

Design and Development of Multipurpose Solar Powered AgRo-Bot

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Abstract

Increasing population requires the food production to be increased which requires better cultivation in the form of proper utilization of seeds and fertilizers with minimum labor work. Now a day, precision agriculture by agricultural robots 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. Prototype of an agricultural robot "Agro-Bot" is modeled for multitasking such as seeding, ploughing and fertilizer spray or irrigation system. It is a four wheeled vehicle which is controlled by ATMEGA328P 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 not pollute the environment. The approach is now to develop smarter machines that are intelligent enough to work in an unmodified or semi natural environment.

Keywords: AgRo-Bot, Arduino, Solar panel, Fertilizer spray, Seed sowing, Ploughing

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I. INTRODUCTION

In India, near about 70% people are dependent upon agriculture. As compared to other fields globalization in agriculture system is less. So, it is necessary to make some advancement in this field [1]. The main motive for developing Agricultural automation technology is the decreasing labor force, the reasons are the need for improved food quality [2].

Now a day, agricultural operation is automated and also there is commercial availability of automatic machineries and robots [3] for designing a robot one has to consider two considerations which are precision requirement in the task and environmental conditions in which robot needs to work for automating the agricultural operation [4]. This AgRo-Bot is a multifunction Robot that performs three major functions normally required in Agriculture field i.e. Ploughing, Seed distribution and Agriculture Irrigation or Fertilizer Spraying. These things are interfaced with Arduino ATMEGA328P and programming for the operation of the mode.

In the field of agriculture autonomous vehicle, a concept is being developed to investigate if multiple small autonomous vehicles, machines would be more efficient than traditional large tractors and human force. These vehicles should be capable of working 24 hours a day all year round, in most weather conditions. Moreover such a system may have less environmental impact if it can reduce over application of chemicals and high usage of energy, such as diesel and fertilizer, by control that is better matched to stochastic requirements.[9]

II. PROPOSED IDEA

After studying the existing model on agriculture techniques and robots we listed many disadvantages that we are overcoming with our proposed idea which is AgRo-Bot programmed on single arduino chip with multiple functions. Vehicle controlled by ATMEGA328P microcontroller (Arduino) as master controller.

The proposed system integrates all the functions such as ploughing, seeding, and Irrigation into a single robot and performs the operations automatically. The whole arrangement with arm is used for ploughing, seeding and Irrigation or Fertilizing whenever required AgRo-Bot will move in field. It gives us the option to choose the mode of its operation by remote controller. It will be convenient for farmers to operate in their desired mode. Agro-Bot will also be equipped with solar panels which will help in recharging the batteries by natural source of energy. It will also help in decreasing the use of non-renewable sources of energy and will not pollute the environment.

Table 1: Comparison of Sowing Techniques [8]

Table 1 indicates that AgRo-Bot is the best Digging and Sowing Technology

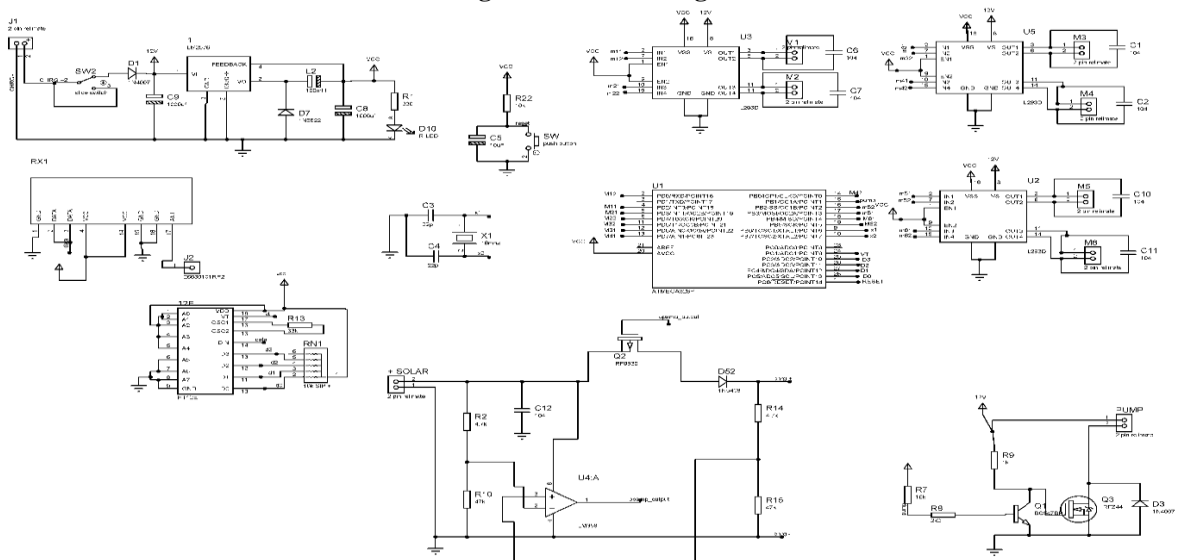
SR NO.	PARAMETERS	MANUAL	TRACTOR	DIGGING AND SOWING USING AGROBOT
1	Man Power	More	Moderate	Less
2	Time Required	More	More	Less
3	Digging and Sowing Technique	Manually	Manually	Automatic
4	Seed Wastage	Moderate	More	Less
5	Energy Needed	High	Very High	Less
6	Pollution	No	More	No

III. METHODOLOGY

The primary aim of our project is to develop a multitasking agricultural robot, which can be used for agricultural processes like digging the soil, seed sowing, and irrigation system or fertilizing, keeping in mind low cost and more efficient. This robot will derive its power from solar panel making it energy efficient and eco-friendly. The whole interfacing is shown in Figure 1. The base frame of the robot is made up of Mild Steel. The wheels are driven by DC geared motor with specification of 12V and 30RPM. DC motor with this specification has been used so as to vary the speed of the robot.

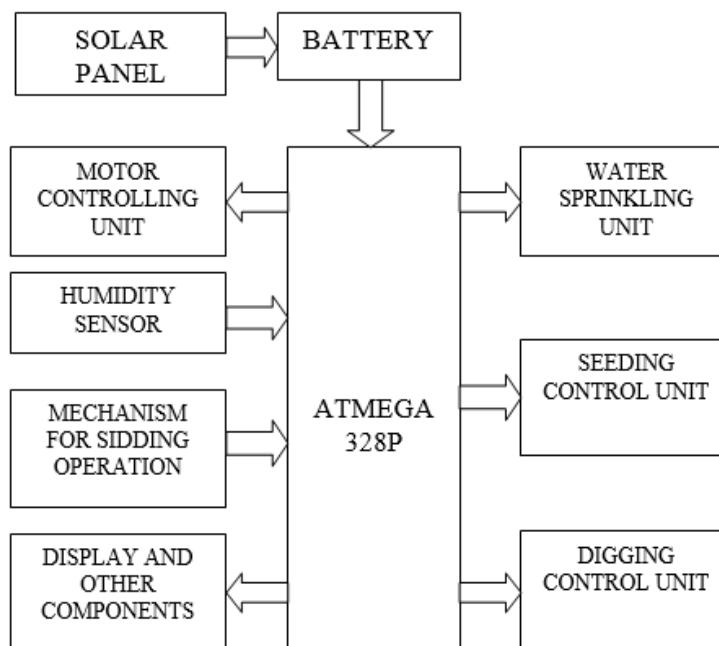
- Front end of the frame is used to direct the AgRo-Bot.
- Back end of the frame is used for digging process. Metallic teeth like structure are used for digging. This can be elevated using robotic arm.
- A Funnel has been used to drop the seeds at their location. The funnel is made of plastic material and is connected to vibrating dc motor and the seeds flow through the funnel through the drilled hole on the shaft to the digged soil.
- A circuit has been designed on the Printed Circuit Board (PCB) to interface all the components and control the agricultural processes. The main component which executes the processes is a microcontroller ATMEGA328P which is commonly known as Arduino. The circuit contains a DC motor driver L293D which can control two DC motor simultaneously. Switches which are used for input value and selection of mode of operation.
- The circuitry defined above is interfaced and controlled by Arduino uno. Arduino uno is a microcontroller which can be used to operate multiple tasks using logical programming.
- A Solar panel is placed on top of the robot and is connected to the battery for charging and providing power to the robot. 5W solar panel has been used in this robot and 12V_battery is connected to the power supply circuit.
- We are using three switches for setting the parameter, mode selection and for reset.
- A separate mechatronic sprinkler with water motor is used for irrigation or fertilizing process. It connects with the humidity sensor which sense the moisture of the soil.

Figure 1: Circuit Diagram



IV. BLOCK DIAGRAM

Figure 2: Block Diagram of AgRo-Bot



V. ALGORITHM IMPLEMENTATION

The algorithm of farming system is performed as:-

1. Start the machine via switch.
2. Display the parameters on the LCD screen.
3. Set the parameter (length & width) according to the field by switch 1 and switch 2 respectively.
4. Now we select the modes of operation for farming according to the process. Mode 1 is for the seed distribution which actuates the vibrator motor for dropping the seed. Mode 2 is for digging purpose. We click ok on mode 2 it simply start the digging in forward direction according to straight line. Mode 3 is used for Irrigation or Fertilization purpose will actuate according to the humidity of soil.
5. When this process is continue in work it will go in forward direction. These processes can be implemented according to the requirement of user.

VI. PROCESS

AgRo-Bot is performing three main operation. These all operations are executed and control by the Arduino. The processes are following as:

1. Ploughing: This application is very easily achieved by attaching the metal like structure at the back side of the robot. For this application we require to give good mechanical strength to the robot, because it is quit heavy and when it is place on soil for ploughing purpose, it required more force to move forward. This is the initial operation in the farm. This application has no delay time. Once it place on the farm. It continuously plough the soil through the ploughing tool which operate on 12V DC.

2. Seed Distribution: The dropping of seed is done using the dc motor vibrator mechanism. For that we are using the special mechanical head at the shaft of dc motor. This DC motor is attached with a funnel at the back side of the robot. The point on the farm where we want to dropping the seed is comes, the dc motor has large rpm vibrates so due to his vibration seeds are dropping from the funnel and a thin Al sheet is fixed below the hole of the funnel to control the quantity and density of the seeds. In this way the controlling action of motor takes place at equal distance of farm, and also it dropped quantities seed's on the farm.

3. Irrigation: A separate irrigator in the form of a mechatronic sprinkler was developed to apply variable rates of water when soil is dry or to spray fertilizer. A humidity sensor is attached with this sprinkler which will sense the moisture of the soil and give command to the water pump for supplying the water.

VII. DESIGN MODEL

Figure 2: 3D Model of Agro-Bot [6]

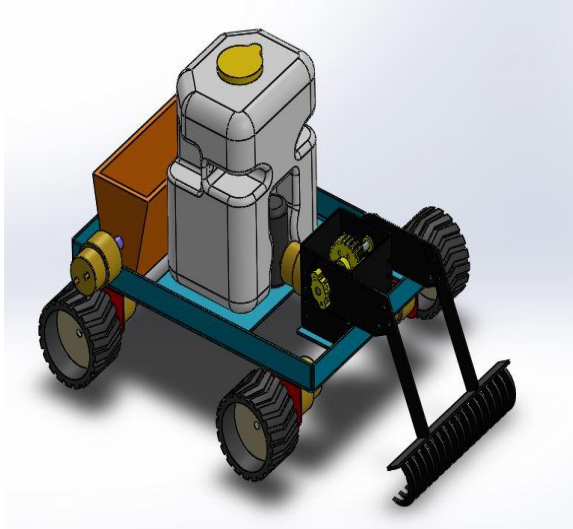
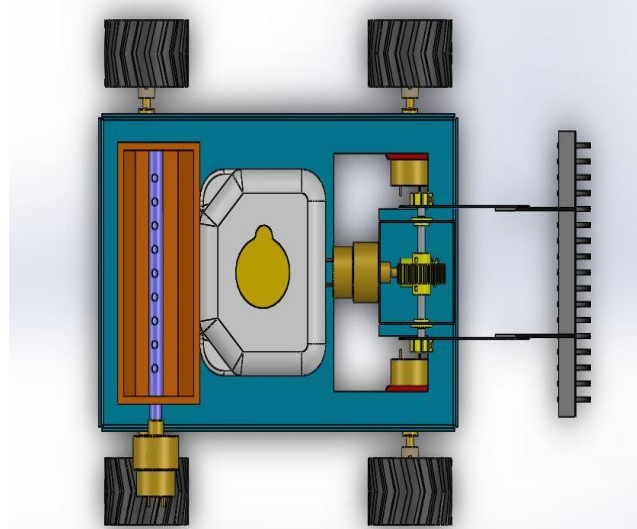
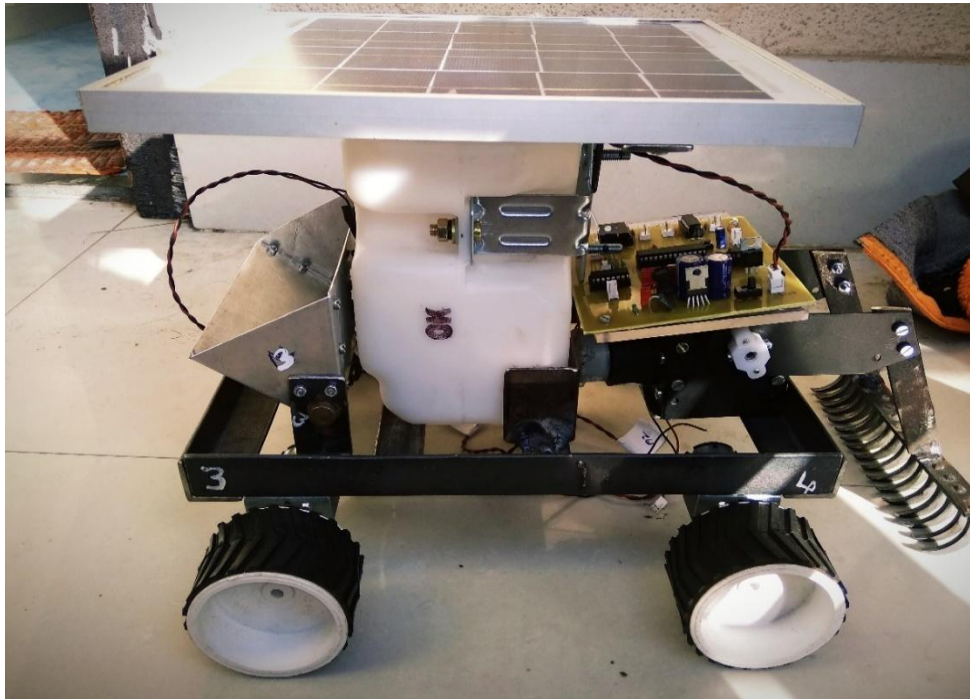


Figure 3: Top View of Agro-Bot[6]



VIII. RESULTS AND DISCUSSION

Figure 4: Actual Model



The Figure 4 shows that it is a Four wheel robot. A Arduino Controller (ATMEGA328P) is used to control its actions. Solar Panel is mounted on top of the AgRo-bot to charge battery. A Plougher is at the back side of the AgRo-bot for ploughing purpose. A separate irrigation tank is provided for irrigation. A funnel having holes is at front side for seeding purpose. It runs at 50 RPM speed with 4 motors.

The weight of of the Agro-bot is less to operate and handle. This further protect the human workers from the harmful effects in handling chemicals. This improves the fresh produce and also reduce labor cost. [8]

IX. CONCLUSION

“Agro-Bot” is specially designed to facilitate the farmers so that the demand of food can be met easily. Agriculture robot serves better result than manual system. It is expected that this robot will change the trend of farming in the upcoming days from manual to automate. The implementation of Agro-Bot has significant saving in the term of time, efficiency, man power, wastage of resources and also it works at much cheaper price. By the

help of this robot we can create the interest of youth in farming which is very important for our development. Robots can come over the difficulties in farming and also it leaves scope of further advancement in it.

X. FUTURE SCOPE

Since the AgRo-Bot performs three main functions namely ploughing, seeding and fertilizer spraying. So can we add harvesting operation too. As far as future enhancement are concerned, this project has ample scope. As an extension to this initial prototype many sensors can be added to detect obstacles and make the robot smarter. Sensors to detect the depth of the land to appropriately sow seeds can be added.

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