Seed Sowing Robot

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Abstract- *In modern globalization many technologists are trying to update a new development based on automation which works very effectively and is based on real time technology. Nowdays we see the problem faced by the farmers. The wages of the labours are high. The aim of the design is to reduce the labour work and increase the efficiency of the production. The reduction of labour reduces the man power and due to use of high technologies in the system the crop production will be increased and people can do other works. The essential objective of sowing operation is to put the seed and fertilizer in desired depth and provide required spacing between them and cover the seed with soil. We can achieve yield by proper compaction. The requirement of small scale sowing machine are they should be simple in design, affordable for small scale peasant farmers, easy maintenance for effective*

Keywords- Agricultural automation; Mobile robot; Single seed selector; Seed sowing; Space farming

I. INTRODUCTION

Cropping is important and tedious activity for any farmer , and for large scale this activity is so lengthy also it needs more workers. Thus agriculture machines were developed to simplify the human efforts. In manual method of seed planting, we get results such as low seed placement, less spacing efficiencies and serious back ache for the farmer .This also limited the size of field that can be planted .Hence for achieving best performance from a seed planter, the above limits should be optimized, thus we need to make proper design of the agriculture machine and also selection of the component is also required on the machine to suit the needs of crop.

The agriculture is the backbone of India .And for sustainable growth of India .Development of agriculture play vital role. The India has huge population and day by day it is growing thus demand of food is also increasing. In agriculture we saw various machines. Also there traditional methods are there. Since long ago in India traditional methods are used . Also India has huge man power. Implements locomotion, sensing, actuation, seed handling, data processing, communication etc. Fig. 2 shows the overall block diagram of the robot

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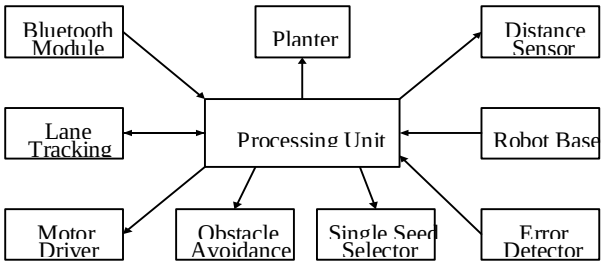

Fig. 2. Higher-level block diagram of the robotic vehicle

A. Robot Base and Structure

As illustrated in Fig. 1, the field of maize crop consists of rows and columns formed by ploughing the soil using tractor. Keeping in view the field structure the robot is designed in such a way that it will move on the row hills with its left and right wheels on both sides of the row hills as illustrated in the Fig. 4. Two nozzles are placed to move into high soil in order to create the space where the seed is to be thrown. On top of the nozzles, two single selectors are installed in order to pick the single seeds one by one and send to the planter for sowing. Fig. 3 shows schematics of the proposed robotic vehicle.

B. Single Seed Selector

One of the main modules of this paper is the single seed selector. Its function is to pick up a single seed from the bulk of seeds to sow in the soil. Maize crop requires that one seed should be sown at a single place so that there is no congestion of the crop. As the corn leaves are larger in size and are spread so their seeds are required to be sown one seed at a single place maintaining a particular seed to seed distance. The seeder has to pick up a single seed from the bulk and then transfer it to the planter which helps to sow the seed in the soil. As illustrated in Fig. 5, the seed selector consists of a linear actuator, vacuum pump, 2 funnels, DC motor, nozzle and a small plastic fan. The nozzle is attached to vacuum pump and linear actuator in order to suck a seed and move up and down inside the funnel. The suction force created by vacuum pump sucks the seed to the open end which fogs the nozzle. Consequently, this up-down motion separates the seed out of the bulk. Fabricated prototype of seed selector is shown.

C. Distance Measurement

It is possible that the field at some places is damp usually when there is dew on the ground at dawn. The dampness can cause the robot wheels to slip away. Rate of distance covered by each wheel with respect to time was required to know about the slipping caused due to the soft surface under the wheels [20]. Encoders are used for the purpose to resolve the issue of wheel slipping by measuring the angle of rotation. Each rotation is then multiplied with the circumference of wheel in order to get the distance covered by each wheel. If the difference between each wheel rotation is detected then surely there is a slippage and the controller will send the commands to wheels in order to solve this issue.

D. Lane tracking and following

From Fig. 1 which shows the nature of rows and columns in the field. So we have to make a high torque robot that would automatically move in the field and exactly follow the lanes by making sure that it provides no damage to any hill row or a lane. Therefore initial problem is to state how robot automatically follows path exactly i.e. following a lane in the field by avoiding the damage to the hills and rows.

We go for image processing [21-23] and G.P.S [24] at first, to make robot able to follow lane in field, but these solutions are expensive, complex and need a strong processing unit which indirectly increase the cost of the project. So, research was conducted about the use of ultrasonic sensors in the path following. As shown in Table I ultrasonic sensors offer several benefits over image-processing counterpart in terms of cost, complexity and easiness in usage without requiring intensive analytical equations [25].

TABLE I. COMPARISON BETWEEN PROPOSED METHOD, IMAGE PROCESSING AND GPS

Factor	**Comparison between alternatives**		
	Ultrasonic Sensor	***Image Processing***	***GPS System***
Cost	Low	High	High
Complexity	Low	High	High
Accuracy	High	High	Low
Precision	High	High	Low

Two sensors are placed on both sides of the robot which are used to measure the distance between wheel of the robot and the hill row. The sensors used continuously send their measured data to the ADC which is used to covert analog signal in to digital which further passes it to the controller. This controls the lane following and tracking of the robot by generating special commands to the motor driver based on the measured values. The motor driver controls the speed and direction of motors based on the commands from controller to avoid robot damaging the hill rows and inappropriate sowing of seeds. The use of ultrasonic sensors take some to measure values which create delay in the decision process due to which small oscillations are produced in the robot's motion and the system quickly goes to overshoot condition. This issue was resolved by implementing a PID controller which reduces the overall fluctuations and results in the steady state motion.

E. Bluetooth Module for Android Base Movement

Wheels are embedded with Gear Motors; they are unable to move until the motor are electrically energized. So to manually control the movement of robot, Bluetooth module is used to communicate to the Android Mobile. Fig. 8 shows the android application which is used to send signals to the robot [27]. The controller receives the signals and generates commands accordingly.

H. Motor Driver

Relays are used to make H-bridges in order to control the motion of the gear motors used to move the robot. An H-bridge is an electronic circuit that enables a voltage to be applied across a load in both directions. These circuits are often used in robotics and other applications to allow DC motors to run forwards and backwards. The H-bridge arrangement is generally used to reverse the polarity or direction of the motor, but can also be used to 'brake' the motor, where the motor comes to a sudden stop, as the motor's terminals are shorted, or to let the motor 'free run' to a stop, as the motor is effectively disconnected from the circuit.

The difference in the speed of both wheels will vary the direction of robot there are three different ways to control the robot's movement [28]:

- When left wheel moves faster the robot will turns to right as shown in Fig.9 (a).
- When right wheel moves faster the robot will turns to left as shown in Fig.9 (b).
- When both wheels are at same speed, robot will move in a straight direction.

I. Error Detector

While the robot is being working automatically, there are some possibilities when the robot causes an error and the system will stop working. So in order to resolve this issue we are using Sim 900 GSM modules. GSM/GPRS is a 2G technology and has an uplink bandwidth of 890-915 Mega Hertz and the downlink bandwidth of 935 -960 Mega Hertz.

Hence the controller will detect the error and then send commands to the GSM module in order to send the error message to the owner.

J. Processing Unit / Controller

The main processing unit used in this research paper is Arduino Mega 2560. It is an open-source prototyping platform based on easy-to-use hardware and software [29]. Over the years Arduino has been the brain of thousands of projects, from everyday objects to complex scientific instruments. It is used as an input and output device to get continues readings from sensors and based on these readings generate corresponding control signals to ensure the accurate working of the robot. All the modules like single seed selector, ultrasonic sensors, GSM and Bluetooth module etc. directly communicate with Arduino using I/O ports

SOFTWARE DESIGN

Flow chart of the overall software architecture is below

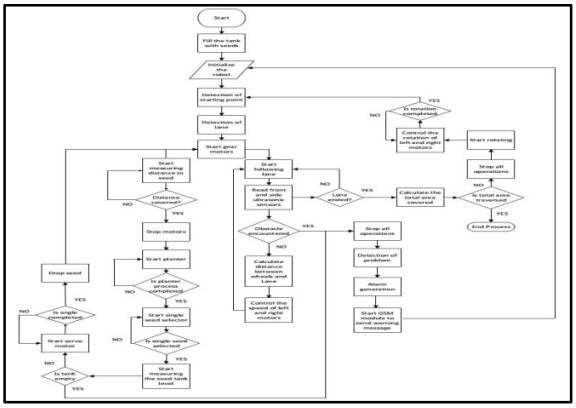

Fig. 10. Flow chart of the proposed software architecture

II. RESULTS

The aforementioned strategy for tracking a lane was initially validated using a mini-robot as illustrated in Fig. 11 where the robot is tracking a wall as shown. The actual path followed by the robot, demonstrates the tracking effectiveness. The working of single seed selector is illustrated in Fig. 12, where single seed is being picked and thrown down through the funnel as shown above.

//ADD Screenshots here

III.CONCLUSION

This robot is designed using DC components and the whole system is battery operated. So solar panels might be used to charge the batteries at the locations where people face electricity problem and where there is no availability of electricity . As a future enhancement, the robot is also designed in such a way that it will not only be used for the seed sowing process of maize crops but will also be used for some other crops like Bean, Cotton and Grain. The robot can also be used for fertilizing and spraying pesticides to the crop fields. As the robot sow the seeds after specified distance so weed detection and recognition also become so easier

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