Agricultural Intelligent Robot

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Abstract

This project mainly emphasizes on the usage of automated agricultural equipment in the field. This robot can plough , sow and can level the land. In existing methods humans are intended to work a lot individually for each steps in farming viz. plough, sowing, and leveling but this technology has made the existing processes even more easier. The robot uses metallic plougher to plough and level the land. A seed storage tank is placed on the top of the robot and it can disperse the seeds individually along each teeth of the plougher. The leveler which is placed behind the seed storage tank closes the soil along with soil. The robot travels in a straight manner in the field. It can automatically sense the distance travelled by the robot and when it reaches the end of the farm it automatically turns accordingly and starts to do the same in the next straight line. In this way the processes are carried out till the end of the farm.

Keywords—*plouhging, seed sowing, levelling, arduino*

I. INTRODUCTION

In our country all the agricultural machines are working on manual operation otherwise by petrol engine or tractor and they are very expensive. To implement a prototype model of drilling and seed sowing machine system within the limited available source and economy. This project mainly focuses on the automation of agricultural farming equipment like plougher, sower. It makes use of artificial sensing technology and ploughs the land in an efficient manner with accuracy. The main aim of this project is to facilitate the use of unmanned agricultural robots in actual farming and to automate the existing agricultural methodologies. The idea of robotic agriculture (agricultural environments serviced by smart machines) is not a new one. Many engineers have developed driverless tractors in the past but they have not been successful as they did not have the ability to embrace the complexity of the real world. Most of them assumed an industrial style of farming where everything was known before hand and the machines could work entirely in predefined ways – much like a production line. The approach is now to develop smarter machines that are intelligent enough to work in an unmodified or semi natural environment. These machines do not have to be intelligent in the way we see people as intelligent but must exhibit sensible behaviour in recognised contexts. These robots should be capable of making correct decisions and should proceed the task without any interruptions. The robot has overcome some of the existing methodologies in Agribots, let's see some of them in detail.

In existing methodologies the robots can be used to pick the fruits, harvest, weed cutting, fertilizer spraying, i.e an Agribot can do a particular function at a time. These techniques have overcome in Multipurpose Agricultural Robots, in these types the robots are controlled using human commands or wired controls. Such robots need continuous monitoring and instructions at each step. They are also used in agricultural practices. Now a days such robots are used in many applications like planting, harvesting, weeding etc. Some of these robots are run by fuel engines and cause pollution. Most equipment manufacturers are developing larger machines, with 42 meter booms. In this project all these drawbacks were overcame and it can replace all the existing types. This robot particularly uses battery supply and would not cause any kind of pollution. These type of robots when used in large number in a field can have efficient automatic control and can be used for a long time without human intervention.

When the field area and its measurements are given, the robot can perform the following actions viz. plough, sow, level in the field in a linear and ordered manner. Due to automation the work become easiest, errorless and it saves money also. The cost of the robot is also cheap and it can replace the high cost robots. When such robots are used in large number in large fields, they can perform the actions perfectly in particular sections as divided by the user. Hence the overall cost can also be reduced and maintenance is also very less. Economic factors include lower labour costs (a significant saving if they can be made fully autonomous), incremental investment in, perhaps, a small machine each year, rather than a single large machine every 5 years.

II. BLOCK DIAGRAM

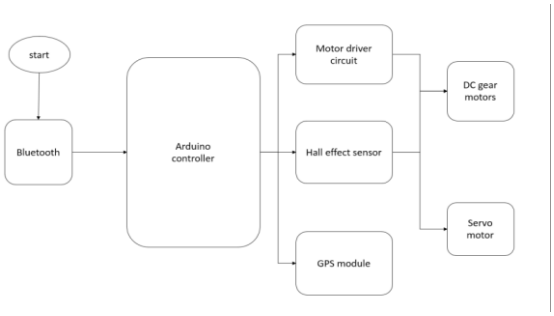

Figure 1- Block diagram

The user should give the start command to initiate the robot to start farming. The start command can be given using a Bluetooth module connected to the Arduino. The start command initializes the GPS module to turn on and it begins to sense the latitude and longitude to check the status. Once the GPS is turned on, the Arduino controller starts to recognize the initial distance and starts measuring. The distance measured by the GPS is the actual distance travelled by the robot in the field. At the same time motor driver circuit is also turned on and the robot begins to move in a linear way and starts to plough. The DC gear motors are controlled using the motor driver and they make the robot to move in forward direction. The motor driver will also control the servo motor and the back wheel is controlled using servo and a DC gear motor coupled to it. The DC gear motor controls the wheels and in turn the plougher which is connected to the base of the robot is also controlled. Hence the robot begins to plough and sow the seeds into the soil. This process makes a linear way for the robot and hence it can plough till the end of the farm. It turns automatically to the either side and does the same till the end. This is the overall explanation and let's see the project components and their specifications.

III. COMPONENTS

A. Battery

First a 12v battery supply is required to turn on the total circuitry. A 12v and 2A battery is used to run the robot. At times solar panel along with a battery controller can also be used.

Figure 2a- Battery

B. DC Gear Motors

The DC gear motors are used to run the front and back wheels in a linear way. The motors are controlled using L293D motor driver IC and the specifications of the motor are 10rpm and 35kg

Figure 2b- DC Gear Motor

C. Servo Motors

The servo motors are used for angular control and top-down movement.

Figure 2c- Servo Motor

D. Controller

An Arduino controller is used to control the over all circuitry of the robot. It requires 5v supply and it is connected serially through a cable. The Arduino controller sends serial data to all the connected equipment and make sense of the data flow.

Figure 2d- Arduino

E. Hall Effect Sensor

A Hall effect sensor is a transducer that varies its output voltage in response to a magnetic field. Hall effect sensors are used for proximity switching, positioning, speed detection, and current sensing applications. In a Hall effect sensor a thin strip of metal has a current applied along it, in the presence of a magnetic field the electrons are deflected towards one edge of the metal strip, producing a voltage gradient across the short-side of the strip (perpendicular to the feed current). Inductive sensors are just a coil of wire, in the presence of a changing magnetic field a current will be induced in the coil, producing a voltage at its output. Hall Effect sensors have the advantage that they can detect static (non-changing) magnetic fields. In its simplest form, the sensor operates as an analog transducer, directly returning a voltage. With a known magnetic field, its distance from the Hall plate can be determined. Using groups of sensors, the relative position of the magnet can be deduced.

Figure 2e- Hall Effect Sensor

F. Plougher

This metallic spike like structure is used to plough the field and can also close the ploughed soil to level the upper layer of the soil. The plougher is made of soft steel material and it is bent at the top to ensure complete ploughing.

Figure 2f- Plougher

G. Wheels

The forward motion is made by the front wheels and the angular movement is controlled using a thin rear wheel. The front wheels have 7cm diameter and 4cm width. The shaft holes are 6mm in circumference. The rear wheel has 7cm diameter and 2cm width and the shaft holes are 6mm in circumference.

Figure 2g- Wheels

(Front wheel) (Rear wheel)

IV. METHODOLOGY

This whole system of the robot works either with battery or solar power. The base frame is made for the robot with 3 wheels and the rear wheels are driven with dc gear motor. One end of the frame, cultivator is fitted which is also driven by dc motor and design is made to dig the soil. Funnel is used to store the seeds and the seeds flow through the funnel through the drilled hole on the shaft to the dug soil. On the end, leveler is fitted to close the seeds to the soil. Whole robot requires the 12v battery to operate the system. GPS module is used to measure the distance covered by the robot. The robot moves in a linear way along the field in a straight manner. Based on the distance covered, the robot senses to the turns and twists in the field. When the robot reaches the end of the field, it automatically turns itself around to plough the next path. In this way the robot can plough and sow the seeds in the entire field.

A. Ploughing

Ploughing is one of the most important primary cultivation processes and has been carried out since the start of civilization. It is effectively the inversion or mixing of topsoil to prepare a suitable seed bed. It also has the ability to bury surface crop residues and control weeds. A small robot utilising current technology does not have the energy density to sustain ploughing over a large area due to the high levels of energy needed to cut and invert the dense soil. A metallic spike like structure is connected to the centre of the robot at the base and can plough the soil from the bottom layer. It is one of the first steps in farming. During this process we till the land and make it ready for the seed sowing. By tilling we mean that a plough will be used which will have teeth's like structure at the end and will be able to turn the top layer of soil down and vice-versa The ploughing tool has two spikes in the front and they are spaced at a fixed distance. The plougher can plough the soil in a convoluted way and can dig the soil firmly and correctly. Here additional mechanisms are not used especially for the plougher. The robot moves front and hence the plougher attached to it will pull it together in the direction of the wheels.

B. Seed sowing

Seed sowing comes next where the seeds need to be put in ground at regular intervals and these needs to be controlled automatically. Limiting the flow of seeds from the seeds chamber is typically doing this. A typical mechanism is used to sow the seeds into the ground. Two tubes are placed near the ploughers and the tubes are covered partially with a closure. The closure is connected to a servo motor and when needed, it can open and close accordingly when the actual distance is measured and sensed by the controller. At specific positions the closure opens and drops a seed into the soil.The seed requires contact with the soil moisture to allow uptake of water and nutrients, it requires stability to hold the growing plant and a structure that allows the roots to develop and the shoots to grow. A solution is two fold. Firstly if we do not compact the soil in the first place there is less need for energy inputs for remedial loosening. Natural soil flora and fauna can be encouraged to manipulate the soil to give a good structure. This is one of the reasons to opt for smaller machines. Secondly, if the majority of the soil rooting depth is acceptable, then only the local environment of the seed needs to be conditioned before seed placement, which will take a lot less power.

C. Levelling

The ploughing tool is used again here to close the soil. It works in a simple manner that existing paths which are formed by the two ploughing spikes are closed by the leveller to ensure the seed does not come out of the soil. It also functions automatically as the plougher do. To make sure of the alignments 3 blades are used here and they are placed behind the plougher. Seed sower is placed in between these two blades. In this manner the ploughed soil can be levelled using the three blade metallic spiked structure. This would allow not only allow the spatial variance of seed density to be changed but also have the ability to alter the seeding pattern. Most seeds are dropped at high densities within each row, whilst having relatively more space between the rows. From first agronomic principles, each plant should have equal access to spatial resources of air, light, ground

moisture, etc. if the majority of the soil rooting depth is acceptable, then only the local environment of the seed needs to be conditioned before seed placement, which will take a lot less power. Add to this the ability to place nutrients in the correct proximity to the seed we can improve the early phase of establishment.

V. IMPLEMENTATION

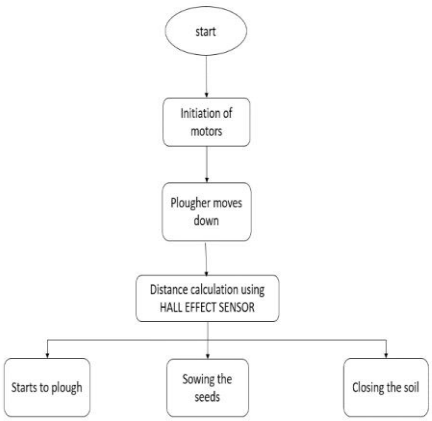

Figure 3- Implementation Diagram

Initially start command is given using HC05 Bluetooth module which is connected to the Arduino module. It initializes the GPS module and it begins to sense the geographical positions. When the latitude and longitude are determined, the robot begins to move in the forward direction, at this time the plougher moves down and get fixed deep into the soil. The robot moves in forward direction and due to the pulling capacity of motor, the plougher begins to plough the soil from deep surface. Now the seed sower begins to sow the seeds into the soil. The sowed seeds should be fixed at one particular location and should drop the seeds at particular intervals. To ensure this, the distance travelled by the robot should be calculated. To measure the distance travelled by the robot, HALL EFFECT sensor is used. The sensor senses the actual distance travelled by the robot using electronic circuits. The sensor circuit sends the distance travelled by the robot. The hall effect sensor is also controlled using Arduino controller and also maintains equal co-ordination with the actual driving system. The robot moves in a linear way and makes the count of the output of the hall effect sensor. Based on the total area of the land, the count of the sensor is set and the rear wheels turn when the output of the counting circuit covers the total land area. The distance is actually calculated in counts and the controller makes use of the count to make decision to control the wheels. The measure of the distance enables us to calculate the location to drop the seed. At each particular location along the ploughed soil, a seed will be dropped. This process is continued till the end of the farm. A straight path is formed in this process. When the end of farm is reached, the robot automatically turns 90 degrees and begins to continue the above mentioned processes. The direction of turning is automatically decided based on the situation. When the robot has to turn either side, the rear wheel of the robot comes down and turns left or right so that the front wheels also rotate and it turns on the either side to start ploughing.

To ensure perfect operation, the robot body is fixed with a metallic frame and can ease ploughing and sowing. To sow the seeds, pipe like structure is used here and the motor which closes the pipes are rotated according to the speed of the robot and the distance covered. The closure opens at particular times and seed drops into the soil. Servo motor is used to control the pipe closure. Servo controller is used to control the servo motor and it is interfaced to Arduino controller. The controller is sensed using special sensors. These sensors can determine the particulars of soil like humidity, moisture etc. To continue the process till the end of farm, the robot turns either side and continues the above mentioned processes. The robot is capable of maintaining automated data flow and intelligence. It can sense the distance to be travelled and the location where the seeds are to be drown and the position where it has to make turns accordingly. To do so the robot uses artificial sensing technology and makes it easier to enhance the movement in an easier way. The robot also uses soil parameter testers like humidity, moisture etc. The robot also uses a monitoring system to notify the completion of the task. When the function is complete the robot sends notification to the user through GSM and can also be tracked at any time in the farm. In case of any obstructions in the field, the robot stops for some time and can resume the paused task. An IR obstacle avoidance sensor is used to sense the obstacle and stops the robot's movement for some time, a delay is created at this time and it exists till the obstacle gets removed.

Two blades plough will increases soil fertility and reduces ploughing time. After ploughing large harrows/cultivators should be used for loosening soil and levelling the ground which in turn helps in easy growth of roots and helps in absorbing nutrients from ground. Weeding equipment. Sowing equipmentThis kind of operations are controlled together by the Arduino controller with motor driver circuits. The motor driver sends command to the motors and controls the forward and backward movement of the wheels. At times the robot has to turn to either side, to do this process the rear wheel is turned right or left and the forward wheels are made to rotate in backward directions. The reverse commands are given at this time and the motor terminals are interchanged in the program by sending HIGH and LOW bits to the terminals. This change will make the DC motors to reverse the direction and turns the robot 90 degrees.Most seeds are dropped at high densities within each row, whilst having

relatively more space between the rows. From first agronomic principles, each plant should have equal access to spatial resources of air, light, ground moisture, etc.

VI. CONCLUSION

This equipment may be in our future, but there are important reasons for thinking that it may not be just replacing the human driver with a computer. It may mean a rethinking of how crop production is done. Crop production may be done better and cheaper with a swarm of small machines than with a few large ones. One of the advantages of the smaller machines is that they may be more acceptable to the non-farm community. The higher quality products can be sensed by machines (color, firmness, weight, density, ripeness, size, shape) accurately. Robots can improve the quality of our lives but there are downsides. The present situation in our country all the agricultural machine is working on manual operation otherwise by petrol engine or tractor is expensive, farmer can't work for long time manually to avoid this problem, we need to have some kind of power source system to operate the digging machine. This automated agriculture robot performs the following objectives.

- Dig the ground to the specified depth.
- Sow adequate amount of seeds in the dug hole.
- Perform all operations automatically in a sequence.
- Safe and easy to operate.
- Reliable, durable and economical.

This paper concludes about the efficiency of the use of the robotic technology in the agricultural tasks. The development of the crop production is done by knowing the needs of the crop such as the type of the soil, weeding, and watering, leveling, drilling, seeding, weather monitoring. To improve the efficiency in the agricultural sector there is a need of the mechanical control system. This can be achieved by the robots which can work faster with more productivity.

VII.SCOPE FOR FUTURE WORK

In the future, this robot can be equipped with other features of farming like testing the moisture content of the soil, then irrigation facilities etc to help the farmers. The solar energy can be generated and used as a source of power for the functioning of the robot by attaching the solar panel to the device. It reduces the human efforts and performs the activities automatically and accurately. The moisture content, soil efficiency can be checked by equipping the robot with the suitable sensors to detect the specific level. If the desired level is not reached then the sprinkler can be attached for the irrigation purpose. This provides the efficient farming.

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