

Design and Development of Solar Powered Autonomous Seed Sowing Robot

G. Shanmugasundar¹, G. Manoj Kumar², S.E. Gouthem³, V. Surya Prakash⁴

¹Associate Professor, Department of Mechanical Engineering, Sri Sai Ram Institute of Technology, Chennai, Tamil Nadu, India.
E-mail: Shanmugasundar.mech@sairamit.edu.in

^{2,3,4}Department of Mechanical Engineering, Sri Sai Ram Institute of Technology, Chennai, Tamil Nadu, India.

Abstract

In this era of technological revolution, we can implement new technologies in the field of agriculture for increase in the overall production of agricultural commodities. One of the most significant component in agricultural procedure is seed sowing machine. Nowadays, the agricultural activities are performed by using tractors, which uses fossil fuels for functioning. Harmful gases are released throughout the process, which cause a lot of damage to the environment. Our work make use of solar power to which overcomes this problem and is also cost efficient. In this project, the solar power is collected by using solar panels and then the power is saved in batteries with the help of charge controllers. In the rear wheel of the machine, a DC shunt motor has been connected through a transmission system. This DC motor is powered by the batteries. We make use of IR sensors to get the tract of the path, the machine should go through. A ploughing machine is attached to the machine, which digs the soil for sowing and then, seeds are sowed on the basis of the revolution of the wheel. The plougher then covers it back with the soil after sowing the seeds. Fertilizers are also sprayed along the way. The Micro Controller Unit (MCU) is used for controlling all the above mentioned operations.

Keywords: Autonomous Seed Sowing, Solar Panel.

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INTRODUCTION

Among the top producers of agricultural products, India always stands at the top. It is the second largest producers of rice and wheat (the world's major food staples) after China. There are many challenges in the process of farming, which includes the availability of water resources, climatic changes, the availability of agricultural lands, and environmental challenges. We focus on overcoming the environmental challenges during the process of agriculture. The agricultural sector guarantee a sustainable environment, but the problem is only with the method of implementation. By using the conventional method of the farming, which is making use of the tractor for various agro activities, releases carbon di oxide along with some other harmful gases. This leads to air pollution, noise pollution, water pollution and it may lead to energy crises in few coming years. We have designed an automatic seed sowing machine which is powered by solar energy, which overcomes these environmental challenges. The main advantages of using our machine are that, it reduces the pollution, the time consumption, and saves lot of money when compared to the use of tractors.

MATERIALS AND FEATURES OF THE SYSTEM

2.1. Materials

There are three types of materials have been used in this research which are High carbon, Medium carbon steel and Low carbon steels. Steel with high carbon content is utilised to build gearbox systems and Steel having medium carbon content is used for constructing the machinery components like shafts. The structural components would be built using the Low carbon steel.

2.2. Features of the System

1. Ploughing
2. Seed Sowing
3. Sand Leveller
4. Fertilizer Sprayer.



Figure 1. Intergration of the manual seed system

WORKFLOW DIAGRAM

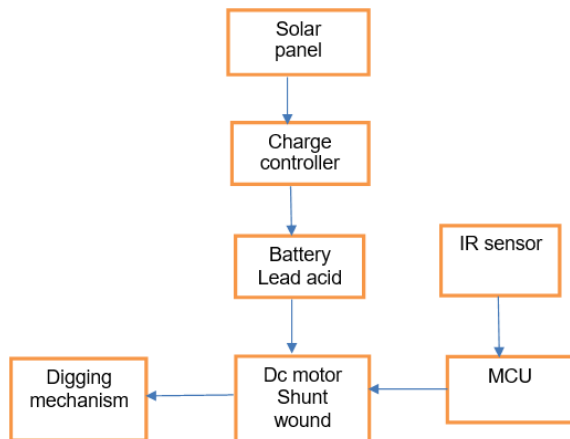


Figure 2. Components diagram

MATERIALS USED IN THE SYSTEM

The components which are used for the development of Autonomous seed sowing robot are Micro Controller Unit (MCU), DC Shunt Motor, Infra-Red (IR) sensors, Charge Controller, Solar panel, Battery, Soil plough, Seed Storage tank, Seed Disc, Soil cover.

4.1. Arduino Microcontroller

The Arduino Nano Microcontroller is used in our project and it is one of the important components in this research project, the output signal given by the Infrared (IR) sensor to the MCU and the Micro Controller Unit controls the DC Shunt motor according to the output of the Infrared sensor.

4.2. Infra-Red (IR) Sensor

The Infra-Red (IR) sensor is an electronic device that measures and detects the infra-red radiation. In this research, an infrared sensor is utilised to regulate the robot's direction and speed as well as detect obstructions in its path. It sends a digital output to the Arduino, which controls the robot's mobility desired path of the robot.

4.3. Charge Controller

The charge controller is used for the conversion of solar energy collected by the solar panel the electrical power. The electrical power after the conversion in the charge controller is stored and used through the battery.

4.4. Solar panels

They are collective array of photovoltaic cells which absorbs radiation from the sun for generating electricity. The major principle involved in the solar panel is the conversion of solar energy to electrical energy. It is made up of a semiconductor material and consists of Photovoltaic (PV) cell. In this research, a 12 volt solar panel has been used and it is used for supplying electrical energy to the DC Shunt Motor.

4.5. Battery

In this research project, a 12V Lead acid battery has been used for storing the electricity from the Solar panel.

4.6. Soil plough, Seed storage tank, Seed Disc, Soil cover

The digging the soil in the agricultural field is done by using soil plough and the seed are stored in the seed storage tank from which the seeds are added based on the requirements. By using the disc, seeds are dropped into the field by the robotic wheel revolution. Once the seeds are dropped in the field, it is covered by using the soil cover.

COMPARISON AND MODIFICATIONS OF THE SYSTEM

In market seed sowing machine is manually operated is available or semiautomatic and IC engine operated seed sowing machine is only available. And in this project the seed sowing machine is operated through the solar power not through any fossil fuel. And another main thing is this machine is fully automatically operated through the IR sensor and MCU. The system is completely automatic helps to control the system automatically without any manual power applied to the system. The system automatically moves through the field without any help of the fuel powered engine system (Fig.3).



Fig 3. Semi-Automatic System

GEAR MECHANISM



Fig 4. Gear mechanism

The mechanism (Fig.4) used in this seed sowing machine is normal power transmission Mechanism. Here the power from the rear wheels is utilized for the plantation of seeds. This is done by providing a bevel gear at the rear axle of the seed sowing machine. The power from the wheels is transferred to the disc containing the seeds in a perpendicular direction to the wheel axle. This is done by assembling a bevel gear normal to the bevel gear which is already present in the wheel axle. Since the wheel rotates, the bevel gears fixed to the axle also rotate. This in return, rotates the bevel gear which is assembled perpendicular to the bevel gear in the axle. As a result, the seed disc which contains the seeds also rotates.

WORKING METHODOLOGY

The main working functions in this project is digging the agricultural field, sowing the seed into the dig and covering the soil after seed sowing and keep going in a correct path and repeating the seed sowing process. All the above mentioned process have been done by using the solar energy from the sun. So, first the solar panels embedded on the robot absorb the solar energy from the sun by using the Photovoltaic cells where the solar energy gets converted to

electrical energy. Next, it gets transferred to the charge controller, wherein the power supply is limited and given to the batteries for saving the electricity. The electricity will be supplied to the DC Shunt motor from batteries when the solar energy is not separately is not sufficient to run the machine. The electrical energy is transformed into mechanical power by using the DC Shunt motor and the transmission systems are used for transferring the mechanical energy to the rear wheel of the robot. The most important component in the machine is the Micro Controlling Unit (MCU). It controls the DC motor by switching it on, switching it off and also has the control over its motion. The MCU controls the DC motors based on the results of the IR sensors. The IR sensors are used to find the correct path in which the machine has to go. It also identifies if there is any obstacles across the way. The seed sowing process will take place by first digging the soil with the help of plough. Then a seed which is stored in the seed storage tank dropped into the seed disc, and it is sowed into the soil. The one wheel revolution which is one seed per revolution determines the seed sowing time of the autonomous robot. Then the soil is put back and adjusted. Fertilizers can also be sprayed along the way while the sowing process takes place.

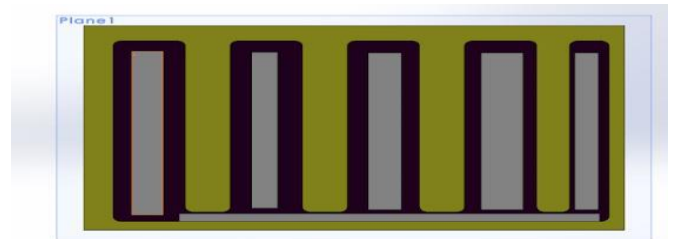


Fig 5. Machine pathway

The vehicle traverses the field according to the above pathway (Fig.5). The vehicle moves between the two black stripes and digs the soil between the stripes. When it reaches one end the sensor in the vehicle senses the pathway of the stripes and turns the vehicle accordingly. The seed draft is a container like structure which is used to store the seeds. It contains a small hole at the bottom through which the seeds pass through. The tube contains a slit which is used to plant one seed at a time in such a way that only one seed passes through it.

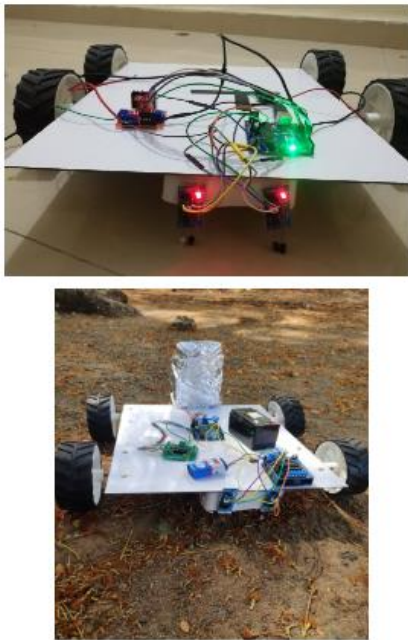


Fig 6. Developed Seed Showing Robot

CONCLUSION

In India, around 60% to 70% of the total population depends on the agriculture and its related activities. Hence, the primary goal of this study is to build a fully automated seed sowing and fertilizer spraying robot and also this research work is developed by working with the conventional energy so that the fossil fuel demand can be reduced and also the environmental pollution made by the existing unconventional energy sources can be reduced. This research work saves lot of time as well as money for the farmer as it will be a onetime investment and it can be used in remote areas where the availability of the fossil fuel is considerably less.

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