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Multi-Purpose Agricultural Robot

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Abstract: The paper presents about the multiple agricultural tasks done by the single robot. To develop the efficiency of the agricultural tasks we have to find the new ways. This project deals with a novel approach for cultivating lands in very efficient way. The distinctiveness of this agriculture robot system is it is multitasking abilities which can drill, pick and place, seeding, pumping water & fertilizers, weather monitoring to work in both agriculture, afforestation and gardening platform.

Keywords: Drilling, Pick And Place, Weeding, Weather Monitoring.

INTRODUCTION

The project is to make use of agriculture robot for cultivating the land, planting and monitoring the field by Gathering the data of different atmospheric conditions and also to Monitoring the field at particular instants of time. Different kinds of tasks are present in a crop field. In this generation technology is mostly using in every field, to perform any work particular robot's using for a particular task. To perform all the tasks in the agriculture field, we are implementing "Multi-Purpose Agricultural Robot". This robot has different modules add to it, and those modules can be replaced easily to perform required work. This robot runs by using DC power supply. It consists of 14 dc motor totally in that 4 motors are viber motors used to control the robot, these motors will provide high torque and low rpm. For all dc motor require large DC power supply, for that one 12v car battery is used. To control the robot "Arduino and Raspberry pi" control boards are used. And 24 relay modules used to control all the motors.

We had designed our agricultural robot through the CATIA Software.

Existing System:
Different robots are used to complete the agricultural tasks such as pick and place, seeding, watering, drilling, and leveling the soil and weather monitoring.

Numerous specialists have created driverless tractors in the past however they have not been effective as they didn't be able to grasp the multitasking nature of this present reality. The greater part of them expected a mechanical style of cultivating where everything was known before hand and the machines could work completely in predefined ways – much like a creation line. The methodology is currently to create more brilliant machines that are sufficiently used to work in an unmodified habitat culture. One method for understanding the multifaceted nature has been to distinguish what individuals do in specific circumstances also, break down the activities into the machine control.

Proposed system:
Using different robot for the different tasks can consume more time and power, and cost of each one is also more. To avoid these kinds of problems we were using the single robot to perform a different kind of agricultural tasks. And the cost same when compared other robots. Our Robot can perform tasks like Seeding, Drilling, Pick & Place, Levelling, Pumping,

And Weather monitoring. Different tasks will have different modules, all the modules are fixed to the robot. Each module can be separated easily for the particular tasks. Power consumed by each module is minimum.

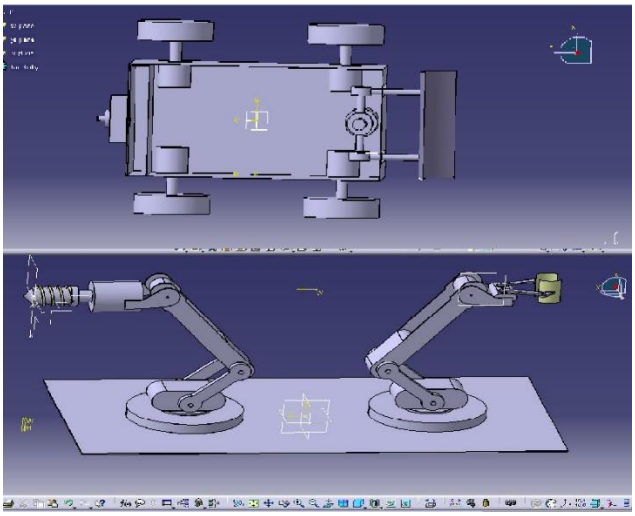

Figure 1. Design of robot

Block diagram:

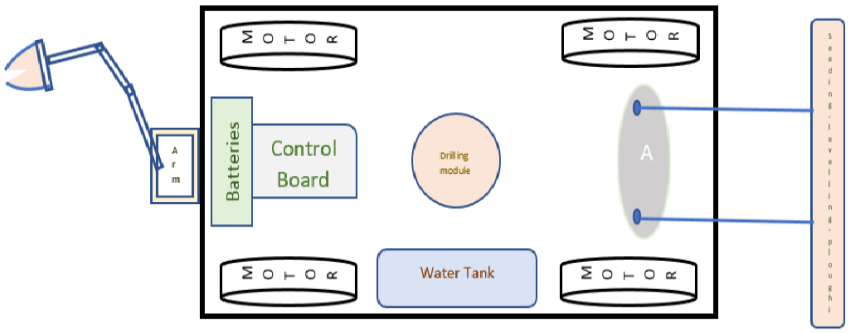

Figure 2. Block diagram

1. Seeding:

Design:

Though many numbers of operations performed in the agricultural field, the significant operation is seed sowing. Here we obtained a new technology for sowing the seeds in a particular order. The seeds are placed with some specific gap between them and which is different for every crop. So in order to overcome the problem, we are designing a seeding wheel in our robot which will itself dig the soil and place the seeds; there are three wheels are using at the front of the robot. The wheel was in hexagonal in shape with two hexagonal plates are connected by using a flat rod and the plate radius is 120mm; a metal gear was placed Perpendicular to each wheel and the circular pipe is used to store seeds. All three wheels are connected single Linear Actuator with help of one metal rod

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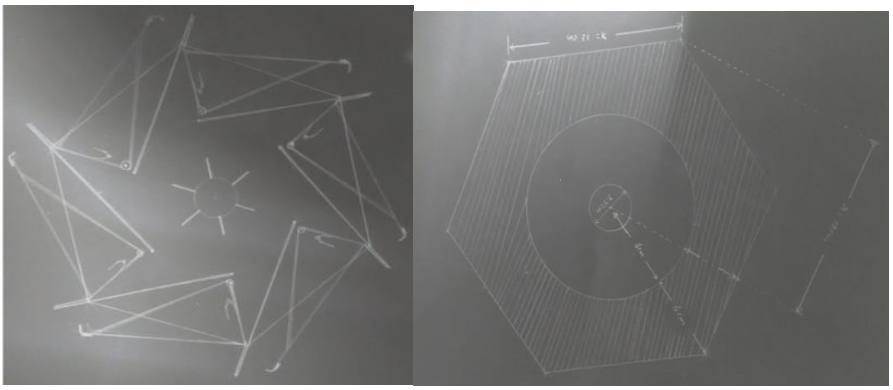

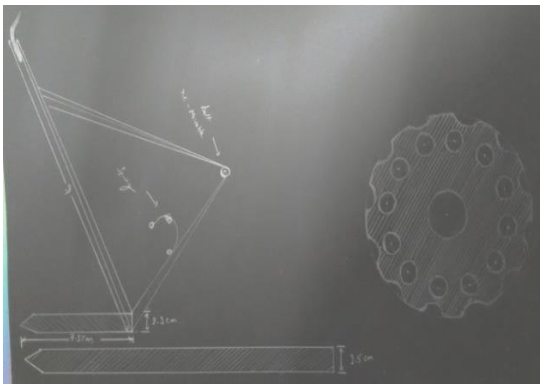

Figure 3. Design of Seeding Wheel

Working:

This seeding mechanism works on the principle on "Push to Open". All the Three wheels are connected to the single rod. This will help to rotate all the wheels at a time. The spacing between the wheels can be adjustable, and the distance between each in a row is 15cm. Seeding mechanism starts operating by the motion of the robot. Robot path controlled by using 'Arduino Mega board'. Length and breadth of field are given to Arduino program, this will estimate the path of the robot according to this actuator will function. All the seeding setup is attached to the actuator. When robot starts functioning actuator comes down, seeding teeth's dig the surface of the soil. This Actuator will also help to lift the seeding mechanism while any obstacles were present in the path, and also in the turning points. The robot starts forward seeding also start to rotate along the direction of robot wheels. Metal gear attached to each and every wheel, these gears contains some holes which can help to flow the seeds one by one inside to seeding wheels through a pipe which is attached to metal gear. Seeding wheel contains six teeth's, initially these teeth are closed; when it starts rotating trigger will pushes and teeth's will open, seeds will be placed in the soil. This mechanism works similar to remaining wheels. So, each seed is placed inside the soil with specified distance. By using this mechanism, we can plant seeds in particular rows and columns. This help to estimate the number of plants has placed and also the outcome of the product. And the crops can grow in a perfect manner.

Figure 4. Seeding Wheel Assembly

2. Drilling:

Design:

Drilling module is placed inside the robot attached to the centre metal bar, 15cm diameter hole was made at the bottom of the robot to move driller up and down. Earth soil was different in different places, the hardness of the soil will vary indifferent. For that, the driller needs to be strong and sharper. For these requirements, we were made an 12* 15 cm earth auger bit. And the weight of the auger bit is 2.5 kg, in order to make drill by using this Auger it requires high torque and rpm motor. So, 1000rpm and 5kg torque one Dc motor is used to rotate Auger bit. Two Linear actuators are used these will help to push and pull driller. And the frame was made to hold the Drilling motor and actuators. The total length of the drilling module 47cm when it is in OFF condition and 62cm in ON.

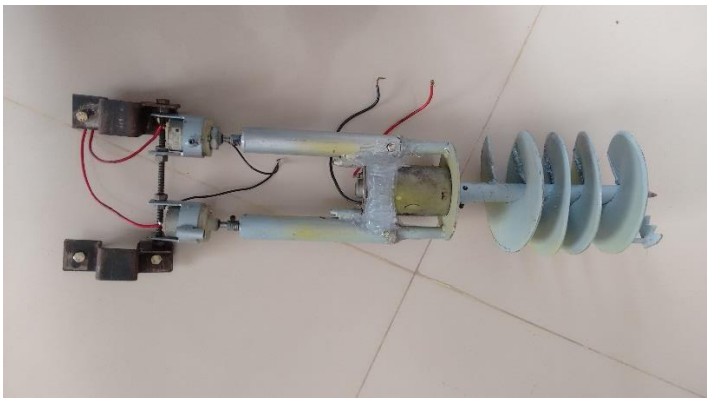

Figure 5. Driller

Working:

To drill the soil for placing the plant is one of the tasks done by the robot. Drilling module is will works normal drilling mechanism. This drilling mechanism is controlled by Arduino Mega board. To start this function first we need measure Length & Breadth of the field and given to Arduino board. And also we need to give the distance between two holes. The robot will estimate the path and it will start operating the drilling module. First two actuators will start functioning, these actuators will push drilling motor to move down. When Earth Auger reaches the earth surface with some minimal delay drilling will start functioning. Driller rotates clockwise direction continuously and actuator pushes down simultaneously. This process will make 13 cm circular hole and 15cm depth to the earth surface. After completion of this process, driller starts rotating in counter clockwise direction for few seconds and it will stop, Actuators starts pulling back the drilling mechanism inside to robot. After completion of one whole robot will move forward to a distance which is equal to the previously entered distance between two holes. This will start again the drilling process to make a hole likewise one by one in a row with equal distance on given. The size of the hole can be varied by changing auger bit. After completion of making all holes in the specified length and breadth of fields, all the holes placed exact manner in a row and column wise. Plants can be placed by using robotic arm because every hole is made exact position. After growing plants to a certain time, the crop seems in very beautiful.

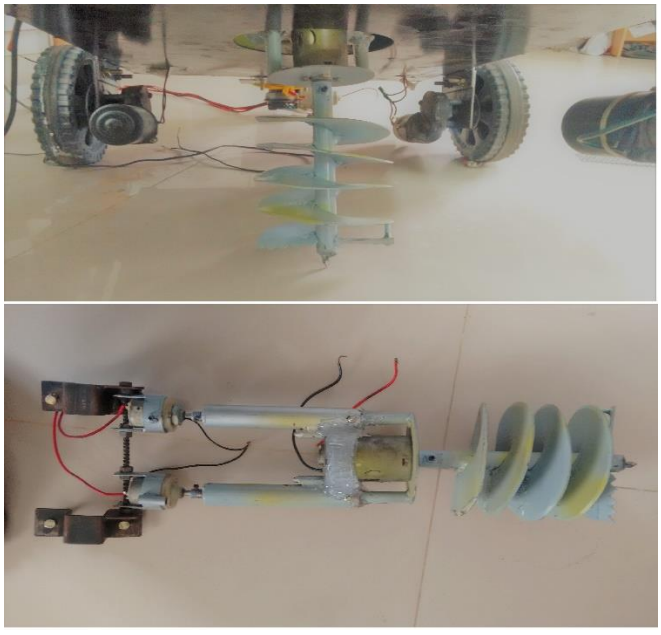

Figure 6. Drilling Assembly

3. Pick & Place Robotic ARM:

Design:

Robotic ARM is placed at the back side of the robot. This ARM consists of 4 dc Linear Actuators and one viber motor is used as a base motor for the ARM. Linear Actuator was made by using 12*120 mm tread rod, one DC Gear motor with 200rpm 20kg torque, and two different sized metal pipes. $1_{1/2}$ *2-inch metal pipe to hold dc gear motor, and ¾ *8-inch metal pipe is to fix thread rod. Thread can't be fixed directly inside the metal pipe; So, 1-inch circular nut was made for thread rod to fix inside ¾ -inch pipe. Both metal pipes having holes at the corner. The frame of the Robotic Arm is made by using 2mm metal sheet contains 5mm holes. This metal sheet cut in four different sizes, same sized sheets are connected parallelly by using 5mm bolts in zig zag passion. This Frame is lightweight and strong. And gripper is made with acrylic sheet, has two fingers. This gripper will function with help of DC actuator. The length of the full arm is 165cm.

Working:

Pick & Place works on the principle of the normal hand mechanism without any use of sensors. First, we discuss the design guideline and a working principle. Second, we realize and apply the mechanism by combining a mechanical finite four states system m and our previously developed passive closure gripper. Third, we analyze and clarify some properties of the hand. Furthermore, we confirm the validity of the developed hand by manipulation experiments. We had to make sure that any payload mechanism doesn't affect the internal mechanism of the robot. So, viber motor is used as a base motor for the arm, it has torque and minimal rotation speed. These viber motor cannot be used directly. Because, if the motor makes one successful rotation arm will rotate 360^0, this rotation will lead to breaking all the, also controlling the rotation of with some angle is not possible manually; to avoid this problem relays required with some time delay. The time delay can help to rotate the arm with a certain angle. And the Arm is controlled by using "Arduino Mega board'' with help of relays. Each motor requires 2 relays, the arm contains 5 dc motors, it requires 10 relays to control the movement. This can be controlled by using the keyboard. On the field this arm will help in different situations like plants are placed on top of the robot and arm will hold one plant lifts up arm will rotate & it will place in a hole which is drilled previously, holding the thing, picking obstacles, etc.

Figure 7. Design of robot

4. Levelling:

Design:

The design of lever is easier when compared all other the module. By taking a metal sheet and make a bent to certain angle this will form an arc shape. The size of the leveling sheet 2mm thin, 50cm length and 15 cm height. From the center make 5mm holes horizontally with some distance to the both sides of the center this will allows connect with front Actuator. Leveling plate was placed at the front side of the by replacing with seeding module.

Working:

Leveler is placed at front of the robot. This will help to make an uneven surface to a flat shape. This will work simply by making Front actuators come down. When robot starts moving forward, the even surface has up's down's leveler will make all the area to flat surface. This is very compatible for leveling gardens, small areas, closing gaps, etc.

Figure 8. Leveller

5. Pumping water and fertilizers:

Design:

For pumping water and fertilizers requires small dc pumping motor. This pumping motor made by using 1000 rpm dc motor can support 12v to 24v. 5 liters can be used to collect water, it is attached to pumping motor. In between motor and tank check valve is fixed to control the flow of motor.

10mm 3 meters' length transparent pipe is connected dc motor, and the edge of the pipe is connected to sprinkler it is attached robot arm. Pumping motor and tank is placed at the side of the robot.

Working:

By giving dc power to pumping motor, the motor starts pulling water or fertilizers from the tank and starts pumping water through the pipe. The motor can pump a maximum of 250ml per minute. The pipe is attached to the robot arm, by Arm using we can make sprinkle liquid directly to the plant. This will help farmers to keep away from poisonous fertilizers.

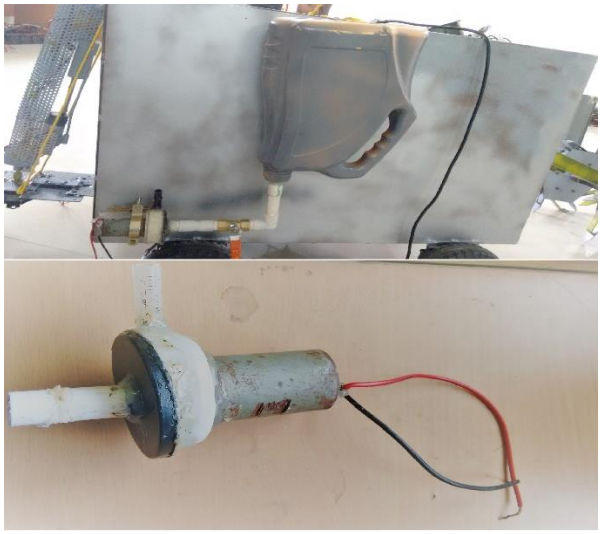

Figure 9. Pumping Motor Design & Assembly

6. Weather monitoring:

As the agriculture totally depends upon the weather conditions it is necessary to develop the weather detecting techniques in a robot. The ability to monitor the environmental conditions is necessary for agriculture. Weather parameters are considered and by using sensors we are performing the activity. Microcontrollers are used for measuring the units of temperature, relative humidity, water level and soil moisture. For the weather monitoring, we are using Arduino software and the sensors to calculate the weather parameters. The output is collected and given to the system.

Advantages:

- Multiple tasks are done by single robot
- Work will be reduced
- Time is reduced
- Efficient use of resources
- Seeds and plants can be planted in rows and columns
- Reduced in human power

Disadvantages:

- Controlling motors are difficult
- Complex connections
- Large dc batteries required

CONCLUSION

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.

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