DESIGN AND DEVELOPMENT OF ELECTRIC CULTIVATOR

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ABSTRACT

In Today's world, the agriculture field is evolving with new research. Different automated and eco-friendly solutions are immerging in agriculture as plants, and nursery is important part of the agriculture field and facing many problems due to relying on traditional methods.

The problems are manual efforts required for weed control and low productivity due to more time required for plantation. To overcome this problem electric cultivator is designed and developed based on a chain sprocket mechanism. The electric cultivator comprises of D.C. motor, rechargeable battery, ploughing rotor blades, and control switch. The D.C. motor which provides the torque required to rotate the blades which are coupled to the shaft and driven by chain drive assembly. This research focus is on solar-powered cultivator operated by a switch on the frame and it can move in forward and reverse direction as well.

The power supply to the motor is given by using a battery. The battery is charged by a solar panel and alternatively, it can be powered by using an AC source. The system uses a 24v battery to power the electric cultivator.

I. INTRODUCTION

Background:

Agriculture is the backbone of the economy. As it is the largest source of employment and income to millions of people and also provides a vast market for our industrial products but most of the agriculture practices rely on conventional methods such as bullock carts, and working labour which affects the efficiency and productivity of the agricultural sector.

It shows that lack of mechanization or automation is one of the major roadblocks for improving the productivity of agriculture. To improve productivity weed control is also an important aspect. To resolve this problem there are some existing solutions which are tractor and power tillers which use conventional and non-renewable energy resources like petrol and diesel. These existing solutions produce emissions and pollutants like carbon monoxide, nitrogen oxide, methane, and unburnt hydrocarbons which are not environment friendly. Most of the farmers are small landholders and they cannot afford the cost of the tractors and power tillers.

So, the motivation of the research is to provide solutions for those small landholders to improve their productivity and wellness by providing the multifunctional cultivator using an electrical power supply which will introduce automation in the current agricultural practices which can improve productivity and reduce the effort and time required. It will be affordable to the small landholders and reduce pollution. The cultivator used for weed control and loosening of soil.

The use of clean energy in weeding machines against petroleum fuels will cut the risk of environmental hazards and reduce dependency on petroleum fuels. With the use of solar energy, the problem of the unavailability of fuels will be resolved. The production capability of Weeder can be conveniently expanded as per need and low maintenance is required due to the absence of any moving parts (Bhattacharya, 2016). In addition, it reduces the cost of weeding operations as a result increase the income of farmers. To overcome the limitations of petroleum fuels, the solar-powered Weeder is developed.

Shabbir J. Karjatwala et al. (2018) [1] have designed and developed a mini cultivator and tiller which can be easily handled by farmers. They have also used methods for the selection of tools depending on moisture content in the soil. The air-cooled engine of four-stroke OHV 163cc engine was used for generating power required. The main conclusion of this research is that any farmer in India can easily handle this mini cultivator. This machine was affordable to farmers and capable of performing multiple functions.

Nidhi Kumari et al. (2020) [2] have promoted the mini power tiller among marginal factors. The main objective was to collect information on the various obstacles facing farming for the small landholders. It states that the farmers of Bihar have mainly relied on potato farming. It includes the comparison between the mini power tiller and the traditional methods of farming. The use of a mini power tiller reduced the cost and time of operations as compared to human and bullock pair involvement in farm activities. In comparison to humans, total cost saving for plowing, ridge making, and potato digging by mini power tiller were observed. 5 They have done the testing with a 4.10 kW power tiller for drawbar performance with a three bottom mouldboard plough and 5-tyne cultivator revealing that the use of 60 kg ballast weight could develop a maximum pull of 1333.75 N with cage wheels under field conditions and derived that it can enhance the productivity with reduced labour charges

CULTIVATOR

A cultivator is an agricultural equipment used for soil loosening before seed boing and creating a loose seedbed and controlling the weed after the crops begin to grow. Weeds- disturb the growth of plants by disrupting the photosynthesis of plants and it is not desired for the growth of the plants. Toothed-type cultivator is similar to chisel Plows but they are used for different purposes cultivators work near the surface and do not disturb the plant growth and chisel Plows works deep inside the surface and can disturb the plant growth. small toothed cultivators are usually used for small-scale applications such as gardening and are manually operated. Cultivators are usually manually operated or attached behind two-wheel or four-wheel tractors. for two-wheel tractors cultivators are fixed and powered by tractors transmission coupling. Four-wheel tractors are usually driven by power take-off.

Two-stroke engine cultivator:

As the name indicates a Two-stroke Engine cultivator derives its power from a two-stroke engine. It requires petrol (or Gasoline) as a fuel.

Fig 1: Conventional cultivator

Purpose of balancing wheel:

The purpose of a balancing wheel on a cultivator is to provide stability and control during operation. A cultivator is a farm implement used for tilling and preparing the soil for planting. It typically consists of rotating blades or tines that break up the soil and remove weeds.

When the cultivator is in use, the blades or tines penetrate the soil and exert force, which can cause the implement to bounce or become unstable. This bouncing motion can be particularly noticeable when the cultivator encounters uneven terrain or obstacles in the field.

The balancing wheel, also known as a gauge wheel or depth wheel, is typically positioned at the front or back side of the cultivator. It is designed to provide support and help maintain a consistent depth of tillage. The wheel rolls along the ground, acting as a guide and preventing the cultivator from digging too deeply or riding too high. By keeping the cultivator at a consistent depth, the balancing wheel helps ensure uniform tilling and prevents uneven soil disturbance. It also helps improve control and maneuverability, making it easier for the operator to steer and maintain a straight line. Overall, the balancing wheel plays a crucial role in stabilizing the cultivator and optimizing its performance by maintaining a consistent depth of tillage, reducing bouncing or tilting, and enhancing overall control and efficiency during soil preparation.

II. FABRICATION METHODOLOGY

Mild Steel (Low Carbon) and cast iron is selected for the fabrication. This alloy is the most commonly available of the cold-rolled steels. It is generally available in round rod, squarebar, and rectangle bar. It has a good combination of all of the typical traits of steel - strength, some ductility, and comparative ease of machining. Chemically, it is very similar to A36 Hot Rolled steel, but the cold rolling process creates a better surface finish and better properties.

For Mild steel Minimum Properties

- Ultimate Tensile Strength, psi 63,800
- Yield Strength, psi 53,700
- Elongation 15.0%
- Rockwell Hardness B71

Chemistry

- Iron (Fe) 98.81 - 99.26%
- Carbon (C) 0.18%
- Manganese (Mn) 0.6 - 0.9%
- Phosphorus (P) 0.04% max
- Sulphur (S) 0.05% max

Mechanical property reference data for various grey cast iron, includes tensile strength, shear modulus of elasticity. Torsional modulus of elasticity, endurance limit and Brinell hardness data. The American society for testing material [ASTM] numbering system for grey cast-iron is established such that the numbers correspond to minimum tensile strength in KPSI. Thus, an ASTM no.20 cast iron has a minimum tensile strength of 20 KPSI. Note particularly that the tabulation are typical values. Multiply strength in KPSI by 6.89 to get strength in Mpa. Steels given for comparison purposes. Tensile and hardness given as rolled and heat treatedby water quench and tempered at 425°F. the SAE 1050 heat treated is roughly the properties of most anvils. However, the temper condition given is softer. Use the SAE 1095 temper for anvils.

Physical properties

1. Specific weight -0.071N/cc
2. Melting point – (1150-1300) °c
3. Modulus of elasticity 1.000*10^5 N/mm^2
4. Modulus of rigidity 0.350*10^5 N/mm^2
5. Thermal conductivity 0.130 cal/s cm°

III. DESIGN OF ASSEMBLY

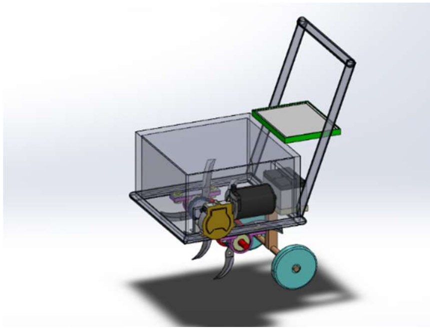

Fig 2: CAD model

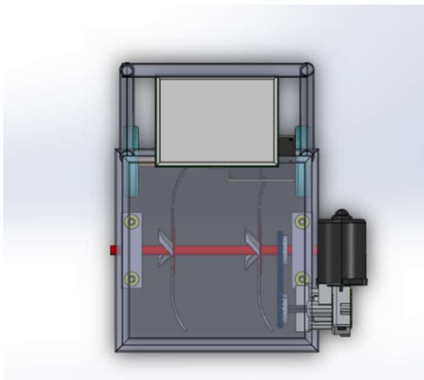

Fig 3: Top view:

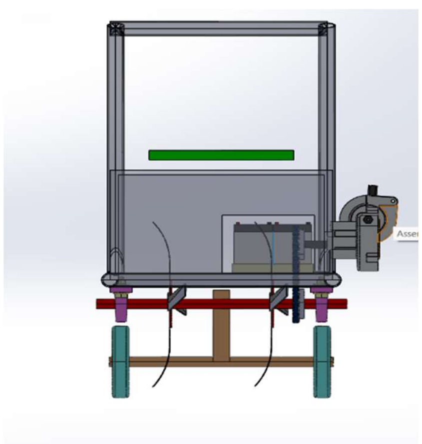

Fig 4: Front view:

Result

The testing phase of the electric cultivator involves evaluating its performance, functionality, and safety to ensure it meets the desired standards and requirements.

Fig Final Product

IV. CONCLUSION:

While this research project marks a significant step towards a more sustainable agricultural sector, there are opportunities for future improvements. Increasing the battery capacity would extend the operating time and enhance the system's reliability. Reducing the weight of the powertrain components would improve manoeuvrability and ease of use. Further advancements in blade design would optimize cultivation effectiveness, and automation features could enhance the efficiency and precision of the cultivator. Additionally, incorporating detachable blades for multipurpose applications would enable farmers to use the system for various agricultural tasks.

V. REFERENCES

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