Robotic Vehicle for Seed Planting & Weeding Applications

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Abstract

In modern globalization, many technologists are trying to update a new development based on automation which works very rigidly, high effectively and within short time period. The progressive invention in agriculture system is becoming an important task especially because of rising demand on quality of agriculture products and declining labor availability in rural farming areas. Agribot is a robot designed for agricultural purposes. It is designed to minimize the labor of farmers in addition to increasing the speed and accuracy of the work. It performs the elementary functions involved in farming i.e. ploughing the field, sowing of seeds and covering the seeds with soil. The robot is autonomous and provides the facility for optional switching of the weeding system when required. The designed system involves navigation of robot to the destination successfully and does the above functions.

Keywords: Electromechanical, Seed planting, Ploughing, Weeding, Obstacle detection

I. INTRODUCTION

India's record of progress in agriculture over the past four decades has been quite impressive. The agriculture sector has been successful in keeping pace with rising demand for food. The contribution of increased land area under agricultural production has declined over time and increases in production in the past two decades have been almost entirely due to increased productivity. Contribution of agricultural growth to overall progress has been widespread. Increased productivity has helped to feed the poor, enhanced farm income and provided opportunities for both direct and indirect employment. The success of India's agriculture is attributed to a series of steps that led to availability of farm technologies which brought about dramatic increases in productivity in 70s and 80s often described as the **Green Revolution**. The major sources of agricultural growth during this period were the spread of modern crop varieties, intensification of input use and investments leading to expansion in the irrigated area. In areas where 'Green Revolution' technologies had major impact, growth has now slowed. New technologies are needed to push out yield frontiers, utilize inputs more efficiently and diversify to more sustainable and higher value cropping patterns". At the same time there is urgency to better exploit potential of rain fed and other less endowed areas if we are to meet targets of agricultural growth and poverty alleviation. Given the wide range of agro ecological setting and producers, Indian agriculture is faced with a great diversity of needs, opportunities and prospects.

Future growth needs to be more rapid, more widely distributed and better targeted. These challenges have profound implications for the way farmers' problems are conceived, researched and transferred to the farmers. "On the one hand agricultural research will increasingly be required to address location specific problems facing the communities on the other the systems will have to position themselves in an increasingly competitive environment to generate and adopt cutting edge technologies to bear upon the solutions facing a vast majority of resource poor farmers". The robotic systems play an immense role in all sections of societies, organization and industrial units. The objective of the project is to develop a microcontroller based system that helps in on-farm operations like seeding and weeding at pre-designated distance and depths with all applicable.

A. Traditional Sowing Methods:

Traditional methods include broadcasting manually, opening furrows by a country plough and dropping seeds by hand, and dropping seeds in the furrow through a bamboo/meta funnel attached to a country plough. For sowing in small areas dibbling i.e., making holes or slits by a stick or tool and dropping seeds by hand is practiced. Multi row traditional seeding devices with manual metering of seeds are quite popular with experienced farmers.

II. PROPOSED SYSTEM

Agribot is a robot designed for agricultural purposes. Instead of using line follower, camera for live screening in the proposed system obstacle detector is used. It is designed to minimize the labor of farmers in addition to increasing the speed and accuracy

of the work. It performs the elementary functions involved in farming i.e. weeding the field, sowing of seeds and covering the seeds with soil. The robot is autonomous and provides the facility for optional switching of the weeding system when required.

This robot is applicable for seed planting and weeding applications. In this ultrasonic sensor is used for obstacle detection. By using this robot become autonomous. Arm cortex SAM 3X8E controller is used. Agribot can move in farm autonomously by row by row for seed planting or weeding. This robot is designed in such a way it can be sowing any seed. By using keypad we can select particular seed. As per our selection of seed, seed planted inside soil as per it have to plant and also distance between seeds maintained. And distance between two rows also placed as per different crops. LDR is used for indicating seeds in the dispenser by glowing the LED. If seeds is empty then led stop glowing.

III. METHODOLOGY

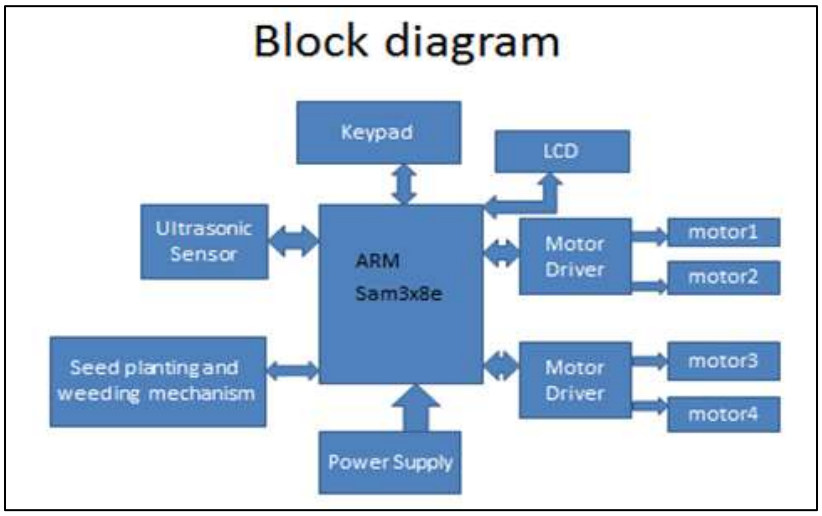

Fig. 1: Block Diagram

The following system design is achieved depending upon the requirements. The block diagram of the robotic vehicle is shown in figure ultrasonic sensor for controlling movement of robot as per selected crop, Keypad is used to select particular seed seen on LCD from different options.

DC motors used for movement control of robot, motor driver is used interface motors to controller. One motor is used to Ploughing or weeding purpose which is selected manually. Other one for seed planting. . By using keypad we can select particular seed. Agribot can move in farm autonomously by row by row for seed planting or weeding as per selected option on keypad. Then robot can be sowing any seed, as per our selection of seed, seed planted inside soil as per it have to plant and also distance between seeds maintained. And distance between two rows also placed as per different crops.

IV. HARDWARE DESIGN

The circuitry mainly consists of ultrasonic obstacle sensor, 4 DC motor responsible for robot movement and remaining two for seed planting and Ploughing or Weeding purpose. These all work is controlled by Sam 3X8E controller as per selected crop by keypad with help of LCD.

The hardware of agribot is mounted on Chassis. All the hardware components and their features are explained below.

A. Arduino Due Board

LCD, keypad, Sensor and DC motors all connected to Arduino board.

The Arduino Due is a microcontroller board based on the Atmel SAM3X8E ARM Cortex-M3 CPU. It is the first Arduino board based on a 32-bit ARM core microcontroller. It has 54 digital input/output pins (of which 12 can be used as PWM outputs), 12 analog inputs, 4 UARTs (hardware serial ports), a 84 MHz clock, an USB OTG capable connection, 2 DAC (digital to analog), 2 TWI, a power jack, an SPI header, a JTAG header, a reset button and an erase button.The board contains everything needed to support the microcontroller; simply connect it to a computer with a micro-USB cable or power it with a AC-to-DC adapter or battery to get started. The Due is compatible with all Arduino shields that work at 3.3V and are compliant with the 1.0 Arduino pinout.

The Due follows the 1.0 pinout:

B. TWI:

SDA and SCL pins that are near to the AREF pin.

C. *IOREF:*

Allows an attached shield with the proper configuration to adapt to the voltage provided by the board. This enables shield compatibility with a 3.3V board like the Due and AVR-based boards which operate at 5V.
An unconnected pin, reserved for future use.

D. *Obstacle Detection*

The important task of Agribot is Obstacle Detection. The ultrasonic sensor working with the help of waveforms. First waveform is Trigger, second is 8 consecutive clock pulses and third is time it takes to leave and return. Ultrasonic ranging module HC - SR04 provides 2cm - 400cm non-contact measurement function and the ranging accuracy can reach to 3mm which can be used for obstacle detection. The module includes ultrasonic transmitters, receiver and control circuit. The basic principle is by using trigger for at least 10us high level signal and then Module automatically sends eight 40 kHz cycle and detect whether there is a pulse signal back. If the signal gets returned through high level time duration, test distance can be calculated as shown in equation.

$$\text{Test Distance} = \frac{\text{Velocity of sound} * \text{High Level Time}}{2}$$

E. *DC Motor Driver*

A DC motor is an electromechanical device that converts electrical energy that can be used to perform movement of agribot chassis with the help of L293D IC. Power required to run the motors through Arduino is not enough, L293D driver IC is able to achieve the current rating issues. It is a Dual DC motor Controller. Agribot requires 60 rpm motors so that torque given by it will withstand the complete weight of whole assembly.

- Seed Sowing Mechanism
- Weeding Mechanism

F. *Working Principle*

Input to the robot given from keypad then that robot can start moving forward and performs various operations like seed sowing and simultaneously digging operation is performed as the sharp pointed iron plough is attached on the front of agribot 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.

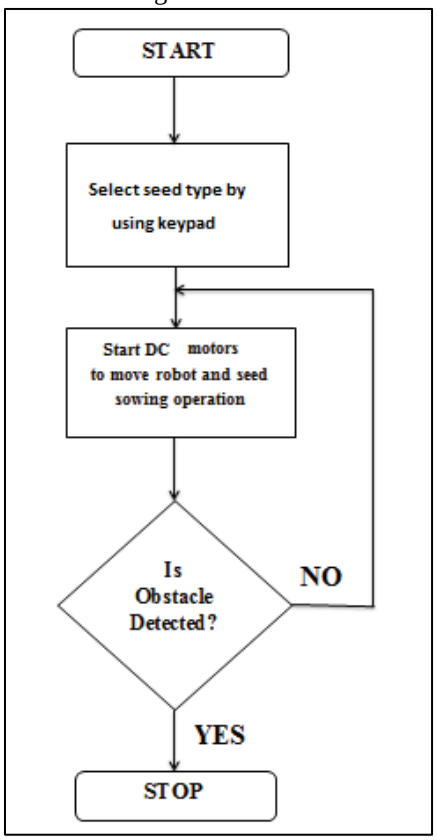

Fig. 1: Flowchart of Execution

G. *Results:*

The proposed system gives a compact, low power and low cost system with an efficient output. The Table shows the placement of seeds in different contours effectively by controlling agribot in get the expected results.

Different seeds	*Expected Distance between seeds (inch)*	*Distance between seeds (inch)*	*Expected Seed depth inside surface (inch)*	*Seed depth inside surface (inch)*
Soybean seed	*2-4*	*3*	*2-3*	*3*
Jowar seed	*2-3*	*2*	*3-4*	*3*
Wheat seed	*0.5*	*0.6*	*3-4*	*3*
Peanut	*2-3*	*2*	*2-3*	*3*

Hence the Agribot gives near about 92% accuracy regarding placement of seeds.

V. CONCLUSION

In this project we made an effort to overcome some problems in agriculture. This project is very useful for the farmers who are intended to do agriculture activity but facing the labor problem. The system is beneficial to the farmers for the basic seed planting operation. The mode of operation of robot for different seed is very simple to configure. Low percentage leading to wastage of seeds can be reduced by the use of this system. Labour problem can be reduced. As compared to the manual and tractor based seed planting, ploughing, weeding time, energy required for this robot machine is less. Also wastage of seed is less. So this system will be a better option for the farmers who want to perform the seed planting operation in a well-organized manner.

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