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Zigbee Based Automatic Rover

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ABSTRACT*: In the current generation, most of the countries do not have sufficient skilled man power specifically in agricultural sector and it affects the growth of developing countries. The problem focused here is direct seeding. The manually operated seed sowing technique associates exposure of seeds to rats, birds and snails. So, it is mandatory to automate this sector and a progressive innovation becomes necessity for raising the demand on agro product quality. To give an elucidation to these problems, a sensor guided rover for digging, precise seed positioning and sowing has been proposed to reduce the human effort and also to increase the yield. The rover's navigation is performed by remote guiding devices fortified with the positioning system. Ultrasonic sensors are used to detect obstacles present in the pathway and it maps alternative route for smoother navigation. The rover is steered by high torque DC motor fitted with the available rotating seed storage hopper and digging tool. With the help of zigbee module the robo will receive the command and move further.It can augment with precise weed remover, fertilizer spray unit, pesticide application which enriches Indian agricultural field.*

KEYWORDS*: Direct Seeding, Digging, Ultrasonic mapping, Robot positioning, Seeding sowing, Autonomous robot. wireless communication*

I. INTRODUCTION

As one of the trends of development on automation and intelligence of agricultural machinery in the 21st century, all kinds of agricultural robots have been researched and developed to implement a number of agricultural production in many countries, such as picking, harvesting, weeding, pruning, planting, grafting, agricultural classification, etc.[3]. And they gradually appear advantages in agricultural production to increase productivity.

Autonomous agricultural robots are an alternative to the tractors found on fields today. Cultivation tasks like seeding, spraying, fertilizing and harvesting may be performed by fleets of autonomous agricultural robots in the future. Independent of the actual design a serious agricultural robot will be a complex and expensive vehicle – the challenge is therefore to prove that it is competitive to traditional technology and may even bring a decisive lead.

One critical factor here is the optimal utilization of the robot over the day and over the year. To reach a full utilization the agricultural robot needs to be a vehicle with some basic capabilities and the possibility to support multiple applications. Among the basic capabilities we surely require a navigation system for safe and autonomous navigation. India's record of progress over the past four decades in agriculture has been quite impressive. In the current generation, man power shortage is a major problem specifically in agricultural sector and it affects the growth of developing countries. In India at most 70% of people are dependent on agriculture. The progressive invention in agriculture system is becoming an important task because of rising demand on quality of agriculture products and declining labor availability in rural farming areas.

Today agricultural robots can be classified into several groups: harvesting or picking, planting, weeding, pest control, or maintenance. Scientists have the goal of creating "robot farms" where all of the work will be done by machines. The main obstacle to this kind of robot farm is that farms are a part of nature and nature is not uniform. It is not like the robots that work in factories building cars. Factories are built around the job at hand, whereas, farms are not. Robots on farms have to operate in harmony with nature. Robots in factories don't have to deal with uneven terrain or changing conditions. Scientists are working on overcoming these problems.

Traditional methods include broadcasting manually. The common practice for digging the fields are by using bull or by tractor and the method of sowing the seeds are by hand. Later, the seeds are sowed in the furrow through a bamboo funnel attached to a country plough. For example sowing seeds in small areas they employ dibbling method i.e., making holes or slits by a stick or tool and dropping seeds by hand is practiced. Later, the multi row traditional seeding devices with manual metering of seeds are quite popular with experienced farmers. It is a large time consuming approach. Besides being wasteful, planting was very imprecise and lead to a poor distribution of seeds.

In this paper, the sensor guided rover is developed which is used to automate the process of digging and sowing crops such as sunflower, baby corn, groundnut and vegetables like beans, lady's finger, pumpkin and pulses like black gram, green gram etc. & to reduce the human effort and to increase the yield. All these process are advanced by modifying the mechanism in farming which is self-guided by giving commands in PC or mobile and sending through a wireless module. The obstacle detector and sowing control sensor are also used.

TABLE1
COMPARISON BETWEEN SEED SOWING METHODS

S.no	Parameters	Manual	Tractor	Digging and seed plantation machine
1	Man Power	More	Moderate	Less
2	Time Required	More	More	Less
3	Digging and Sowing technique	Manually	Manually	Automatically
4	Adjustable seed Distance	No	No	Yes
5	Seed Wastage	Moderate	More	Less
6	Energy Needed	High	Very High	Less
7	Pollution	No	More	No
8	Alarm and Display	No	No	Yes

II. METHODOLOGY

The assembly of the robotic system is built using high torque DC motor, Ultrasonic Radar for obstacle detection, sowing control sensor, relay driver circuit, Zigbee module, PC, Battery package, Arduino mega2560 microcontroller and LCD module which is shown in figure 2.1

When DC motor is started, the vehicle moves along the particular columns of ploughed land for digging and sowing the seeds and its movement is controlled by remote guiding device. If any obstacle in the pathway of the rover is discovered, the rover's alternate route is guided by the Ultrasonic radar, whereby the ultrasonic signals gets transmitted and received for obstacle detection.

The sowing control sensor is used to sense whether the seed box is full or empty and sends instructions to the trained person through a wireless controller (Bluetooth) and an acknowledgement message is received.

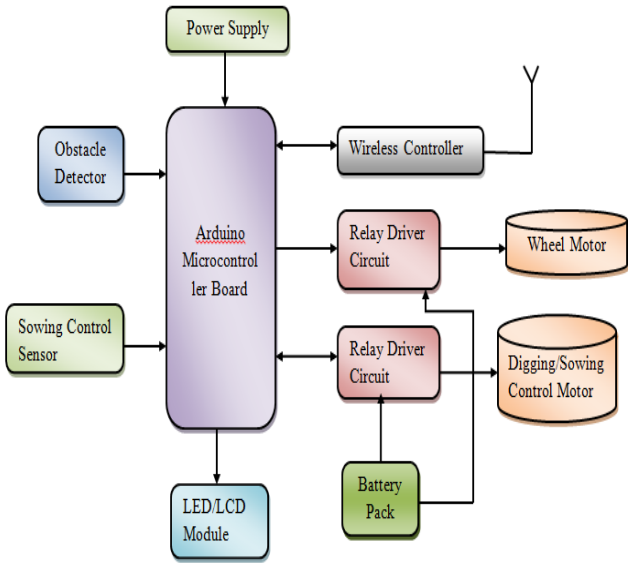

Figure 2.1

Station/remote control:
Tx/Rx

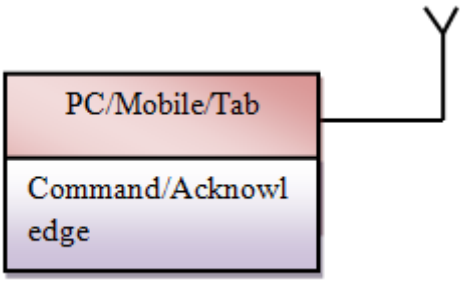

Figure 2.2

LCD module is used to display the condition of the battery level. The remote control transmitter and receiver is shown in Figure 2.2
There are two cases the robot can find,
Case I: If Obstacle present
If any obstacle is present like hard rock in its path, the ultrasonic sensor senses it and sends the corresponding control signals to the microcontroller to turn the vehicle in forward direction and come back against same row per column.
Case II: If no Obstacle is present
If there is no obstacle in the way of vehicle, it moves up to the end of the column and the microcontroller moves in next column and in reverse direction.

III. IMPLEMENTATION

My Project work is divided into two modules.
1. Mechanical module
2. Electronic module

MECHANICAL MODULE:
The mechanical parts of the robot are designed with the help of Solid works Design Software. The line diagram of the digging mechanism, seed sowing rotatory drum and bottom of the robot is drawn and it is converted to three dimensional diagram using extrude Boss/Base and all the parts are assembled by using mate in Solid works Software.

The mechanical module of the rover consist of
- ❖ Seed Storage Hoppers
- ❖ Rotatory Drum
- ❖ Pipes
- ❖ Digging mechanism with blades
- ❖ Bottom frame of Robot
- ❖ Wheel of the robot

The three dimensional diagram of digging mechanism consist of several blades which is used to dig the soil upto 1 to 2 inches is shown in the Figure 3.1

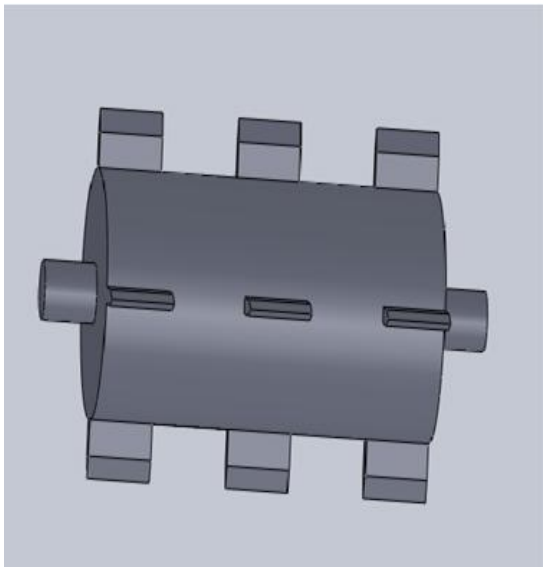

Figure 3.1

The advanced seed plantation machine consists of storage hoper which the seeds to be planted are stored along with a sensor to detect whether the seed drum is empty or full. Below the hoper, rotary drum is provided which has a hole throughout with pipes to drop the seed properly into the soil. The three dimensional diagram of seed storage hopper is shown in figure 3.2

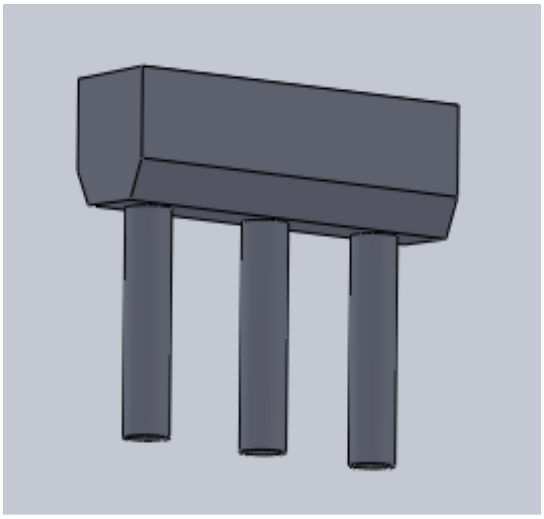

Figure 3.2

The three dimensional diagram of overall model of the robot is designed and developed using Solid works software which is shown in Figure 3.3

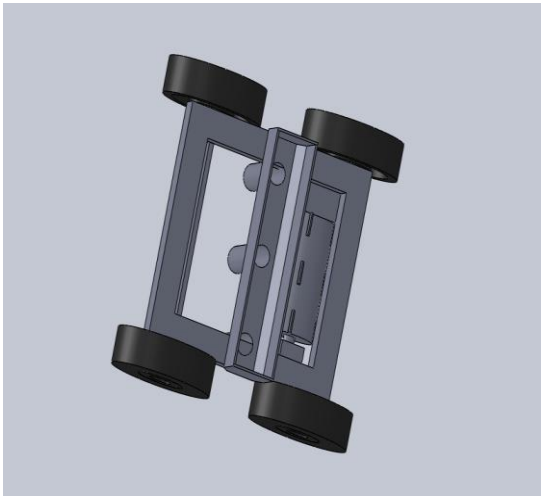

Figure 3.3

ELECTRONIC MODULE:

It consist of

- ❖ Arduino microcontroller board
- ❖ Obstacle detector sensor
- ❖ Sowing control sensor
- ❖ Wireless controller
- ❖ LED/LCD module
- ❖ PC/Mobile

In Electronic module, ultrasonic radar is used to detect if any obstacle present in the land and send the control signals to the Arduino mega2560 microcontroller. Sowing control sensor is to detect whether the seed box is empty or full. 16x2 LCD module is used to display the condition of the battery level.

IV. RESULTS AND DISCUSSONS

In order to validate the functionality of the software, the designed system is simulated using the Proteus ISIS7 design suit software. The simulation includes Arduino with Atmega328 microcontroller, where it is connected to the motor through the motor driver L293D to run the motor in simulation. Two switches are connected to the Arduino Board.

Condition: 1

If switch 1 is closed, and switch 2 is open, the motor will rotate in the forward direction.

Condition: 2

If the switch 2 is closed, and switch 2 is closed, the motor will rotate in the reverse direction which is shown in the Figure 4.1

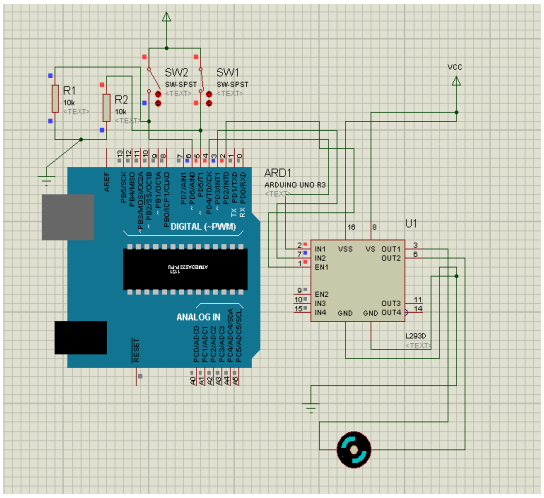

Figure 4.1

In Figure 4.2 LCD is used for displaying the condition of the battery level and also indicating the direction of robot in forward and reverse. In buzzer, sounder is used indicating the beep sound is simulated using Proteus ISIS7.

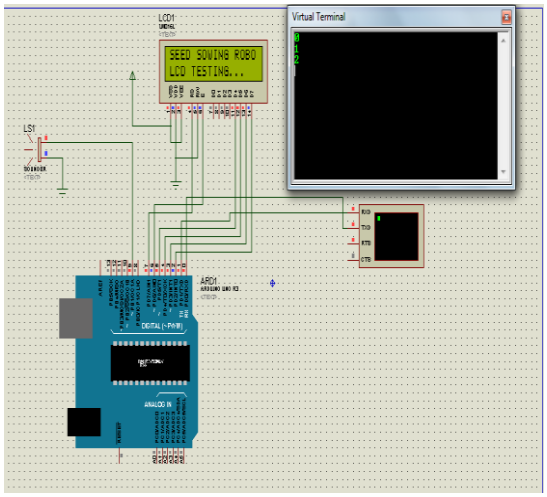

Figure 4.2

For an electronic module, the navigation of DC motor is tested and controlled with the help of Arduino microcontroller board. For driving a DC motor, Transistor 2N222A is used. Command for digging and for sowing seeds are given through a PC and it is controlled by mobile phone as a remote using a Bluetooth module.

Figure 4.4 indicates the snapshot results for sending the commands.
The commanding signals are given as an input to the microcontroller to control the rover. The associated commands and the corresponding action are listed below.
Command S- Stop the rover
M- To move the rover
D-Digging mechanism is enabled.
A-Sowing mechanism is switched on.
O- Digging and Sowing are disabled.

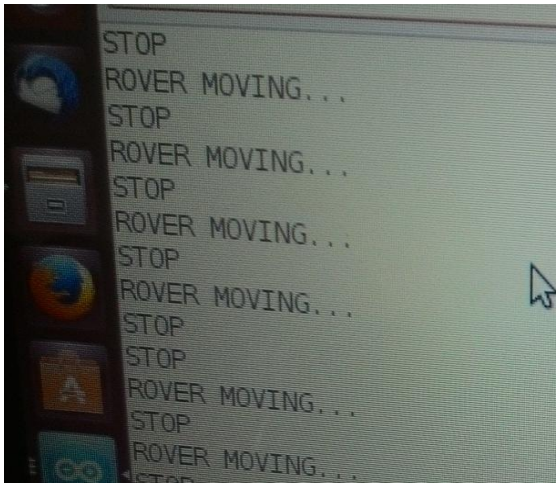

Figure 4.3

ZIGBEE cc2500

Zigbee cc2500 RF is a wireless transmitter receiver used in 2400-2483.5MHZ ISM/SRD band system. It is a low cost 2.4GHZ transceiver used in low power wireless applications. The RF transmitter is integrated with a highly configurable baseband modem. This module provides easy to use RF communication.It can be used to transmit and receive data at 9600 baud rates from any standard CMOS/TTL source.

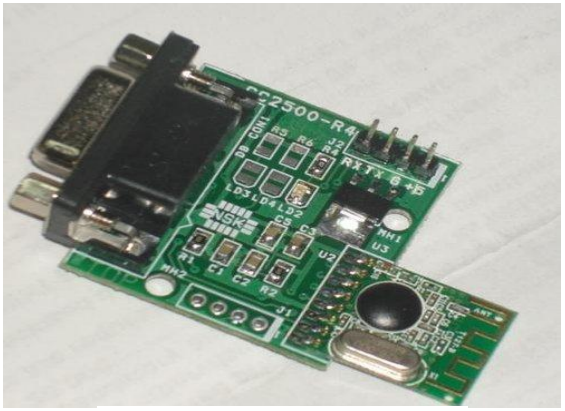

Fig 4.4 Zigbee cc2500-R4 Module

This module is a direct line in replacement for our serial communication; it requires no extra hardware and no extra coding. It works in half duplex mode. (i.e) provides communication in both directions but only one direction at same time. The diagram for Zigbee cc2500-R4 Module is shown in Fig 3.4.

The hardware model of the rover is depicted in Figure 4.5

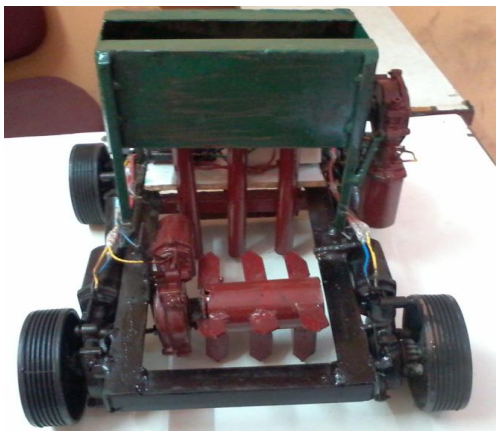

Figure 4.5

SNAPSHOT OF THE ROVER

The Snapshot of the rover shown in Fig 4.6 consist of interfacing of both electronic and mechanical module which is used for digging and seed sowing in agricultural field by sending a command through wireless module.

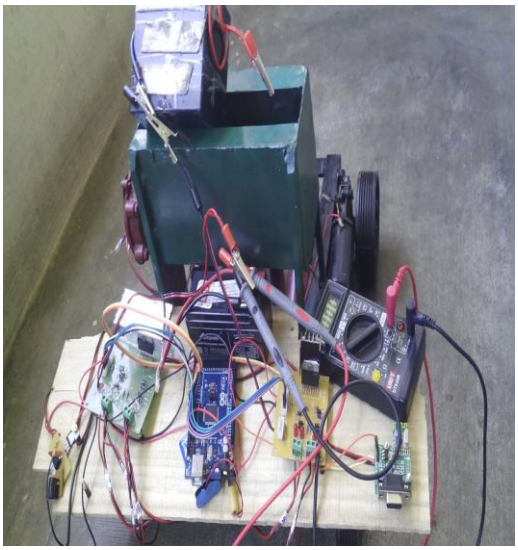

Fig 4.6 Snapshot of the Rover

V. CONCLUSION

The software implementation of the robot is done using Arduino in which the direction of the motor is controlled using the driver L293D and LCD is interfaced for display. The simulation results are obtained using Proteus ISIS7.

The hardware parts of the robot is developed which associates the mechanical assembly of the vehicle, designing the seed drum along with pipes and digging mechanism containing blades..

The experiments with the sensors using the Bluetooth module were successful and showed the versatility of the hardware platform composed of sensors, and microcontroller. The results with the Bluetooth modules showed the limitation of this data transmission which are basically the limited range. Bluetooth communication generally having to be supervised by a central unit (PC) situated close to the sensor platforms.

VI. CONCLUSION AND FUTURE WORK

The agricultural rover is built using a DC motor in which it is controlled by sending a command to the PC through the wireless controller Zigbee cc2560 module.LCD display is used to indicate the position of the battery. The mechanical parts of the rover is designed and developed using solidworks design suit software. The simulation results are obtained using Proteus ISIS7.

By implementing this project in the field of agriculture it can help the farmers in the initial stage of agriculture. i.e., during digging and seed sowing. It is very useful for the farmers who are intended to do agricultural activity but facing the labor problem.

FUTURE SCOPE

The work may be done by extending the range of communication between rover and the user can be implemented using high range module. Also, the solar power can be taken into account for power management

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