strap drivers, offset cancellation, and a 12-bit ADC that enables 1° to 2° compass heading accuracy. It uses I2C serial bus which allows for easy interface.

3.3 Bluetooth Interface

Fig.3 shows Arduino and Bluetooth interfacing. While interfacing Arduino with Bluetooth the pin 0(Rx) and pin 1(Tx) of Arduino Uno connected Tx and Rx pins respectively, 5V supply from the board to Bluetooth and grounds of both are shorted.

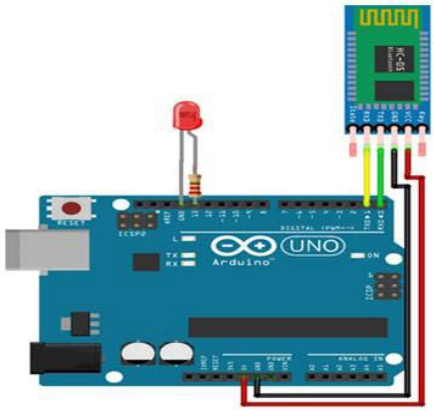

Fig. 3. Arduino and Bluetooth interfacing

3.4 DC Motor Driver

A DC motor is an electromechanical device that converts electrical energy that can be used to perform movement of farmingbot chassis with the help of L293D IC. It is a dual DC motor Controller. Farmingbot requires 60 rpm motors so that torque given by it will withstand the complete weight of whole assembly. In [5] author demonstrated that as power required to run the motors through Arduino is not enough, L293D driver IC is able to achieve the current rating issues.

TABLE 1
PIN CONFIGURATION OF ARDUINO UNO

Pins	Description
0 and 1	Serial Tx and Rx
2 and 3	External interrupts
3,5,6,9,10,11	8 bit PWM
7	BT Reset
10-13	SPI communication
4(SDA), 5(SCL)	I^2C
VIN, GND, 3V3	Power pin
AREF	Reference voltage for analog pins
RESET	Resets the microcontroller

3.5 Relay Circuit

In [5] when solar panel is kept in sunlight and voltage across it is greater than battery voltage, it will start storing the solar energy in the battery. Once the battery gets fully charged, the relay circuitry is on and it will break the connection between panel and battery.

3.6 Obstacle Detection

Ultrasonic sensor is used to measure the distance from the source and the target object. It makes use of time taken by the sound waves to reach back the sensor. The operating voltage is 5V DC and working frequency is 40Hz. The maximum range of this sensor is 400Cm and minimum range is 2Cm with the working current of 15mA. The basic principle is by using trigger for atleast 10us high level signal and then module automatically sends eight 40kHz cycle and detect whether there is a pulse signal back. The functional illustration is as shown in fig. 4.

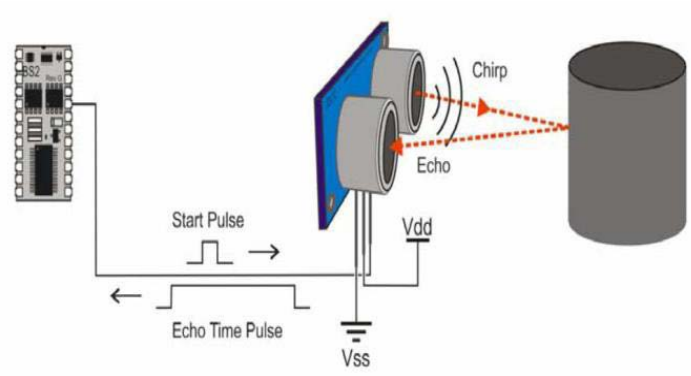

Fig. 4. Working of Ultrasonic Sensor

3.7 Seed Sowing Mechanism

For the application of seed sowing, we are using servomotor. Servomotor is a simple electrical motor, controlled with the help of servomechanism. In this as the shaft of servomotor can be turned by the required degree which is attached with the hopper containing seeds, the mechanism of seed sowing is achieved easily.

3.8 Power Supply

The battery used is a rechargeable type of lead acid battery. Supply voltage is 12V. This battery supplies power to all motors, drivers. The supply is taken from solar panel of 5 watt 12V output so as to fulfill the power requirement for the system. 12V lead- Acid battery is used to store the energy from solar panel.

4 WORKING PRINCIPLE

Fig. 5 shows the flowchart of farmingbot. The farmingbot will be started through the initialization of Bluetooth HC-05 module and configuration of android application developed. After that robot can start moving forward and performs various operations like digging, seed sowing, closing the pit, pesticide spraying. The digging operation is performed by the sharp pointed iron plough is attached on the front of farmingbot and supporter is connected at the back so that removed soil is covered.

If obstacle is detected by ultrasonic sensor HC-SR04, it will stop the dc motors and seed sowing operation till the obstacle is not cleared within specific time otherwise power supply is cut and whole system stops there so that there will be no damage to machine. Android application is used to control farmingbot in the field. There are different buttons to operate farmingbot in the field. Start button is for configuring Bluetooth HC-05 module and android application. Forward button is for starting DC motors in the forward direction and seed sowing button starts the seed sowing and pesticide spraying operation by making servomotors on. For terminating complete activity, stop button can be used etc. The DC motor operation pattern is as shown in table II.

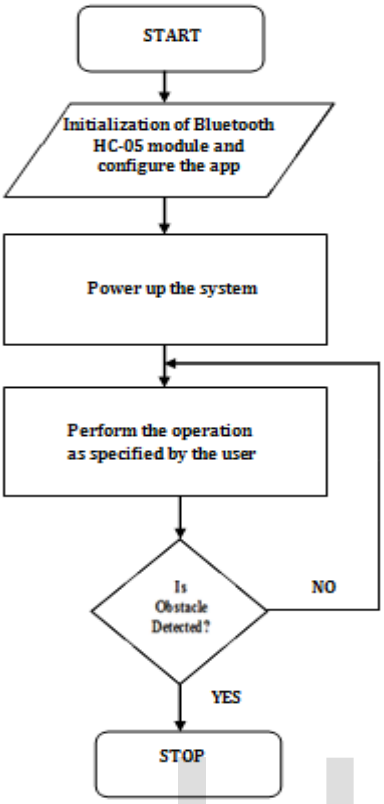

Fig. 5. Flowchart of Farmingbot

Fig. 6. Android Application

TABLE 2
PATTERNS FOR DC MOTOR

Pattern	Input A	Input B
Stop	LOW	LOW
Anticlockwise	LOW	HIGH
Clockwise	HIGH	LOW
Stop	HIGH	HIGH

5 RESULTS

As we can perform multiple operations in a single system it gives cost effective system. Initial step at the implementation stage is movement control of farmingbot. To achieve this arduino is interfaced with motor along with l293d driver IC. The motion of robot is being controlled by writing simple program in arduino platform that makes robot to move in forward, backward, left, right directions. Bluetooth and arduino interfacing is done to makes wireless control of farmingbot. An arm that has been developed for digging operation. Using servomotor and a container for seeds seed sowing setup is created. For pesticide spraying an extra motor and DC water pump are included. A solar panel that has been attached to fulfill the power requirement.

This automated seed sowing farmingbot should have considerable potential to increase the productivity. The chassis handles the complete weight of solar panel battery and the other hardware mounted on farmingbot, which makes farmingbot to perform each and every operation skillfully and successfully. All data collected from farmingbot sends on Bluetooth which will control it's operation using android application successfully. This can be as shown in Fig. 6. The farmingbot gives a compact, low power and low cost system with an efficient output. Fig. 7, Fig. 8,Fig. 9 and Fig. 10 shows the final view of farmingbot.

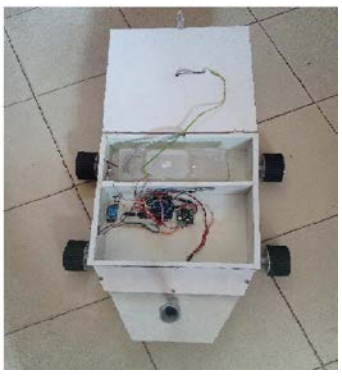

Fig.7. Hardware of farmingbot

Fig. 8. Top view of Farmingbot

Fig. 9. Front view of Farmingbot

Fig.10. Back view of Farmingbot

6 Conclusion

Innovative idea of this project is doing the processes of digging and seed sowing of crops covering the land and pesticide spraying automatically so that human efforts will get reduce up to 90 percent. Agricultural robots or farmingbot is a robot deployed for doing agricultural purposes. Pollution is also a big problem which is eliminated by using solar panel.

The energy needed for robotic machine is less as compared with other machines like tractors or any agriculture tools; also this energy is getting from the solar energy which is found abundantly in nature.

The future scope for this project is not only detecting obstacle but also avoiding it successfully without disturbing the main course of the system.

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