

# Solar Energy Based Multipurpose Agricultural Robotic Vehicle

Elayaraja.D<sup>1</sup>, Aneesh.K.C<sup>2</sup>, Amrutha pavani<sup>3</sup>, Arun kumar A<sup>4</sup>

*Professor, Department of Mechanical Engineering, QIS College of Engineering and Technology, Ongole ,A.P<sup>1</sup> Asst.Professor, Dept. of Mechanical Engineering, QIS College of Engineering and Technology, Ongole,,A.P<sup>2,3</sup> Asst.Professor, Dept. of Mechanical Engineering, E.G.S.Pillay Engineering College, Nagapattinam<sup>4</sup>*

*Email: elayaraja.d@qiscet.edu.in, aneeshnbr87@gmail.com, <sup>2</sup>pavaniamrutha226@gmail.com<sup>3</sup>, arunsaak2416@gmail.com<sup>4</sup>*

**Abstract** - Ploughing the land and sowing the seeds are the primary operations in plantation in Agriculture. Now a days the ploughing operation is carried out by tractors which replaces the traditional method of Ox based ploughing. Both traditional and tractor-based needs human manpower. The work replaces the human power by robotic means. The motto of this work is agriculture more cost effective by reducing the human labors. With this view, a multipurpose ploughing machine is designed and developed which is operated by solar energy. This vehicle will be very useful for agricultural purpose and very simple in construction.

**Keywords-** Robot; Agriculture; solaenergy

## 1. INTRODUCTION

In the world, the primary occupation 42% of total population is Agriculture .It plays a significant role in the life of the people. For the betterment of the life and growth of world economy, mechanization of agriculture process especially agricultural autonomous vehicle is important in order to improve the overall productivity.

In recent years, the development of autonomous vehicles in agriculture has experienced increased interest .This development has led many researchers to start developing more rational and adaptable vehicles. In the field of agricultural autonomous vehicles, a concept is being developed to investigate if multiple small autonomous machines would be more efficient than traditional large tractors and human force. These vehicles should be capable of working throughout out the day and year round, in most all weather conditions and have the intelligence embedded within them to behave sensibly in a semi-natural structured or unstructured environment over long periods of time(1).

Applying robotics in plant production requires the integration of robot capabilities, plant culture, and the work environment. Commercial plant production requires certain cultural practices to be performed on the plants under certain environmental conditions. Some of the environmental conditions are mostly natural and some are modified or controlled. The ones which have been the subject of robotics research include division and transfer of plant materials in micro propagation, transplanting of seedlings, sticking of cuttings, grafting, pruning, and harvesting of fruit

and vegetables (2).The system uses so many automatic methods, which require very less labour. The project intends to develop a prototype of an autonomous agricultural robot that includes an automated guidance system, and has applications in different stages of Agriculture (3).

The paper aims on the design, development and the fabrication of the robot which can dig the soil, put the seeds, leveler to close the mud and sprayer to spray water these whole systems of the robot works with the battery and the solar power. More than 40% of the population in the world chooses agriculture as the primary occupation, in recent years the development of the autonomous vehicles in the agriculture has experienced increased interest. The vehicle is controlled by Relay switch through Bluetooth technology using mobile The idea of applying robotics technology in agriculture is very new. In agriculture, the opportunities for robot-enhanced productivity are immense -and the robots are appearing on farms in various guises and in increasing numbers. We can expect the robots performing agricultural operations autonomously such as ploughing, seed sowing, mud closing and water spraying(4).

This paper represents the design, fabrication, and development of solar operated agriculture robot. The robot can dig the soil, feed the seed, leveler to close the soil, and pump to spray the fertilizer. These all system works on battery and solar power. Vehicle is to be controlled with help of remote. Approximately 50% of people in India work in agriculture sector. In this agriculture sector there is a lot of field work such as digging, harvesting, sowing, weeding, etc. And spraying is also an important operation in agriculture. Which to be perform by the farmer, to

protect the crop from the pest, funguses and any other diseases. It is concept of investigating multi-purpose small machine which is more efficient than the large tractors and human forces. Due to this purpose we design and developing such a system with the following feature. Harvesting is the first step in farming after the completion of this step land is ready for the seed sowing, spray pump is used to spray the fertilizer(5).

The actual power used for machine equipment depends on the struggle of the movement. As of now, in our country 98% of the current appliance use the power by burning of fossil fuels to operate combustion engines as a consequence of which we have to face the problem of air, water and noise pollution and most importantly has led to a realistic energy crisis in the near future. Now the approach of this paper is to design the machine to minimize realistic energy and increase the solar power. The main profit is increase the use of solar energy because sun have unlimited resources of energy and this will not finish with time. The energy generated to the fossil

## **2. MATERIALS AND METHODS**

This setup consists of seed container with the door arrangement which is placed over the wheel shaft. The hollow cylindrical shaped container consists of two sides enclosed by mild steel plates. The material of the seed container is made of mild steel. The middle of the container is opened to pour the seeds in it. It consists of door Seed exit holes  
Plates with internal threaded.

### **2.1 Digging plate**

Digging plates are used to dig the land and to spray the seeds. There are four holes in the plate. It is used to mount with rod. Digging plates are made of mild steel. These plates are mounted in front of the seed container and coupled in the rod with particular distance using bolts and nuts. By adjusting the bolts and nuts we can vary the position of plates. Rod is mounted with the bearing

### **2.2 Battery**

A battery is a self-contained, chemical power pack that can produce a limited amount of electrical energy wherever it's needed. The basic power unit inside a battery is called a cell, and it consists of three main bits.

### **2.3 Rack & pinion**

A rack and pinion is a type of linear actuator that comprises a pair of gears which convert rotational motion into linear motion. A circular gear called "the pinion" engages teeth on a fuels combustion

gives very bad impact over the health of individuals. But the natural solar energy is less harmful as compare to any other existing energy generation scheme. One more objective of this paper is to reduce the time for digging and seed sowing operation which is very helpful for farmers. By utilizing solar energy to run the robotic machine is also economical. In this project solar panel is used to capture solar energy using solar panel and then it is converted into electrical energy which in turn is used to charge 12V battery, which then gives the necessary power to a shunt DC motor. This power is then transmitted to the DC motor to drive the wheels and control the controller part of the circuit. And to further reduce man power dependency, IR sensors are used to decide the direction of robot in the field. Here four sensors are used to define the territory and robot senses the track and movement from line to line. This robot will move on different ground contours and perform digging, sowing the seed and watering the ground after covering the seed (6).  
mounting plate using bolts and nuts. It can be easily dismantled and assembled.

### **2.4 Frame**

Frame is back bone of the equipment. It is made of mild steel. All the sub-parts in the equipment are mounted in the shaft. It is the rigid structure that forms a skeleton to hold all the major parts together. At the bottom end of the frame wheel with seed container assembly is mounted. In the frame, fertilizer container assembly is mounted and in the top of the frame handle and stand is mounted

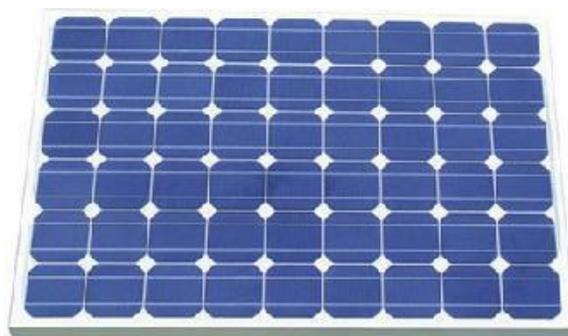
### **2.5 Stand**

Hollow pipe is used as a stand. Stand is used to support the equipment when it is not in moving. It is made of mild steel. There are two holes are provided in the top end of the stand and it is clamped with frame by using bolt and nuts. The bottom end of the stand is enclosed with plate and it is support the stand. A hook is fixed in the fertilizer container. When we move the equipment at that time stand is clamped by using hook linear "gear" bar called "the rack"; rotational motion applied to the pinion causes the rack to move relative to the pinion, thereby translating the rotational motion of the pinion into linear motion. For example, in a rack railway, the rotation of a pinion mounted on a locomotive or a railcar engages a rack between the rails and forces a train up a steep slope. For every pair of conjugate involute profile, there is a basic rack. This basic rack is the profile of the conjugate gear of infinite pitch radius (i.e. a toothed straight edge). A generating rack is a rack outline used to indicate tooth details and dimensions for the design of a generating tool, such as a hob or a gear shaper cutter.

### **2.6 Solar panel**

Solar panel refers either to a photovoltaic module, a solar thermal energy panel, or to a set of solar photovoltaic (PV) modules electrically connected and mounted on a supporting structure. A PV module is a packaged, connected assembly of solar cells. Solar panels can be used as a component of a larger photovoltaic system to generate and supply electricity in commercial and residential applications. Each module is rated by its DC output power under standard test conditions (STC), and typically ranges from 100 to 320 watts. The efficiency of a module determines the area of a module given the same rated output an 8% efficient 230 watt module will have twice the area of a 16% efficient 230 watt module. There are a few solar panels available that are exceeding 19% efficiency. A single solar module can produce only a limited amount of power; most installations contain multiple modules. A photovoltaic system typically includes a panel or an array of solar modules, an inverter, and sometimes a battery and/or solar tracker and interconnection wiring. There are some materials, which are photo

sensitive and they find a place in photo voltaic conversion. A junction of materials, which have different electrical properties semiconductors are used in solar cells, provides the electrical field in most solar cells. Semiconductors are a class of materials with conductivity somewhere between metals and insulators. Solar cells are manufactured from mono-crystalline materials. Low cost cells are round because they are made from sheets, which are cut from mono-crystalline rods as they are pulled from the melt. Joining p and n type material in to a single crystal makes the cross section of a silicon solar cell. Single crystal silicon of ultra-high purity is doped through its bulk with phosphorus to produce n type silicon. The surface of the wafer is subsequently doped with boron to produce p type silicon. This is p-n junction solar cell. The junction is formed slightly below the planar surface of the cell. The back is covered by metallic contact to remove the charges to an electrical load. A fine grid of narrow metallic fingers helps in the collection of charges from the front of the cell. An antireflective coating is used on the top of cell.



### **2.7 Electronic components**



Modern batteries are lead-acid type and provide 12.6 volts of direct current, nominally 12 V. The battery is actually six cells connected serially. Battery electric vehicles are powered by a high-voltage electric vehicle battery, but they usually have an automotive battery as well, so that it can be equipped with standard automotive accessories which are designed to run on 12 V.

An electric motor is a machine which converts electrical energy to mechanical energy. Its action is based on the principle that when a current-carrying conductor is placed in a magnetic field, it experiences a magnetic force whose direction is given by Fleming's left hand rule. When a motor is in operation, it develops torque. This torque can produce mechanical rotation. DC motors are also like generators classified into shunt wound or series wound or compound wound motors.

### **3. ADVANTAGES, DISADVANTAGES AND APPLICATIONS**

#### **3.1 Advantages**

- Low cost
- Easy construction
- Easy to operate
- No power is required
- Solar energy is a renewable energy and the battery is charged continuously
- Highly reliable
- High efficiency
- No need of skilled operators to operate this system

#### **3.2 Disadvantages**

- Maintenance is needed.
- Repairing and replacing is not an easy task

#### **3.3 Applications**

These types of solar operated automatic seed sowing machines have a wide range of applications in the fields like,

- It is applicable in agricultural for seed sowing.

Applicable for agricultural areas are given below. It can be used to sow the following seeds

- Ground nut seeds
- Lady's finger seeds
- Sunflower, etc.,

It can be used to spray the fertilizers

- Sugar cane plants
- Turmeric plants
- Tapioca plants
- Vegetable plants, etc.,

### **4. CONCLUSION**

The multipurpose agriculture robot was developed. It can be modified easily by the requirement of the farmer. The developed robot will be useful in the field of robotics

**Table 1. Cost Estimation of Solar operated multi purpose agricultural vehicle**

Sl. No.	PARTS	Qty.	Amount
1	Battery	1	1200
2	Motor	5	1500
3	Sprayer set up	1	800
4	Frame	1	1500
5	Rack & pinion	1	700
6	Tyres	4	2000
7	Spur gear	4	1200
8	Bearing & bearing cap	8	600
9	Solar panel	1	1800
10	Cutter setup	1	800
11	Connecting links	3	600
12	Switches	1	300



Figure 1. Final assembled vehicle

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