

DEVELOPMENT OF ELECTRICALLY OPERATED TILLER MACHINE FOR CULTIVATION

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Abstract: Earlier Farmers were using Traditional farming methods which is time consuming and hardworking hence we introduce new technology called tractors which can be used as cultivator to plow/cultivate land. Generally, these machines are costlier, polluting our environment and not affordable to our Indian farmers, hence we decided to make compact portable electrically operated cultivator (Tiller) machine at affordable rate. Working of this machine is based on battery and motor mechanism which can be capable to move cutter or tiller. Rather than developing IC engine-based mechanism we prefer to work on electrically operated mechanism as it is clean source of energy and don't pollute environment as well. Majority of our Indian farmers adopt subsistence farming in which they follow traditional farming methods. Such farming is very hardworking and not more efficient so our basic aim of this project is to developed small portable cultivator machine which turn towards modern farming methods. This report describes design, manufacturing, fabrication analysis of proposed model. Our project aims to achieve high safety, reduces human effort, increases the efficiency of the soil tiller, reduces the work load, reduces the fatigue of workers and reduces maintenance cost.

Keywords: Electric motor, Battery, Controller, Differential, Tiller

1. INTRODUCTION

1.1 BACKGROUND:

Agriculture is the backbone of Indian economy. As per census 2011, Nearly about 50% Indian population is engaged in agriculture sector while 80% rural population struggling to survive on agriculture. Most of the Indian farmers adopt subsistence farming methods. Subsistence farming is type of farming which uses traditional farming methods/ techniques for farming. These farmers have less land and unable to use high-cost equipment for plough of land. Such farming is very hardworking and not more efficient. Lack of automation is one of the major problems for improving the productivity of agriculture.

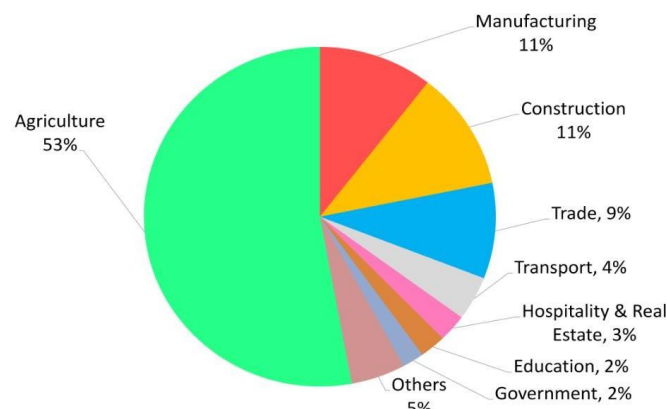


Fig Population engages in different sectors

Earlier Farmers were using Traditional farming methods which is time consuming and hardworking hence we introduce new technology called tractors which can be used as cultivator. But these machines are very costlier and not affordable to our Indian farmers. Such farmers are even not in condition to buy bullock (Ox) who can help to cultivate their land. So, such farmer pulls plough with their hand such farming becomes very hard working and after their such hardworking efforts they did not get much returns from farming. Farmer becomes bankrupts and commits suicides.

1.2 Problem Definition

Small size farms are a huge issue in automation and mechanisation of farming sector. These problems are classified as technological limitations, financial, economic and environmental issues. There are many farming machines available in the market which are generally used for large-scale farming and are not acceptable for small scale farming conditions of the user. These machineries are costlier and also require high maintenance cost, which are not affordable for small scale farmers. Also, Poor rural infrastructures such as roads, bridges, canals, and power network are one of the main hurdles in this sector. In developing nations like India, farm labour is also a big issue. The income of farmers is very low and the wages for farm labours are increasing day by day.

2. LITERATURE SURVEY

Waghmode R.S., Shinde S.R., Dixit A.K., Chanchure A.A., Jadhav K.H. [1]

This research paper deals with design of solar power rotary tiller. Comparative study for small weeders machines and power tillers machine in the Indian market is discussed in this paper. Various techniques used for weed removal in crops field are also discussed here. Their study revealed that most of the Indian farmers are smallscale farmers can afford only portable weeders. The soil tiller and weeder are one of the many farm mechanizations in promoting soil tiller and weeders especially considering the fact that the majority of farmers are having small land. It reduces human effort. Working of their project is based on solar panel energy and it generates energy to run this machine which moves the cutter or tiller. It is saver of time and cost on field operations. Thus, it will have very effective uses on the farm field either for tilling as well as for weeding. Development of energy efficient versatile machines can increase labor productivity, reduced unit cost of operation, improved timeliness of operation.

Ashish Kumar, Rajat Gethe, Sattyendra Pethe Patil, Akshay Waychal [2]

The basic objective of their study is to reduce efforts require for using the manual farnequipment. Their proposed model for soil tiller machine is operated on the solar powerand it consist parts likes Solar plate, motor, 12 V batteries, Pedestal bearings, tiller blade. In this updated soil tiller machine, the rotor blade is fixed on shaft between the two bearings which is fixed on the frame of tiller and wiper motor is attached to the rotor blade using belt and wiper motor is attached on the frame. Solar plate is fixed on the upper section of the tiller so that the sun rays will directly incident on the solar plate and solar plate will provide energy in electrical energy form to the battery which supply current to the motor. The rotation of the motor either clockwise or anticlockwise depending on the connection arrangement. The project mainly concentrates on designing of suitable solar power tiller machine. Project achieves high safety and reduce human efforts.

V. N. MUJBAILE, P. R. Kaware, A.G. Umare, S.S. Taksande, S.S. Malot, M.N. Lanjewar [5]

The shaft of engine can be coupled with wheels of frame. Also cultivating tool is attached to the frame. So that the power developed by engine will force the tool in downward direction inside soil. Also handle can be provide for proper guidance of machine by changing the directions of wheels in required direction. Seed sowing operation can also be performed by providing sowing pans near the tool. So that when tool digs simultaneously seed can be sowed as per required. In their experimentation they observed that the depth of tool totally depends on the molecular structure, condition of soil as well as moisture content into the soil.

Po Niu, Jian Chen, Chenjun Hu, Jindou Zhao [4]

This research paper deals to improve comfort of electric mini tiller based on various field tests. Many research has been conducted on field to improve its operating comfort, but output result is less as expected. As an alternative, a new type of electricalmini tiller machine was developed. For further improvement of its operating comfort, field test experimentation was conducted by these researchers to reduce the vertical force and vibration RMS values at handle. The experiment

results showed that when the position of center of gravity (C.G) moved 19.78 cm toward handle, the vertical force was reduced from 154.24 N to 0 N and vibration RMS values decrease by 20.16% under working condition

3. FABRICATION

3.1 Design Concept:

Our concept is to use battery power as energy source for cultivation of soil. This can be done by using power of battery to provide force to the tools so that they can dig enough soil which should be properly ready for cultivation. Here battery is coupled with the electric motor. Electric motor converts this electrical energy into mechanical energy. To control the amount of electrical supply to the motor we used electric controller. Electric controller controls the supply of current to the motor whose accelerator is provides at the handle so that as per our requirement of power we regulate the supply through it. Now the output shaft is connected with differentialspiral gear. This differential permits the power from battery to be transmitted to pair ofwheels. All assembly including battery, controller and electric motor are mounted on a metal frame of proper dimensions made of steel. The cultivating tool is attached to the frame. So that the power developed by battery will force the tool in downward direction inside soil. Also handle can be provide for proper guidance of machine by changing the directions of wheels in required direction. Seed sowing operation can also be performed by providing sowing pans near the tool. So that when tool digs simultaneously seed can be sowed as per required.

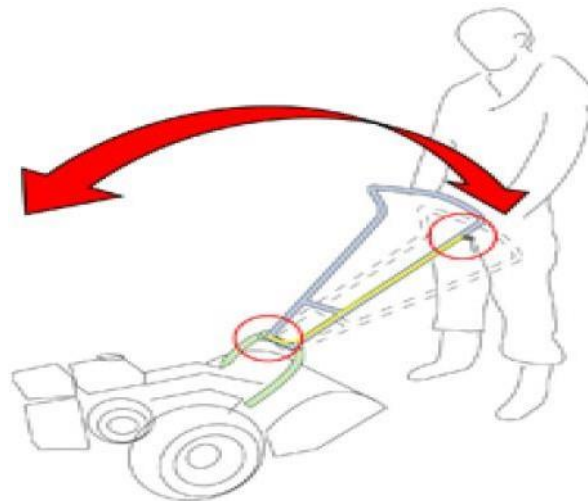


Fig. Concept Drawing

3.2 COMPONENTS OF ELECTRIC TILLER MACHINE

Battery pack – Act as energy source and provide constant current supply

Electric Motor - It converts electrical energy into mechanical energy.

Controller -It controls/regulate current supply to motor from battery as perrequirement

E rickshaw differential- To drive pair of wheels and allow them to rotate atdifferent speed
Wheels (2)

Iron tiller- To cultivate soil hard iron cultivator used called tiller

3.3 Selection of Battery Pack

Batteries are importan3t components in our project mode because electrical energy stored in the battery is the only source of energy to plough and run tiller machine. These batteries are different from ignition batteries which are used in our cars. Electriccars batteries are designed as an energy storage system, capable of delivering powerfor long and sustainable periods.

There are 4 types of electric vehicle batteries as given below

- Lithium-Ion (Li-On)
- Nickel-Metal Hybrid (NiMH)
- Lead Acid
- Nickel cadmium (NiCd)

	Li-On	NiMH	Lead acid	NiCd
Easy access	Yes	No	Yes	No
Expensive	Very expensive	Expensive	Cheap	Very Expensive
Life cycle (In years)	2-3	5	4-5	10-15
Power density(W/kg)	250	300	180	150
Charge time (In Hr)	2-3	4	6-8	2
Cycles	400-1000	500-1000	500-800	2000
Efficiency (charge/discharge)	80-90%	70-90%	70-90%	70-90%

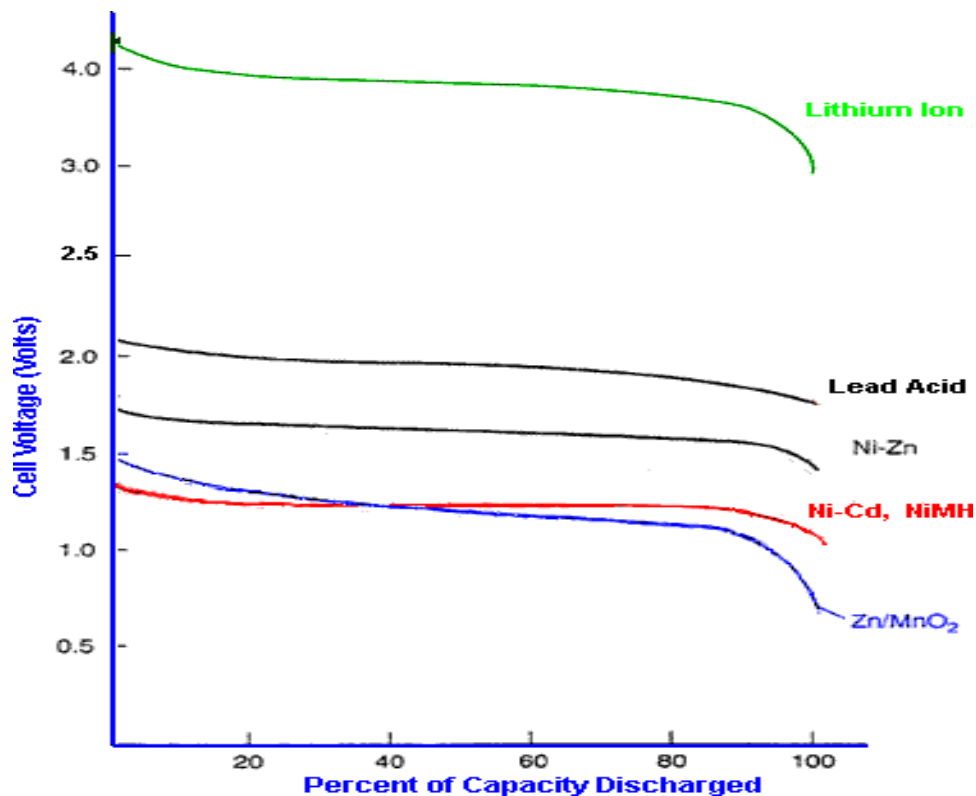


Fig Battery Performance characteristic

4.4 Selection Of Electric Motor

Different types of electric motors are available in market which shows different characteristics, which makes it important to judge motors on some basic parameters for choosing a particular type of motor for an electric tiller machine. Electric motors used in our tiller machine should have important attributes like simple design, high specific power, low maintenance cost, and good control.

Some electric motor which are commonly available in market are given below-

- DC Brushed Motor
- DC Brushless Motor
- AC Induction Motor

Motor Type	Efficiency
DC Brushed Motor	80-85
DC Brushless Motor	80
AC Induction Motor	90

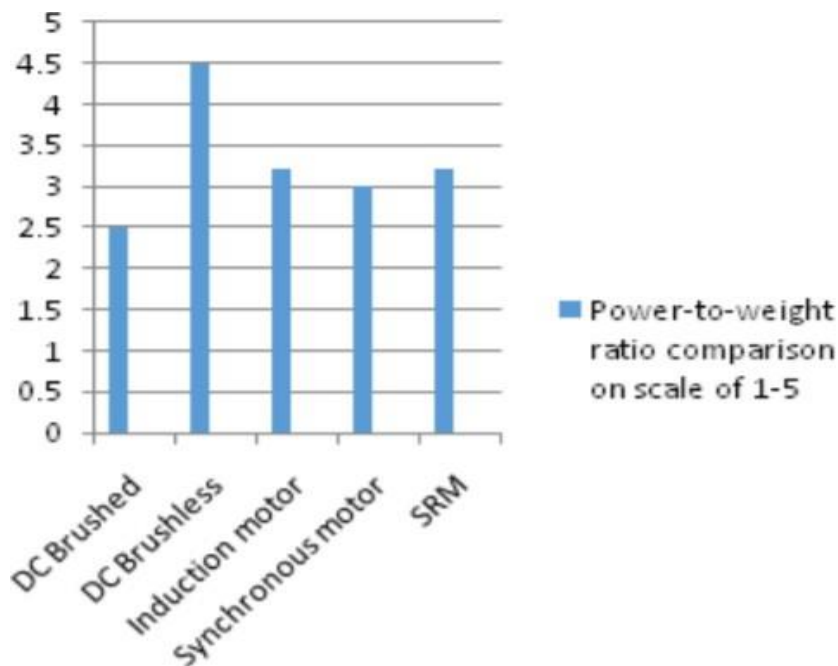


Fig Chart- power to weight ratio comparison

From above observation we choose BLDC motor for our proposed project although it is costlier than other it is easily available, higher power to weight ratio and good efficiency as per required of our project.

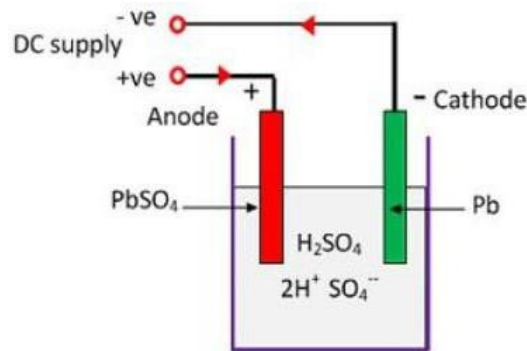
4. WORKING PROCESS

4.1 Working Principle

When the sulfuric acid dissolves (H₂SO₄), their molecules break down into positive hydrogen ions (2H⁺) and sulphate negative ions (SO₄⁻). These molecules can move freely. If the two electrodes are submerged in H₂SO₄ solution and connected to DC power supply then hydrogen ions being positively charged start moving towards electrodes and connected to the negative terminal of the supply. The SO₄⁻ ions are negatively charged start shifting towards the electrodes which is connected to the positive terminal of DC power supply (i.e., anode). Hydrogen ion take one electron

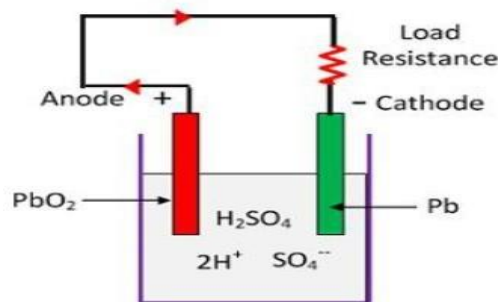
from cathode electrode while sulphates ions take two negative ions from the anodes electrode and react with water to form sulfuric and hydrogen acid.

The oxygen which produced from this reaction further react with lead oxide to form lead peroxide (PbO_2 .) Thus, during charging process lead cathode always remain as lead but lead anode readily converted into lead peroxide which has chocolate colour. If we disconnect the DC power supply and if the voltmeter connected between these electrodes, it will show the potential difference between them. If we connect the electrodes by wire, then current will start flowing from positive plate to the negative plate through external circuit it means the cell is capable of supplying electrical energy.



Recharging of Lead Acid Cell

Fig Charging of lead acid cells



Discharging of Lead Acid Cells

Fig Discharging of lead acid cells

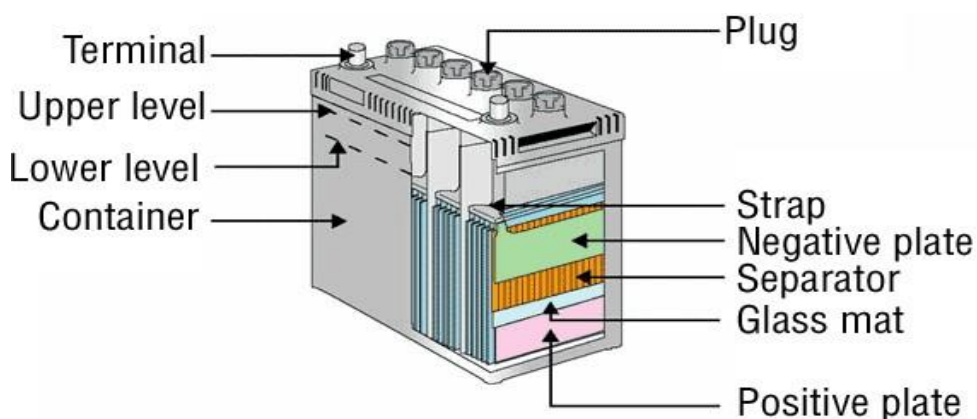
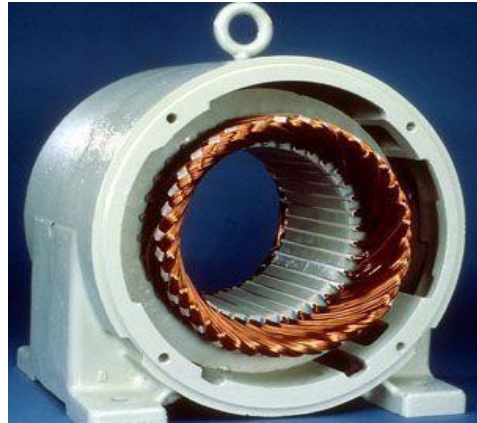


Fig Lead acid battery construction details

4.2.1 Construction Of BLDC Motor

Stator- Each type of stator has the same number of windings. It is made up of stacked steel laminations which has axially cut slots for wire winding.



4.2.2 Working Of BLDC Motor

We know that when a current is supplied through a coil, a magnetic field is generated. Using this principle, if we supply current to the coil A then it will generate a magnetic field and attract the rotor magnet. Due to attraction force position of the rotor magnet will shift in clockwise direction and will align with A. Now if we allow to pass current clockwise direction as shown in fig

To increase efficiency, we can wind coils in opposite direction using a single coil so that magnet will get double attraction. For further increasing the efficiency, we can energize two coils at one time so that one coil will attract the magnet and the other coil will repel it. During this time, the third will be idle.

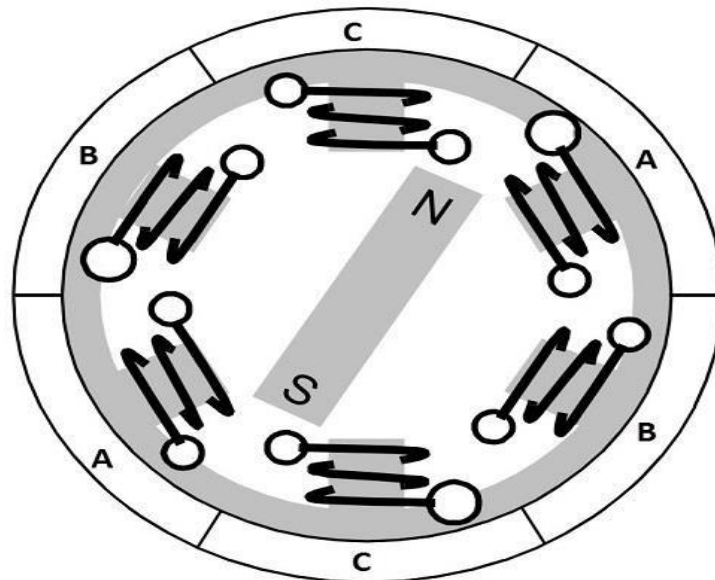
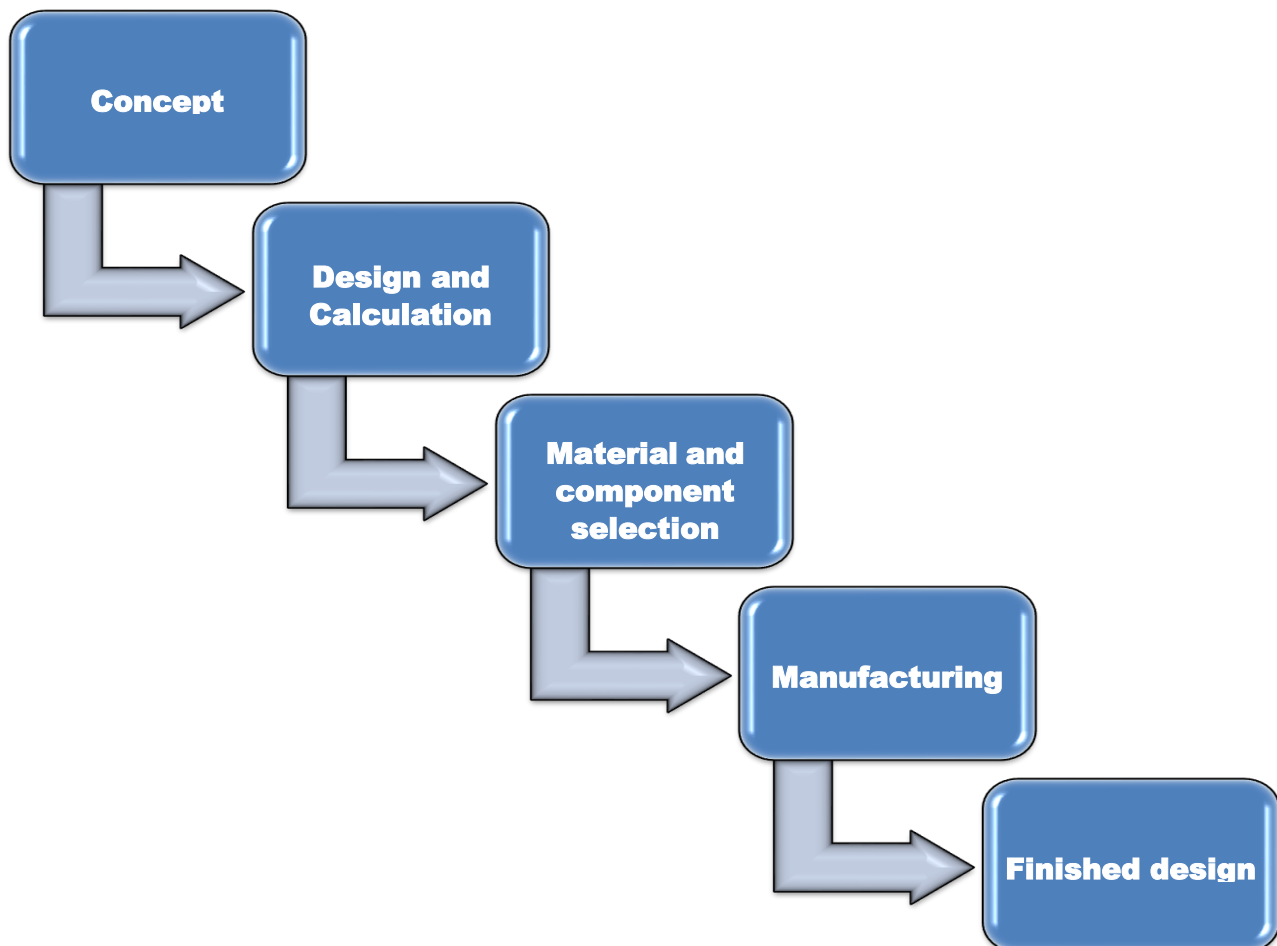


Fig BLDC motor working

4.3 Proposed Methodology



5. CONCLUSION AND FUTURE WORK

5.1 Conclusion

After detail study and research about our proposed project of electrically operated tillermachine following conclusion which we made are as follows:

1. Based on the overall performance of our machine we can assure that our project will satisfy problem faced by small scale farmer, because they are not able to buy costly agricultural equipment.
2. The machine required less man power and less time compared to traditional methods so if we manufacture it on a large scale its cost gets significantly reduce and we hope this will satisfy needs of Indian agriculture.

5.2 Future Scope

1. We can add various sensors to this Machine so that it can monitor and analyse different parameters and display on monitor.
2. We can add Wireless Technology so that we operate Machine by mobile also. We can add number of drills for different crops and operations.
3. We can add tank in Machine like fuel and fertilizer tank to reduce more efforts. There are to be proper provisions are needed to couple the machine with the tractor. We can add solar panel for charging

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