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Design and Fabrication of Electric Tiller Machine with Fertilizer Dispenser for Arecanut and Coconut Plantation

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Abstract

This paper focuses on the conception and production of an electric tiller machine for arecanut and coconut plantations that includes a fertiliser dispenser. When designing the electric power tiller, a software application called Solid Edge was used. Following the findings of our research, electric power tiller was fabricated in a manner that was compatible for engineering applications.

Keywords*: Electric tiller, power tiller, ecofriendly, fertilizer dispenser, manuring*

I. Introduction

A power tiller is an agricultural machine used for preparation of soil, weeding, sowing which contains a set of rotating blades mounted wheel type housing and it is powered by IC engine or electric motor. Through literature review and also the practical applications, came across several advancements and different design types in the field of power tiller. Below we have discussed a few types of power tillers.

Four Wheeled Power Tillers:

There are a variety of power tillers available in the market for big open farms as well as for medium open farms. One such type of tiller is the four wheeled power tiller. These tillers are used in open farms such as paddy cultivation, wheat cultivation etc. However, these huge power tillers cannot be used in areca nut farms because there will be no space for the tiller to move around. Such tillers are efficient, but they cause noise and air pollution [1]. Figure 1 shows the conventional four wheeled power tiller.

Fig 1. Four wheeled power tiller

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Two Wheeled Medium Power Tillers:

Today there are two wheeled power tillers for small farming also, but they are also powered by IC engine which will cause a huge pollution and health problems to the operator by the vibration of the machine [5]. These two wheeled tiller machine are also designed for small paddy farms where the work is less. These two wheeled power tillers are mainly aimed to reduce the cost of the machine and to be affordable by the poor farmers who have small farms [4].These tillers are very heavy, cause pollution and the operator cannot handle machine for long time because of its weight and vibration. Most farmers are elderly people so they can't handle the machine [6]. These tillers cannot be used in arecanut farm as they are difficult to carry this machine around the arecanut tree and also their blades are not designed to do small works. Figure 2 shows the conventional two wheeled medium size power tiller.

Fig 2. Medium two wheeled power tiller

Two Wheeled Small Power Tiller:

Two wheeled small power tillers are designed mainly to be used in small vegetable farms and other similar farms. Figure 3 shows a two wheeled small power tiller.

Fig 3. Small two wheeled power tiller

These tillers have less weight compared to the above mentioned other power tillers. These tillers can be used in arecanut farm, but their blade can cause problems to the root of the plants as they dig little deeper than desired. As this power tiller is also powered by IC engine, they produce pollution as well as vibration.

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Two Wheeled Electric Power Tiller:

There are some power tillers powered by electric motor which is not rechargeable but wired. These wired tillers cannot be used in vast arecanut and coconut plantations, as it is difficult to supply electricity all over the farm. Figure 4 shows a two wheeled electric power tiller.

Fig 4. Two wheeled electric power tiller

Problem Identification

Large amount of pollution is caused by IC engine power tillers. Power tiller which consume fossil fuels expels pollutants which cause air pollution. These machines also cause noise pollution. Another problem is the high periodic expenses and time consumption for traditional manual method which includes separate processes, 33 percent cost of cultivation is spent on weeding alone[3]. Processes like ploughing, manuring and removing soil from plant base area require human effort which will cause back pain and other health problems to the laborers [2].

Electric Power Tiller with Fertilizer Dispenser

We know that ploughing and manuring process need more human effort and the conventional process is more expensive. It also causes pollution and health problems to workers. To overcome this problem, the electric power tiller with fertilizer dispenser plays a vital role. This is an advanced type of power tiller which uses an electric battery to run the tiller blades. It also has a fertilizer dispenser which will dispense fertilizer after ploughing. Figure 5 represents assembled model of the electric power tiller with fertilizer dispenser. It consists of a body with rotating blade with turning mechanism, fertilizer containers and wheels.

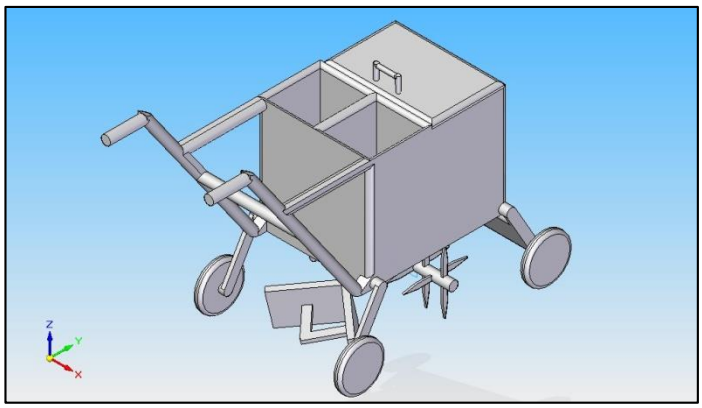

Fig 5. Electric power tiller with dispenser

To design and fabricate electric tiller machine with fertilizer dispenser. To reduce pollution compared to other machines using IC engines. To make the power tiller more cost effective. To reduce human effort and time consumption for different process in arecanut and coconut farm.

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II. Methodology

Methodology is a process of project planning wherein all the major and minor steps of the project whether it may be logical creative fabrication application steps are neatly explained. Methodology is one of the prime components in project planning where all the possible factors and their aftermath effects are relatively considered for the optimum and effective project management. Journal papers are reviewed in order to study and understand the recent updates in the field of electric power tillers. Surveying of literature review helps in simple understanding of the overall activities in our topic. It also helps us to implement further upgradation of work in our research. In this step, we have fully designed the model of the electric tiller machine with fertilizer dispenser in Solid Edge software with actual dimensions which will be useful for us during the fabrication work. Designing of any machine is very crucial work. Because, every dimension that we give is very important so that every part is able to connect to each other during the assembly. Table1.represents the design characteristics of electric tiller machine with fertilizer dispenser.

Table 1. Design characteristics

Battery type	Lead acid
Battery specification	12v, 7amps
Motor type	DC permanent magnet
Motor specification	12v, 90watt, 60rpm
Bearing	H2 02 ball bearing
Chain sprocket	1:1 chain sprocket
Machine dimension	36 x 24 x 30 inches
Wheel dimension	6 inch

Battery

A 12v, 7amps rechargeable lead acid battery is used for the tiller machine. Lead acid battery is used in order to reduce the production cost of the prototype as it is comparatively cheaper, but a lithium ion battery can be used for the long run.

Fig 6. Rechargeable lead acid battery

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Motor

A 12v, 90watt motor with a speed of 60rpm is used for the project. Since having high torque is the primary requirement, low speed is not a concern.

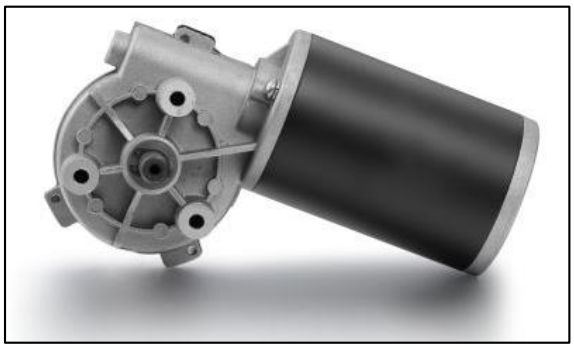

Fig 7. 12v 90watt DC motor

Fertilizer Dispenser

2 dispenser openings leading from the 2 separate containers are provided at the bottom of the tiller machine as shown in figure 8. The opening & closing of the dispenser is controlled by using a spring & lever mechanism.

Fig 8. Fertilizer dispenser at the bottom

A 1:1 chain sprocket is used in the tiller machine to rotate the blades. The drive ratio is kept 1:1 to get the same speed of 60rpm from motor and to maximize the torque output.

Fig 9. Chain sprocket& rotating blades

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These blades of 5mm thickness and 150mm length made out of cast iron are driven by the electric motor using 1:1 chain sprocket to plough the soil. Then V-blade moves soil to both sides.

Fabrication is a sequence of events which is done to create something from its root rather than just assembling it. In this research, fabrication work is the building of electric tiller machine with fertilizer dispenser from scratch. Building each part individually and assembling or welding it together is main goal of our project.

Fig 10. Final fabricated product

III. Results

Final goal of our project is to complete the fabrication of an electric tiller machine with fertilizer dispenser and to conduct a field test. Electric power tiller does not emit any greenhouse gases; it is very eco-friendly. Human efforts are drastically decreased. Maintenance cost is very low. Operations are user friendly. The main disadvantage of the electric tiller machine with fertilizer dispenser is they cannot be used in the high slope farms.

IV. Conclusion

An electric tiller machine with fertiliser dispenser is successfully designed after thoroughly researching and finding solutions. It uses a permanent DC motor of 12v, 90watt, 60rpm to drive the blade and a 12-volt lead acid battery setup installed on the power tiller. The newly developed electric tiller machine with fertiliser dispenser is environmentally friendly. It lessens human effort. However, the initial cost is high but the maintenance is very low.

References

[1] Haruo Sakamoto and Takuya Tsuneishi, Manufacturing and Control of an Electric Power Tiller, Journal of Asian electric vehicles, Volume 3, Number 1, June 2005.

[2] Mr. Vivek D Raut. B.D. Deshmukh, Dinesh Dekate. et.al “Various aspects of Weeders for Economical Cultivation” on volume 3 issue 5 Oct 2013 pp. (3296-3299).

[3] Mr. Tejas B. Raut1, Mr. Shubham P. Wagh2, Mr. Ganesh V. Gawde3 Review Paper on Power Weeder ISSN: 2455-2631 March 2019 IJSDR | Volume 4, Issue 3.

[4] Sanoj Kumar and Pankaj Kumar a Review Article on Different attachments of a power tiller International Journal of Science, Environment and Technology, Vol. 7, No 3, 2018, 1024 – 1035 ISSN 2278-3687 (O), 2277-663X (P).

DOI : https://doi.org/10.56452/0175

[5] Juan, G. S., & Magaña, S. G. C. (2020). Evaluation Parameters Affecting the Performance of Vibrating Vertical Tillage Equipment–First Stage. Agricultural mechanization in asia, Africa, and latin america 2020 vol. 51 no., 51(1), 7.
[6] Haruo Sakamoto,Development of an Electric Powered Tiller for House Gardening, Journal of Asian electric vehicles, Volume 5, Number 1, June 2007.