

DESIGN AND FABRICATION OF ELECTRIC WEEDER ALONG WITH FERTILIZER SPRAYER

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ABSTRACT

Agriculture is a major pillar of the Indian economy, so agricultural industry employs 60 percent of the labor force and generates around 17 percent of the country's GDP. But several smallholder farmers struggle to maintain or increase productivity due to improper weed management. Weed control is essential for agriculture. The act of weeding involves removing weeds from a field. Weeds compete with crops for resources including nutrients, light, water, and other things needed for growth. There are numerous ways to manage weeds. All agricultural operations in modern agriculture use sophisticated farm machinery like tractors, harvesters, and weeders, which speed up the process and simplify labor. Large landowners employ more powerful machinery to weed a larger area, but small landowners cannot afford it. The gasoline used by these weed-eliminating devices is more expensive today, and the pollution it produces is bad for the environment. To promote plant growth and boost productivity, fertilizing crops is important in agriculture. Farmers use fertilizer sprayers to fertilize their crops, which requires more labor and time. Here, an already-existing weed-elimination equipment is upgraded to the next level by substituting electric motors and batteries as replacing the engine and fuel. The replacement is more environmentally friendly and less polluting. By attaching a fertilizer sprayer to the weeder, hence the two processes are combined. Small landowners can afford it, and farmers will benefit from it

Keywords - weed management, small landowners, promote plant growth, boost productivity.

INTRODUCTION

Food is a basic need of all living things. For food, we rely on both plants and animals. Ancient men started farming food in a small area and followed specific practices for managing and enhancing it. Agriculture is the practice of crop cultivation. In agriculture, there are several factors to take into account, like the type of crop, the soil's characteristics, the climate, etc., particularly weed control. In agriculture, weed control is essential. However, weeding needs to be done in the fields. A sort of pest control known as "weed control" aims to prevent or slow the growth of weeds, particularly noxious weeds, in order to lessen their competition with desired flora and fauna, including domesticated species. The act of weeding involves removing weeds from a field. It is a productive pre-harvest technique for managing crop yield and crop protection. Weeds compete with crops for resources including nutrients, light, water, and other things needed for growth. There are numerous ways to manage weeds. All agricultural operations in modern agriculture use sophisticated farm machinery like tractors, harvesters, and weeders, which speed up the process and simplify labor. Large landowners employ more powerful machinery to weed a larger area, but small landowners cannot afford it. These weed-eliminating machines need gasoline, which is more expensive nowadays and contributes to pollution that is bad for the environment. To promote plant growth and boost productivity, fertilizing crops is important in agriculture. Farmers use fertilizer sprayers to fertilize their crops, which requires more labor and time. Application of liquid fertilizer is an appropriate technique for usage in a variety of dryland and soil erosion-prone locations. Here, liquid fertilizer is included in the sprayer to improve the procedure' effectiveness. A specific set of crops are targeted by liquid fertilizer, and there is no chance of loss due to evaporation or exposure to the wind. These agricultural sprayers aid in crop establishment and encourage early rooting. Liquid fertilizer application also serves as irrigation in addition to providing vital nutrients. Application technique has a significant impact on how effectively plants grow. Spraying plant growth regulators has a speedier impact on the flowering and fruiting of flowering crops as well as the flower output. One of this application's biggest benefits is that treatment will be quicker. When agricultural machinery is used in farming operations, human labor is minimized. The introduction of chemical pesticides, better seed varieties, and enhanced farming machinery have all contributed to greater production. The productivity of workers has increased as a result of the use of machines. The quantity of labor performed by people is reduced while using cutting-edge farm technology and equipment. The time spent on unnecessary farming chores was decreased because the construction of farm machinery or implements was completed on schedule. Utilizing contemporary

agricultural machinery and technology lowers labor costs and improves farm profitability. Agricultural tools can increase agricultural output and market food supplies.

LITERATURE REVIEW

This concept says about sensors including image analysis by camera, GNSS, laser and ultrasonic systems. These sensors can improve weed control efficacy in combination with mechanical systems. They also have used RTK-GPS for inter-row hoeing. They are now widely used in many different crops such as especially wide spaced crops like sugar beets, maize or soybean [1]. This concept says about various types of mechanical weeder by year wise from 2000-2019. Weeders like Mandava-Single Row Weeder, Row crop weeder, Manual weeder (V-frame), Hymatic Cono Weeders, Rotary power weeder, Intra row soil weeder. Mechanical weeder has shown to be evolving in design, principle and mechanism over the years reviewing merits, demerit and limitations [2]. This concept says that weed removing technique (i.e.) the automatic weed control systems provide efficient method of weed removing within the rows and inter rows. The machine vision system has been used to detect and differentiate the weeds from the crop. Guidance system has been used to track the rows with accuracy and to control a row cultivator and an autonomous agricultural robot in real-time. Mechanical knife and rotating hoe are two basic designs in mechanical systems for weed removal [3]. This concept says about automation, integrated weed management, intelligent cultivator, interrow weed control, mechanization, robotic weeding, vegetable crops. Also, machine vision technology to recognize crop row patterns and control automated devices that perform tasks such as removal of interrow weeds. Future weed control strategies like weed control actuators on future models may use abrasion with sand blown in an air stream or heating with flaming devices to kill weeds [4]. This concept says that they have designed the three-row manual operated power weeder using CATIA tool. They have analyzed the design in Ansys Work Bench for safe design. Design and development cost reduced for poor farmers and functional efficiency results in 88% [5]. This concept says that they have investigated about the weed control chemicals and methods used in various countries. Integrated weed management (IWM) a holistic approach to weed management that integrates different methods of weed control to provide the crop with an advantage over weeds. IWM has potential to restrict weed populations to manageable levels, reduce the environmental impact of individual weed management practices, increase cropping system sustainability, and reduce selection pressure for weed resistance to herbicides [6]. This concept says that they have investigated about solar powered weeder and also studied the design of weeding mechanism, should consider both weed parameters and soil parameters. From study it had been found that the solar power system should consist of the solar panel, solar charge controller, battery backup, load controller as per designed parameters. solar powered robot Weeder and also there is a scope of increase in efficiency of developed. solar powered rotary Weeder by modifying design of weeding mechanism and electric circuit [7]. This concept says about development of agriculture machinery (i.e.) 4 stroke weeding machines. This machine square measure wide used for weeding cotton, tomato, tapioca, paddy, sugarcane, pulses and numerous alternative plant fields. Thus, the development will satisfy the small-scale farmers for weed removing [8]. This concept says that they have developed simple design of movable solar operated sprayer for farming operation. In this, the system operates in both direct mode and indirect mode. In the direct mode, the sprayer is operated from the electricity generated by 50W solar panel mounted on a movable frame and in the indirect mode it is operated on stored electrical energy in the lead-acid DC battery. The result shows that the system is efficient, portable and provides at least 8 hours of operation daily, but initial cost is higher [9]. This concept says that they have analyzed the process of spraying fertilizer or pesticides and weed removal technique. They used reciprocating & centrifugal pumps, connecting link, crank, nozzles, belt drives, wheel. The equipment is purposely design for the farmers having small farming land say 5-6 acre. It is suitable for spraying as well as weeding at minimum cost for the farmer so that he can afford it [10].

METHODOLOGY

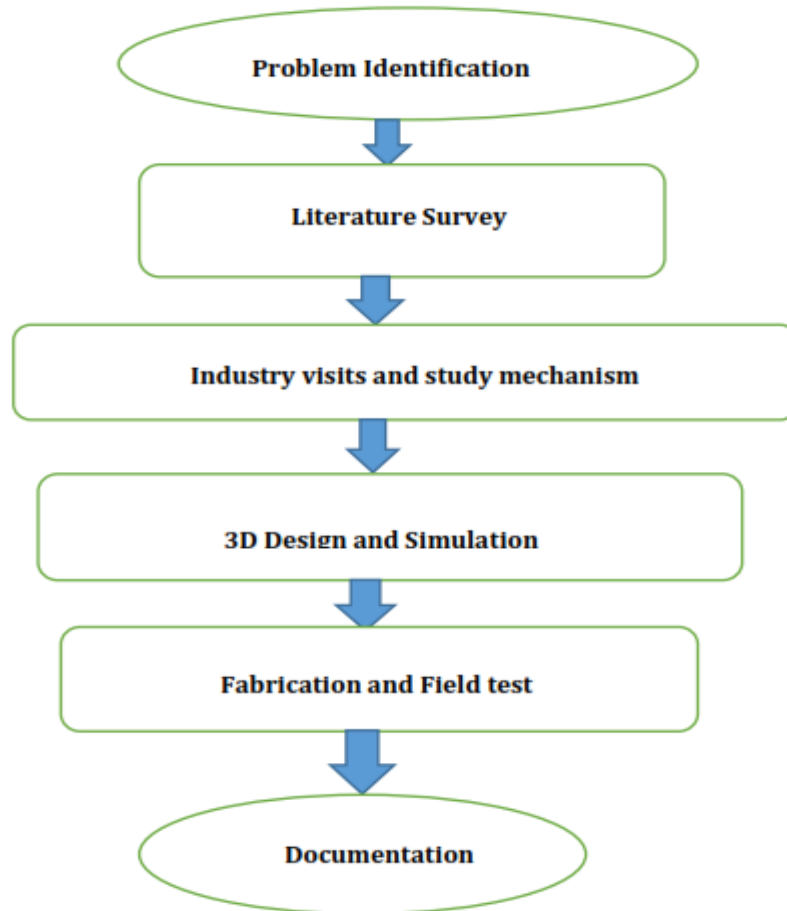


Fig 1: Methodology

COMPONENTS

CHAIN SPROCKET:

A sprocket, sprocket-wheel or chain wheel is a profiled wheel with teeth, or cogs that mesh with a chain, track or other perforated or indented material. Sprockets are used in bicycles, motorcycles, tracked vehicles, and other machinery either to transmit rotary motion between two shafts where gears are unsuitable or to impart linear motion

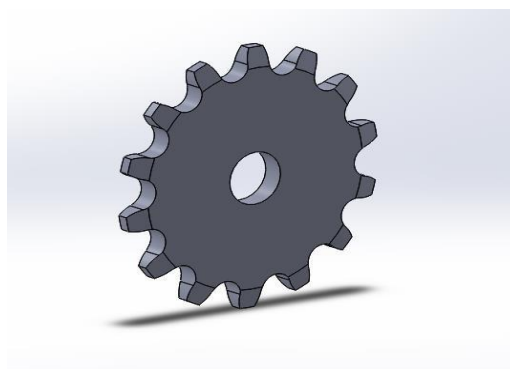


Fig 2: chain sprocket

CHAIN:

Roller chain or bush roller chain is the type of chain drive most commonly used for transmission of mechanical power on many kinds of domestic, industrial and agricultural machinery, including conveyors, wire- and tube-drawing machines, printing presses, cars, motorcycles, and bicycles. It consists of a series of short cylindrical rollers held together by side links. It is driven by a toothed wheel called a sprocket. It is a simple, reliable, and efficient means of power transmission.



Fig 3: Chain

MOTOR:

This is MY1016 250W eBike Motor with Electric Bicycle Combo Kit which has all assembly product you need to build your eBike. It is an Electric Bicycle permanent Magnet DC Motor. MY1016 24-volt 250-watt output for electric scooter and bike motor. This MY1016 is popular reduction motor, simply the most commonly used motor for Scooters, Bikes and quad's available in the market! It is normally found in the better-quality quads and scooters on the market and is classed as a mid-range combination. Now here it comes combo with all necessary items to build your brand new eBike and to save your efforts in looking out for all compatible products and you can get it in just one go at reasonable cost.



Fig 4: Motor

Motor Specifications:

Voltage: 24 Volt DC.

Output: 250 Watt.

RPM (after Reduction) – 300.

Full load current – 13.4A.

No load Current – 2.2A.

Torque Constant – 8 N.m (80 kg-cm).

Torque stall – 40 N.m (400 kg-cm).

Sprocket:

9Tooth only fits #410 bicycle chains.

For Chain Size: Pitch 0.5 inch.

Roller Diameter 0.3 inch.

Roller Width 0.16 inch.

WEEDER BLADE:

The crucial component of a stainless steel rotavator that propels the device in seed bed preparation and residual soil mixing is the blade. Rotavator blades can also be used as weed eaters by cutting through weed plants. (L x W x H) – (10 x 10 x 10) centimeters.



Fig 5: Weeder blade

CYLINDRICAL ROLLER:

A shaft is a rotating machine element which is used to transmit power from one place to another. The power is delivered to the shaft by some tangential force i.e. twisting moment. In order to transfer the power from one shaft to another, the various members such as pulleys, gears etc. are mounted on it by means of keys or splines. We may say that a shaft is used for the transmission of torque and bending moment.



Fig 6: shaft

SPRAYER:

A sprayer is a device used to spray a liquid, where sprayers are commonly used for projection of water, weed killers, crop performance materials, pest maintenance chemicals, as well as manufacturing and production line ingredients. In agriculture, a sprayer is a piece of equipment that is used to apply herbicides, pesticides, and fertilizers on agricultural crops. Sprayers range in size from man-portable units (typically backpacks with spray guns) to trailed sprayers that are connected to a tractor, to self-propelled units similar to tractors with boom mounts of 4–30 feet (1.2–9.1 m) up to 60–151 feet (18–46 m) in length depending on engineering design for tractor and land size.



Fig 7: Sprayer

SPEED CONTROLLER:

A circuit that electronically monitors and controls an electric motor's speed is known as an electronic speed control (ESC). Furthermore, it might offer dynamic braking and motor reversal. In radio-controlled models with electrical power, tiny electronic speed controls are employed. Systems for managing the drive motors' speed are also included in full-size electric cars.



Fig 8: Speed controller

SHEET METAL:

Sheet metals are used historically for plate armor worn by cavalry and widely used for decorative purposes. The applications of sheet metals include automobile and truck (lorry) bodies, medical tables, airplane fuselages and wings, roofs for buildings (architecture), and many other applications. Sheet metal made of iron and other materials with high magnetic permeability has good applications on electric machines and transformers. Thickness of sheet metals are specified in millimeters all around the world. But in US it is commonly specified by a traditional, non-linear measure known as gauge, the larger the gauge number the thinner the metal. The most common used steel sheet metal ranges from 30 to about 7 gauges.

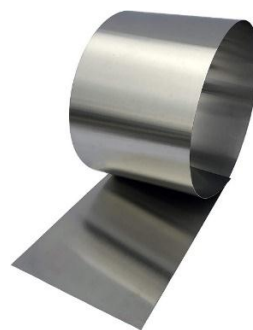


Fig 9: Sheet metal

LITHIUM-ION BATTERY:

A lithium-ion (Li-ion) battery is an advanced battery technology that uses lithium ions as a key component of its electrochemistry. During a discharge cycle, lithium atoms in the anode are ionized and separated from their electrons. The lithium ions move from the anode and pass through the electrolyte until they reach the cathode, where they recombine with their electrons and electrically neutralize. The lithium ions are small enough to be able to move through a micro-permeable separator between the anode and cathode. In part because of lithium’s small size (third only to hydrogen and helium), Li- ion batteries are capable of having a very high voltage and charge storage per unit mass and unit volume .



Fig 10: Battery

DESIGN FEATURES

The weeder was designed for upland crops. Three-dimensional drawing of the power weeder was done by SOLIDWORKS 2018. From that drawing front and side views were drawn and all functional parts were drawn with dimensions in mm.

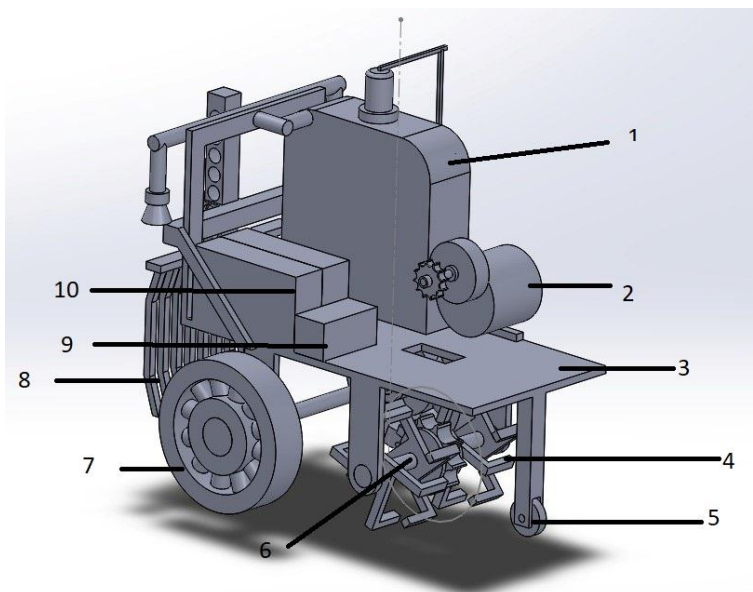


Fig 11: Isometric view

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|------------------------|------------------------|
| 1- Fertilizer tank. | 6 - Shaft. |
| 2- Motor. | 7 - Wheel. |
| 3- Base (Sheet metal). | 8 - Collector. |
| 4- Weeder Blade. | 9 - Speed controllers. |
| 5- Front wheel. | 10 - Batteries |

PROTOTYPE



Fig 12: Prototype

SPECIFICATIONS

Table 1 Specifications of machine

Sr. No	Title	Value
1.	Fertilizer tank (l x h x w)	(34x44x18) cm
2.	Blade radius from center	12.5cm
3.	Wheel diameter	40cm
4.	Pump stroke per rotation of wheel	1
5.	Pump rate of discharge	0.5 litre per minute
6.	Fertilizer tank capacity	16 litres
7.	Overall height of prototype	90 cm

RESULTS

The prototype is tested on the agricultural land and got the better results than compared with traditional method.

Table 2 Testing Results

By Traditional method	By proposed machine
Labor cost =Rs 300 per day	Labor cost =Rs 300 per day (But it would do 3 labors work as a single machine)
Cost of fertilizer spraying = Rs 50 per full tank	Both operations are done simultaneously. Hence no cost

The normal engine-based weeder runs 1 hour per litre whereas the prototype runs 1.5 hours per single full charge and it carries both operations simultaneously. Hence the efficiency of the prototype is greater than other engine-based weeders.

CONCLUSIONS

Since the prototype is made for small scale farmers to save time and labor cost. Easily farmers could handle this prototype. The prototype is mini electric weeder attached with fertilizer sprayer which could be an effective for weeding and fertilizing the crops so this could help to increase productivity in the fields. By using this prototype, the crops like tomato, potato, cabbage, guava, pomegranate can be weeded. The future scope of this prototype would be done fully automatically with the help of sensors, IOT, etc...

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