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Development of Multipurpose Agro-Robot

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Abstract
This project is the newly emerging technology in agriculture sector to save the time and energy that is wasted in repetitive farming tasks automation in farming processes is quite helpful. To design these sorts of robots there should be certain considerations and particular approach considering the agriculture environment in which it will be working. The working of an autonomous robot is based on field parameters i.e. length and width. Prototype of an agricultural robot "Agro-Bot" is modeled for multitasking such as seeding, ploughing and harvesting with a separate irrigation system. It is a tri wheeled vehicle which is controlled by ATMEGA328 microcontroller (Arduino) as master controller, Humidity sensor for irrigation, power supply is provided by solar panel which is eco-friendly to the environment. It will also help in decreasing the use of nonrenewable sources of energy and will not pollute the environment. Other accessories are slaves performing specific operations. The approach is now to develop smarter machines that are intelligent enough to work in an unmodified or semi natural environment.

Keywords: Robotics, Agriculture, Arduino UNO, Sensors & Actuators

INTRODUCTION

In India generally, the traditional seed sowing methods includes the use of animal drawn funnel and pipes driller or drilling using tractor. Earlier method requires labor and a very time and energy consuming. Whereas in tractor-based drilling operators of such power units are exposed to high level of noise and vibration, which are detrimental to health and work performance. The emphasis in the development of autonomous Field Robots is currently on speed, energy efficiency, sensors for guidance, guidance accuracy and enabling technologies such as wireless communication and GPS.

In olden days technology was not developed that much. So, they were seeding by hand. But nowadays technology is developed. So now it's not necessary to do seeding in sunlight. By using robot technology, one can sit in a cool place and can-do seeding by monitoring the robot motion.

In recent years, robotics in agriculture sector with its implementation based on precision agriculture concept is the newly emerging technology. The main reason behind automation of farming processes are saving the time and energy required for performing repetitive farming tasks and increasing the productivity of yield by treating every crop individually using precision farming concept. Designing of such robots is modeled based on particular approach and certain considerations of agriculture environment in which it is going to work. These considerations and different approaches are discussed in

this paper. Also, prototype of an autonomous agriculture robot is presented which is specifically designed for seed sowing task only.

OBJECTIVES

- The aim is to boost the effectiveness of farming tasks like plowing, seeding, weeding, harvesting through automation.
- By employing multipurpose robots, farmers can streamline operations, saving time and labour.
- Multipurpose agricultural robots target lowering production costs by reducing reliance on manual labor, a major expense for farmers.
- Goal is to facilitate precision agriculture using sensors and advanced tech to monitor soil conditions, crop health, and environmental factors.
- In regions facing agricultural labour shortages due to factors like aging populations and urban migration, multipurpose robots can help by automating manual tasks, ensuring farm productivity and sustainability.

PROBLEM STATEMENT

This system has 2 main sections, watching station and management station, that are inter-communicated using/aided by the wireless Bluetooth communication technologies. The management station furthermore as robotic station possesses the amenities that is soil wetness device, seed dispenser, and seed storage, malady Detection, robotic system with motors, ARM microcontroller, and power offer. The microcontroller is brain of this method, which might dedicate the order of suggestions received to any or all the networks, and wise factors processed by their corresponding embedded programs. Robotic mechanism plays by their internal motors and motor drivers that drive the motors in desired directions. The Bluetooth wireless protocol used for signal sending and receiving functions. The ADC is approximation analog to digital convertor and helps in process of analog factors within the microcontroller. Here the one can monitor the golem and send the signal. in line with the received signal the golem can move within the direction and it'll place the seed on field for specific distance. In the planned system artificial intelligence model provides a facility to manage the movement of agriculture vehicle. the standard and amount of agricultural merchandise will cut back by Plant diseases that have created a colossal post impact situation

REQUIREMENT SPECIFICATION

Hardware requirements:

- Arduino UNO
- Moisture sensor
- DC motor
- Battery
- Relay circuit
- Solar panel
- Bluetooth module
- Ultrasonic sensor
- Motor driver

- Humidity sensor
- Temperature sensor

Software Requirements:

- Arduino IDE
- Python

METHODOLOGY

Methodology is a method and technique for designing, collecting and analyzing data to produce evidence that supports a study. Methodology describes how a problem is studied and why a method and technique is used. Methodological studies are a rigorous planning in the course of this semester. In order to facilitate the final project journey, the methodology must be set as best as possible. With this, every step of the journey of this project will not fall short of the set path or more precisely the end result of the study will meet the needs of the problem to be solved. Therefore, it is very important to know and understand in depth each of the processes involved in structural engineering studies. In this chapter, there will be a lot of information about processes and travel through the production of our final project.

Agriculture robot is capable of performing operations like automatic plowing, seed sowing, and water sprinkling. The qualitative development of this project is request for a system which minimizes the working cost and reduces the time for digging task and these entire tasks run by battery source also we can adopt solar energy system. Development aim of this system is that these devices can atomically actions on agricultural operations. Now a day's formers pay lot of money for machines that help them to decrease labor and increase income of crops but efficiency and profit are less. Hence automation is the ideal solution to decrease all the failing by development of machines that performs one operations and automating to increasing the income on a large value.

The main reason behind automation of farming processes are saving the time and energy required for performing repetitive farming tasks and increasing the productivity of yield by treating every crop individually using precision farming concept. Designing of such robots is modeled based on particular approach and certain considerations of agriculture environment in which it is going to work.

These considerations and different approaches are discussed in this paper. Also, prototype of an autonomous Agriculture Robot is presented which is specifically designed for seed sowing task only. It is a four wheeled vehicle. Its working is based on the precision agriculture which enables efficient seed sowing at optimal depth and at optimal distances between crops and their rows, specific for each crop type. Fig 1 shows the Block Diagram of the model.

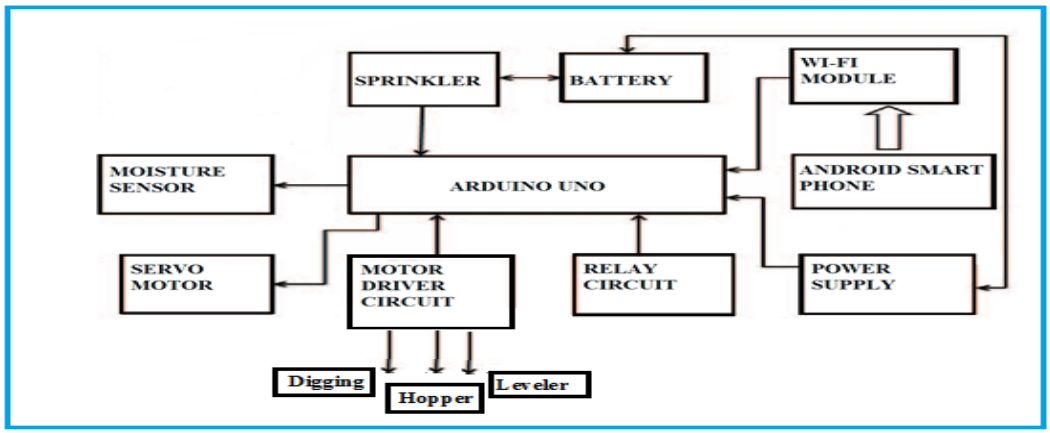


FIG 1 BLOCK DIAGRAM OF AGRO-ROBOT

The fig 2 refers the circuit diagram of multipurpose Agro-robot

1. Power Supply:

12V 1.3 Amp Battery: This is the main power source for the robot. It provides the necessary voltage and current to drive the motors and other components. Thick Red and Black Wires: These represent the positive (red) and negative (black) connections from the battery, delivering power to the circuit.

2. Motor Control (Driver IC 1293d with Motors):

Driver IC 1293d: This is a motor driver integrated circuit (IC). It's crucial for controlling the DC motors used for the robot's wheels. The 1293d allows the Arduino to control the direction and speed of the motors by providing signals to its input pins. It can handle relatively high currents, making it suitable for small to medium-sized DC motors.

LEFT MOTR 1 & LEFT MOTR 2 / RIGHT MOTR 1 & RIGHT MOTR 2: These represent the two pairs of DC motors that drive the robot's left and right wheels, respectively. Using two motors on each side likely allows for differential steering (like a tank). Connections from the Arduino to the 1293d:

The diagram shows multiple connections between the Arduino (specifically, its digital pins) and the 1293d. These carry the control signals that determine the motors' speed and direction.

3. Arduino UNO (Microcontroller):

- Arduino UNO: This is the brain of the robot. It's a microcontroller board that's programmed to control the various functions of the robot, including:
- Motor Control: Sending signals to the motor driver to control the wheels.
- Plow Motor Control: Controlling the plow motor for tilling or digging.
- Seeding Motor Control: Managing the seeding mechanism.
- Spray Pump Control: Activating and deactivating the spray pump.
- Reading Sensor Data: Receiving input from the obstacle detector.
- Bluetooth Communication: Communicating with a user or another device via the Bluetooth module.
- Connections to other components: The diagram shows the Arduino connected to all other modules, sending control signals and receiving sensor data.

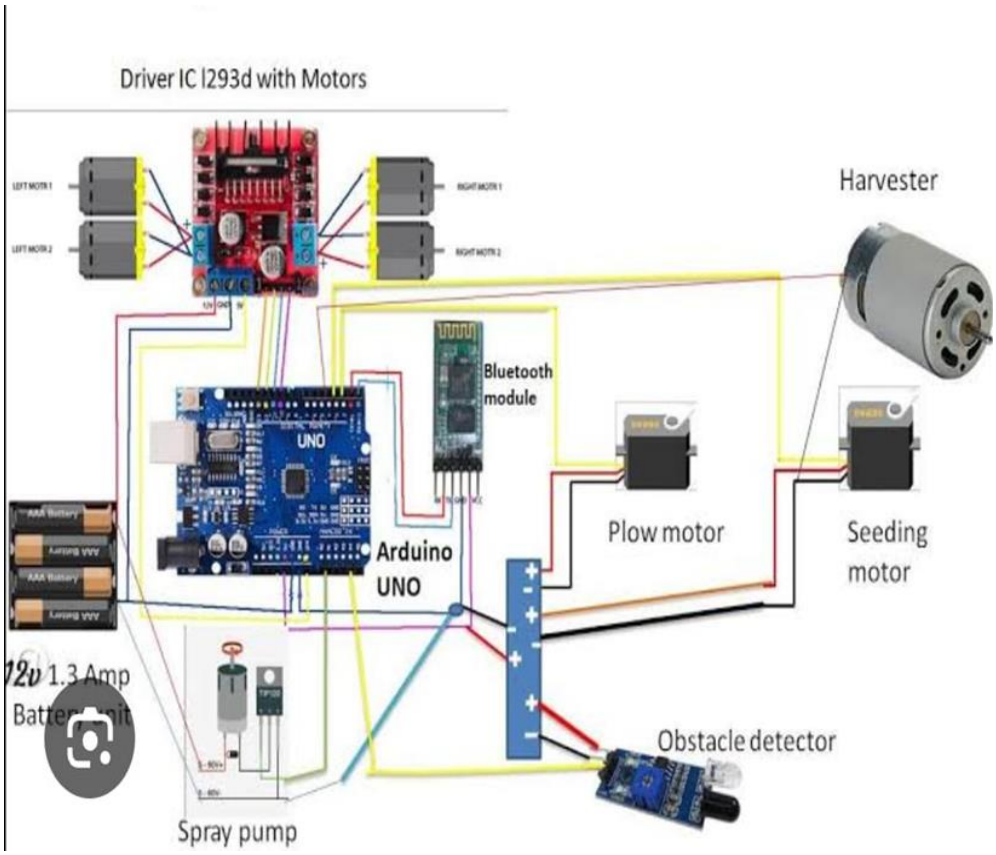
4. Peripherals and Actuators:

- Harvester: This represents the harvesting mechanism, likely a motor-driven cutting or picking tool.
- Plow Motor: This motor powers the pow for tilling or digging.
- Seeding Motor: This motor controls the seeding distribution mechanism.
- Spray Pump: This pump is used for spraying pesticides or fertilizers.
- Obstacle Detector: This sensor detects obstacles in the robot's path and sends signals to the Arduino, enabling it to avoid collisions. The diagram suggests it might be an ultrasonic sensor or an infrared sensor.

5. Communication:

- Bluetooth Module: This allows for wireless communication with the robot, possibly for remote control or data logging.

FIG 2 CIRCUIT DIAGRAM OF AGRO-ROBOT



IMPLEMENTATION

The agricultural robot will be using a chassis as a base to connect and assemble everything on it will be consisting of four motors. Two of which are toy motors and the other being gear motors. The robot is capable of doing three separate functions.

1. Digging
2. Hopper
3. Leveller
4. Sprinkler

These will be working in different modes. Programming of different modes will be done separately the different modes .The LCD will be displaying the input given to the robot by the user the measurements of the length and breadth of the field are to be given in feet.

Fig 3 refers to model of agro-robot.

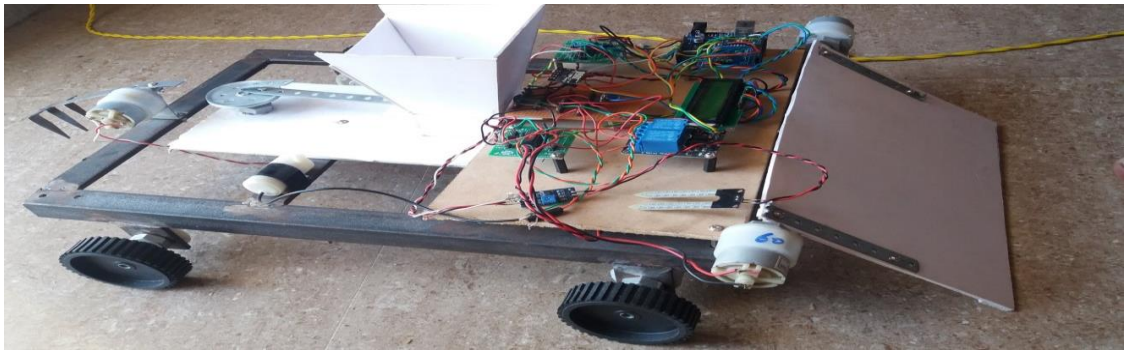


FIG 3 MODEL OF MULTI-PURPOSE AGRO-ROBOT

MODE 1: DIGGING

Here 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, robot which will itself dig the soil and place the seeds. Table 1explains placement of seeding.

TABLE I: THE PLACEMENT OF SEEDING

Placement of seed(distance between two seed)	Farm land
Corn Expected(6-8 cm)	7.2cm
Wheat Expected(8-10 cm)	9 cm
Jowar Expected(10-12 cm)	10cm
Soya bean Expected(5-6 cm)	5.3 cm

MODE 2: HOPPER

Hopper is used to carry seeds and to drop the seed at a particular hole that is being dig by agro-robot. Fig4 refers to hopper.

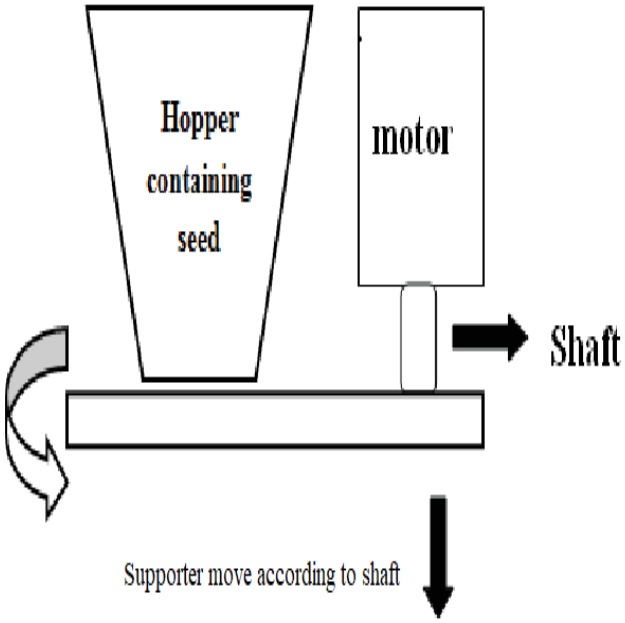


FIG 4: HOPPER

MODE 3: LEVELLER

Leveller 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 and down's leveller will make all the area to flat surface. This is very compatible for levelling gardens, small areas, closing gaps, etc.
Fig 5 refers to leveller.

FIG 5: LEVELLER

Crops	Humidity (%)	Moisture level
Corn	65	33
Yellow corn	65	15.3
Soybean	65	12.6
Wheat	65	13.8
Barley	65	19
Jute	65	13.7
Paddy	65	24

MODE 4: SPRINKLER

This is lightweight, small size, high efficiency, low consumption and low noise water pump. It has been used widely; in household include cooking, cleaning, bathing, space heating and water flowers, etc. Fig 6 refers to sprinkler.

FIG 6: SPRINKLER

RESULTS

The result of the project between referred papers is shown in the comparison Table III.

TABLE III: COMPARISON TABLE

Paper	Methodology	Limitation	Proposed method
Sunitha.M et al., [1]	It uses the robot for seeding the plants at the interval.	Rising of input costs, accessibility of skilled labors, lack of water resources and crop monitoring.	This project aims to Automation technologies with robots were used in agriculture vehicle.
M. Priyadarshini et al., [2]	DTMF technique it overcomes the range problem of using Bluetooth or RF module which having limited working range.	Wi-Fi to communicate between two robots which perform activities like seeding, weeding, spraying of fertilizers and insecticides	Obstacles avoidance operation and metal detection in the path.
Ankit Singh et al., [3]	It uses the remote to operate but needs certain distance for operation.	Perform only two operations like ploughing in the field and then planting a seed at a regular interval.	To drop the seed stepper motor is used and to dig a hole, spike wheel is used.

PROJECT IMAGE

DEVELOPMENT OF MULTIPURPOSE AGRO-ROBOT

Is shown in Fig 7.

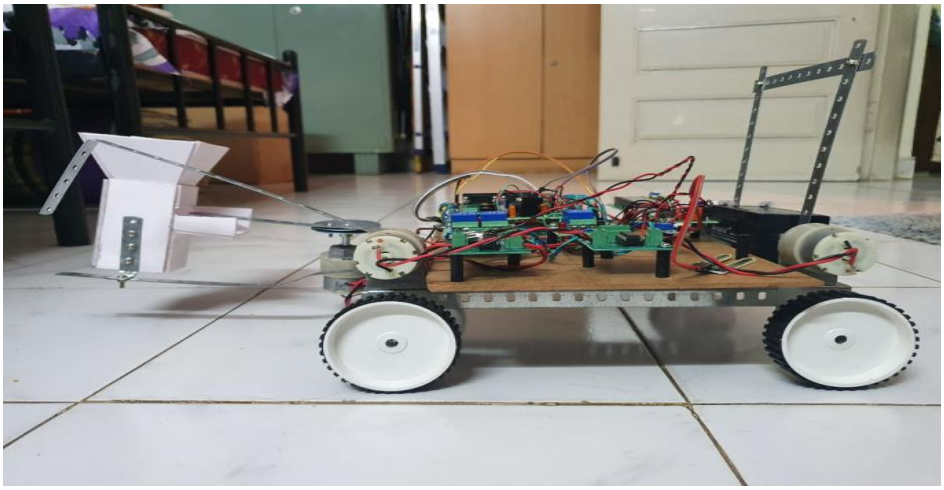


FIG 7: PROJECT MODEL

CONCLUSION AND FUTURE WORK

Multipurpose autonomous agricultural robot has successfully implemented and tested for various functions like ploughing, seeding, leveling and water spraying. It was developed by integrating agricultural robot with C programming. Application of inexpensive navigation sensors to the robot farming system makes the system economically adaptable with the environment. With the development of robot farming system, food production can be increased considerably and economically.

With fully-automated farms in the future, robots can perform all the tasks like mowing, fertilizing, monitoring of pests and diseases, harvesting, tilling, etc. This also enables the farmers to just supervise the robots without the need to operate them. The project can be enhanced to any other kinds of crop. Hence, it can be applicable to the real time agricultural field.

FUTURE WORK

1. Intimation to farming
2. Automated disease prediction
3. Water sprinkling based on moisture levels
4. Pesticides sprinkling automation
5. The robot can be designed with chain roller instead of normal wheel.

In this project, we demonstrated only few types of diseases which were commonly caused and it can be extended for more disease in future. Here only a text message was sent to the farmer but in future a robot can be sent to spray the pesticides to the plants automatically without human interaction.

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