

Design and Fabrication of Multifunctional, Portable and Economical Agriculture Machine

Jawed Rafiq^{1,*}, Himanshu Singh², Harsh Pandey³, Abhay Srivastava⁴, Devansh Awasthi⁵

Department of Mechanical Engineering, Buddha Institute of Technology, GIDA, Gorakhpur, India

Email - javedrafiq62@bit.ac.in¹, bit19me030@bit.ac.in², bit19me052@bit.ac.in³, srivastavabhay706@gmail.com⁴, devanshawasthi44@gmail.com⁵

*Corresponding Author: himanshusingh606564@gmail.com

Abstract: India is an agricultural nation where 70% of the people depend on successful agriculture. However, as the population grows, farms are distributed among families; as a result, the average Indian farmer holds just two acres of land. The system addresses the innovative idea of the Joystick based system in all farming systems. By implementing this project, we can eliminate many difficulties in agriculture. The system runs on solar energy, which is the cleanest energy in the world. Cultivators are very popular these days. The most common machines are used to trim soft grass. As part of our project, Joystick based solar cultivator, seeding and watering system is developed for use and construction. It is placed in a suitable machine structure. The motor has 1000 rpm and is connected to the power source by a coil of wire. The engine revolutions increased with the help of the gears. The electric switch controlled motor makes it easy to use. The machine is controlled by a smartphone. The system is like a mobile robot with four wheels and a cultivator attached to the back of the robot. The seeding system is installed on the robot. The water pump and water tank are installed in the system and can be controlled wirelessly. These characteristics make the system ideal for farming. The aim of the project is to design and develop a complete system that can be used as a cultivator, seeding, irrigation system and mower. The system cultivates the field, sows the seeds and also has an irrigation system for the crops. The entire system is solar powered and controlled by a Joystick smartphone.

Keywords: Agricultural performance, cultivator, Joystick, solar energy, solar cultivator etc.

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1. Introduction

Even if considerable work has already been done, it is crucial to find and use new ideas in the field of agriculture, one of India's most significant occupations. Only a few tractors were in service in 1951, and each and every one of them was imported. 880 tractors were produced in the first year of tractor production, 1961–1962. The farmer's perspective on crop production was impacted by their ignorance of modern agricultural practices. Nataraj. G.K., V. Achutha, Sharath Chandra, and [2016] With the help of this technology, we are able to increase the productivity of farming and agricultural processes, enhancing yields and cost-effectiveness. The terms "plough," "harvest," "seed," and "irrigation" are all frequently used in crop cultivation. In order to complete these steps, farmers must use a variety of agricultural tools and labor. Our goal is to combine all of the various tools into a single piece of equipment that can be used for many different types of seed-to-seed cultivation while implementing all scientific farming techniques and specifications. The same system might be able to handle all of this. India is the largest tractor manufacturer in the world. In order to lower labor costs and increase agricultural yields, farmers are spending an increasing amount of money on machinery. Due to its crucial role in the development of the economy of our nation, agriculture continues to be linked to a number of issues. This multipurpose agricultural machine was created and produced as a flexible piece of machinery that could be used for agricultural chores like excavating, sowing, and seed-covering.[2]

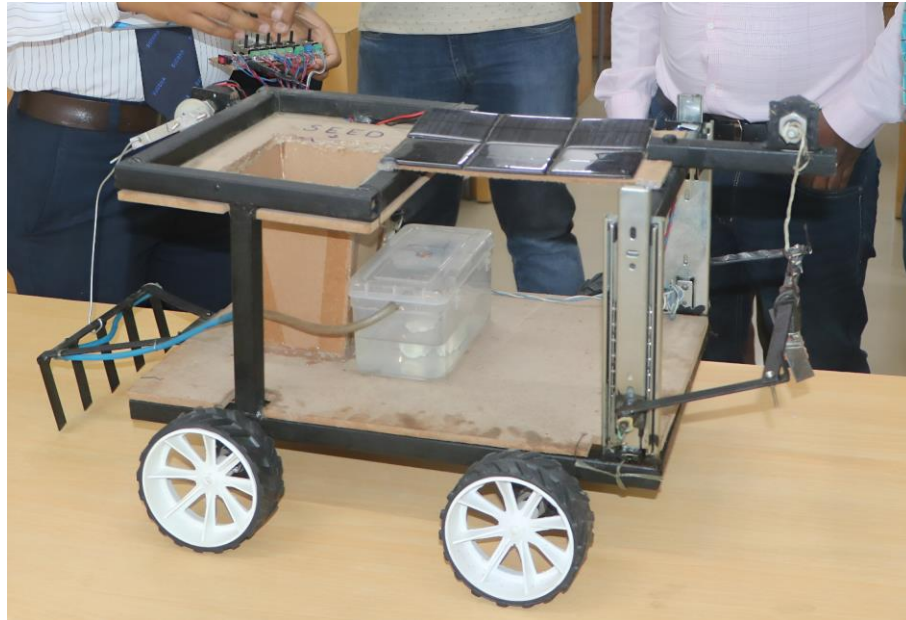


Figure 1. Working Model

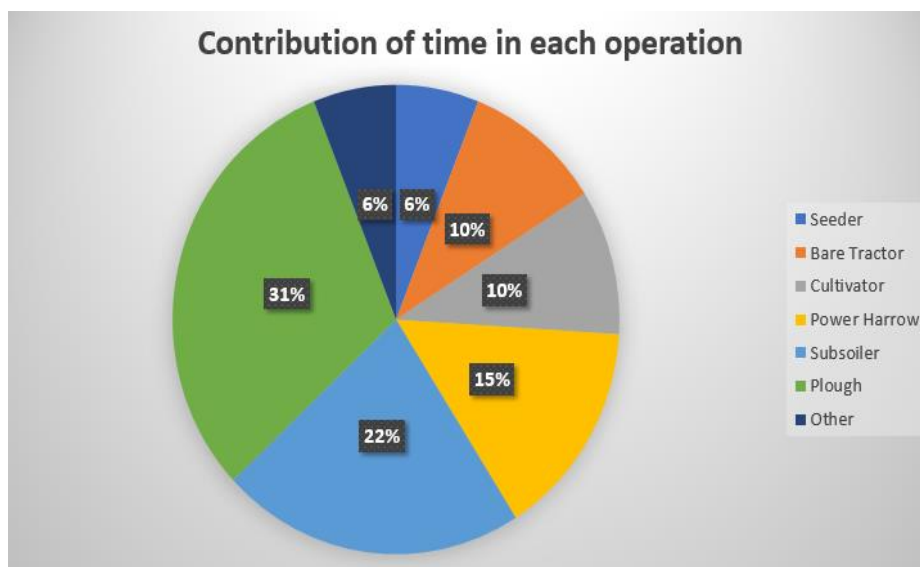


Figure 2. Contribution of time in each operation

These are the project's objectives:

The design of the multipurpose agricultural machinery will benefit Indian farmers on their tiny farms and in rural areas. It will lower the cost of sowing seeds, applying pesticides, and clearing fields of crops, raising the economic standing of Indian farmers in the process.

- ❖ This project's main goal is to design and construct a multifunctional agricultural machine.
- ❖ To keep the price as low as possible so that everyone can afford it.
- ❖ All tasks can be completed by a single person to minimize human effort, which will save labor costs.
- ❖ The entire apparatus will run on solar and electrical energy and be controlled by a joystick. [4]

Table 1. Literature Review

S.No	Authors	Findings
1.	M.V. Achutha, Sharath Chandra. N, Nataraj.G.K, [2016] [3]	The four plans for design and development were mentioned by him. Additionally, they performed the analysis on the Ansys software to assess the load situation and prevent failure issues during project fabrication.
2.	Girish and Srihari [2017] [8] (base of our research)	He brought up the degree of automation in the agricultural sector. The paper's conclusion emphasized the necessity of a multipurpose vehicle for pre- and post-harvesting.
3.	Nitin Kumar Mishra, [2017] [5]	Modern technology can increase comfort, but cost is a bigger worry.
4.	Prof. P.V. Butet, Shailesh Deshmukh ,Govind Rai, Chetan Patil ,Vishal Deshmukh [2018] [6]	The author's case study on farm mechanization in West Bengal, which is a part of India, provides a clear picture of the country's availability and advancement. This made it more likely than not that we would move in the right direction.

1.1. Problem Statement

Agriculture and allied sectors provide for the majority of employment in India. 70 percent of its rural households still depend heavily on agriculture for survival, and 82 percent of all farmers are small or marginal farmers. These farmers are unable to purchase expensive machinery and equipment.

Furthermore, they must exert more human and animal effort. [1]

1. Farming is not mechanized.
2. Extra effort was needed for a different process.
3. More labor was needed.
4. Excessive time is required for each step to be completed.

These are the key areas where our project will focus in order to reduce these issues. [4]

Idea to Solve Observed Problem:

- This is a useful tool that will help to increase efficiency in farming operations. The apparatus is designed to be simple to use in a field environment.
- The controls on the equipment are practical and simple to use. To manage spraying activities, a control switch is available.
- To reduce the need for human labour, the machine will be controlled by a joystick. really simple to use.
- A solar-powered automatic crop-cutting equipment is installed in the model. Additionally, the machine is made more effective with moisture and weather sensors.

1.2. Methodology

When the engine is started, the machine will advance and begin performing the necessary task. The operation is then connected to the equipment. To finish the process, the engine is started after the equipment is linked to the machine. A specially made chain and sprocket distribute engine power to the system initially after the engine has been started. The configuration and speed ratio are designed to provide enough power to the wheel and digger rotor. The wheel's course is followed by the vehicle. The earth can be broken up and the area prepared using a rotor installed on the front of the truck. This procedure is used to get the soil ready for planting seeds. The primary stage is where it is finished. It was followed by a secondary mechanism after seed sowing. In this process, the plug makes a path for seeds that have previously been poured into seed containers. A chain and sprocket gearbox system connects the container's spike wheel configuration, which rotates in tandem with the wheels. This is designed to accommodate various seeds. The design of the mechanism establishes the appropriate spacing for seeding. [2]

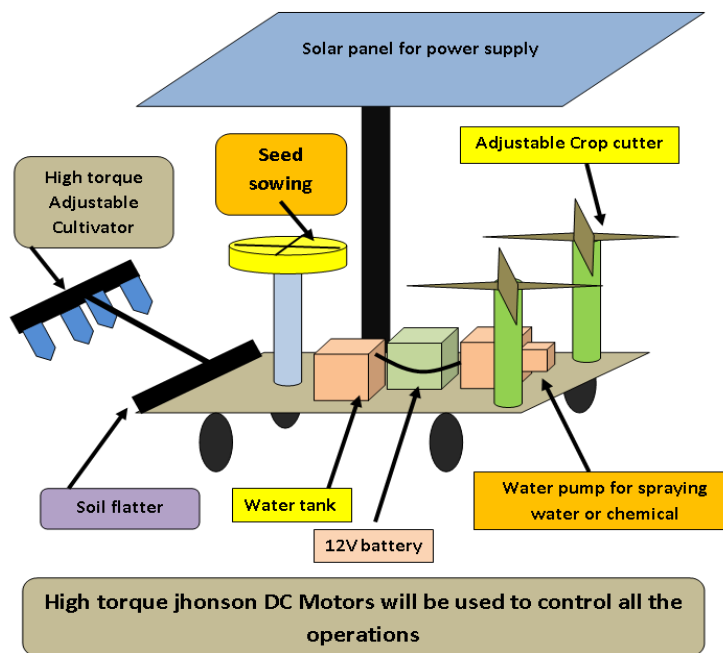


Figure 3. Block Diagram of Proposed Mechanism

2. Working

This manually operated multifunctional agricultural machine is designed and constructed as multipurpose machinery used in agricultural procedures like ploughing, seeding, watering, fertilizing, and levelling soil. It uses a plough to plough the land when it is driven forward. The height of the plough is movable. When the machine is manually moved, seeding will begin because a chain drive connects the drum seed to the front wheel. [3]

- The device will be a mobile robot with four wheels that is connected to everything. The field attached to the robot's back will be cultivated by the system using a cultivator.
- With the use of a rack and pinion, motors, and a soil flattener, a cultivator may be moved up and down.
- Two customised 12V high RPM drill machines with cutting blades will be utilised to harvest the crop.
- For seed sowing, we utilized a robot-mounted seeding device
- For power supply, we can utilize a solar panel and a battery. The entire system will run on solar power. Another option is a 12V adapter.
- For proper watering, a water pump and water tank are mounted to the system. The machine will be controlled via the joystick controller.

Table 2. Used Equipment and Materials

S No.	Description	Quantity	Size	Price Approx.
1	Base plate wooden	1	2.5x1.5 feet	350
2	Plastic Wheel	4	2.5inch dia.	120
3	Rack	4	6inch length 50teeth	200
4	Pinion	4	1inch dia. 20teeth	100
5	Aluminum disk	1	6inch dia. 2mm thick	50
6	Aluminum hollow rod	1	10mm OD and 1feet length	200
7	Iron plate	1	12x2 inch 5mm thick	50
8	Cultivator	1	12inch length 5mm thick	200
9	Iron rod	4	1feet length	150
10	Free wheel	2	-	80
11	Crop cutting blades	2	3inch.	80
12	Sprayer	1	-	40
13	Water pump.	1	-	250
14	12V drill machine	2	-	1200

2.1 Components used in Mechanism

i. DC MOTOR

Geared DC motors can be thought of as an extension of the DC motor, whose Insight features have previously been clarified here. A gear assembly is joined to a DC motor to create a geared motor. RPM, which stands for revolutions per minute, is the measurement of a motor's speed. The gear assembly helps increase torque while reducing speed. The appropriate set of gears can be used to reduce the speed of a gear motor to any desired value. The concept behind gear reduction is that a vehicle can move more slowly while still creating more torque. This insight will go over every small and significant aspect that goes into creating the gear head and, in turn, the operation of the geared DC motor. [6]

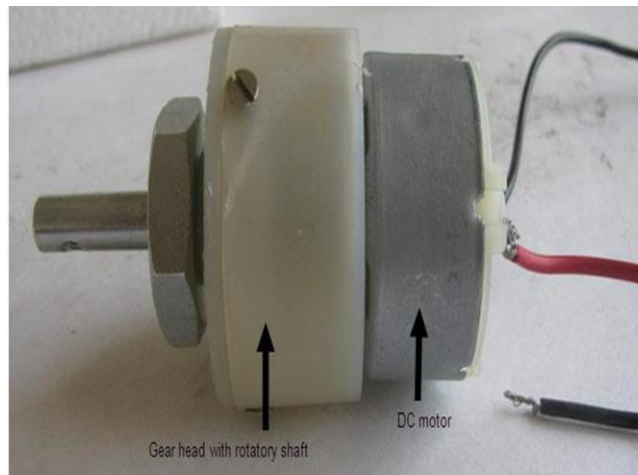


Figure 4. DC Motor

ii. CAST IRON: -

Cast iron is a group of iron-carbon alloys with a carbon content greater than 2%. Its value comes from its relatively low melting temperature. Grey cast iron has graphite flakes that deflect a passing crack and cause countless new cracks as the material breaks, while ductile cast iron has spherical graphite "nodules" that stop the crack from spreading further. White cast iron has carbide impurities that make it easy for cracks to pass through. [9]



Figure 5.Cast Iron

iii. MEDIUM-DENSITY FIBERBOARD: -

In order to make medium-density fiberboard (MDF), wood fibers from leftover hardwood or softwood are separated, combined with wax and a resin binder, and then pressed into panels under intense pressure and heat. Plywood and MDF often have different densities. Although it is made of separated fibers, it can be used as a building material in a similar way to plywood. In comparison to particle board, it is stronger and denser. [8]



Figure 6. Medium Density Fiberboard

iv. SOLAR PANEL:-

A solar panel, or photovoltaic (PV) module, is a collection of photovoltaic cells mounted on a framework for installation. Sunlight serves as the energy source for solar panels, which use it to generate direct current power. A group of PV modules is referred to as a PV panel, while a system of PV panels is referred to as an array. Solar electricity is used to power electrical equipment through photovoltaic arrays.[7]



Figure 7.Solar Panel

v. BATTERY:-

An electrochemical oxidation-reduction (redox) cycle is used by batteries to convert the chemical energy contained in their active components directly into electric energy. In this type of reaction, electrons are transferred from one material to another using an electric circuit. [6]

The two primary battery types are determined by the characteristics of the cell, so let's go on. Primary and secondary batteries are two categories of batteries. The secondary one can be recharged, but the primary one cannot.



Figure 8. Battery

vi. WIRES:-

Wires, typically in the form of wire rope, carry mechanical weights. In the context of electricity and telecommunications signals, "wire" can refer to an electrical cable. The "solid core" of this kind of cable might be formed of a single wire or several strands that have been braided or stranded together.

Although wire often has a cylindrical shape, it can also have different cross-sections, such as square, hexagonal, flattened rectangular, or other shapes, for both decorative and practical purposes, such as high-efficiency voice coils in loudspeakers. Specially flattened wire is used to create edge-wound coil springs like those found in Slinky toys.



Figure 9. Wires

vii. JOYSTICK CONTROLLER:-

It has a base and a stick that can be turned in different directions and moved to either the left or right to control the movement of the cursor on a computer. The movement of a pointer or cursor is managed by adjusting a lever on the joystick. It is an input tool made out of a stick that pivots on a base and communicates its angle or direction to the object it is controlling.[10]

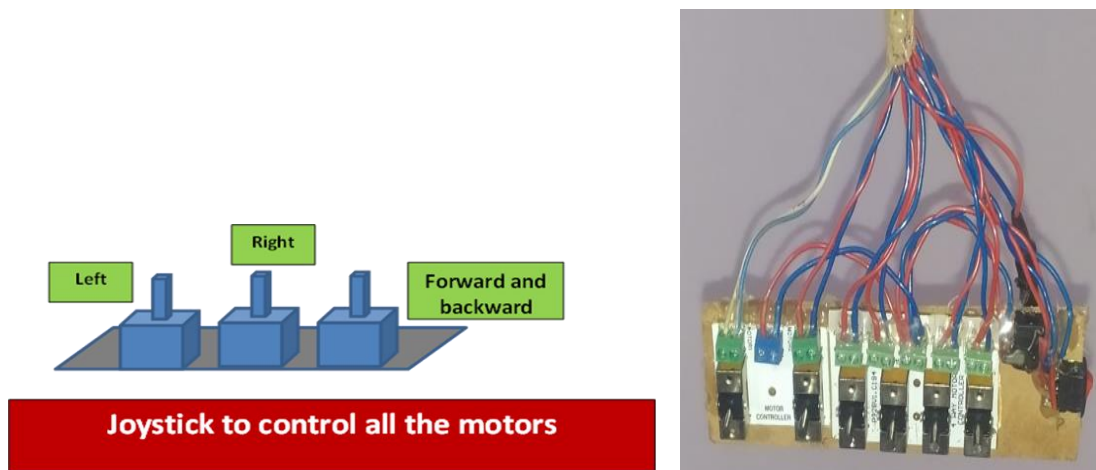


Figure 10. Joystick Controller

3. Experimental Result

- Our Watering System connected with sensor works efficiently.
- Wheel design according to farming land should be designed, and we are working on it.
- In multipurpose machine in addition to crop cutting and seed sowing, the arrangement for fertilizer and manure can be made.
- In this machine instead of sowing in two rows it may be increased further.
- In our machine farmer is walking with machine during the operations, providing seating arrangement into the machine will be beneficial.
- Proper programming after study of crops and soil, will enhance the efficiency of the machine.

4. Conclusion

- Due to their inability to afford pricey farm machinery, small farmers will find that the machine's total output will satisfy their demands.
- If we manufacture the machine on a wide scale, its cost will be drastically decreased, and we expect that this will help to address the partial impetus of Indian agriculture. The machine required less human power and less time than conventional approaches.
- We can solve the labor shortage that Indian agriculture has today in this way. [5]

5. Future Scope

- In order to improve performance and be more environmentally friendly, diesel engines and alternative petrol engines can be utilized in multipurpose farming equipment in place of petrol engines.
- In multipurpose machinery, manure and fertilizer can be arranged in addition to ploughing and seed sowing.
- Instead of sowing in two rows, it can be increased on this machine.
- When seeding and ploughing with our machine, farmers must walk alongside it; therefore, adding chairs would be advantageous. [4]
- It will take the place of the outdated framing method. A person can wirelessly control the system.
- It is a dependable, quick, and safe technique of farming. It can change it to a grass cutter.
- It can be used in future engineering project. [5]

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