International Journal of
INTELLIGENT SYSTEMS AND APPLICATIONS IN ENGINEERING
ISSN:2147-6799 www.ijisae.org Original Research Paper

Design and Construction of an Electric and Solar Hybrid Tiller

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Submitted: 17/08/2023 **Revised:** 09/10/2023 **Accepted:** 21/10/2023

Abstract: Agriculture has been a fundamental component of the human ecology. Nonetheless, conventional agricultural practices need substantial human labor and are time-consuming. Tilling is among the most labor-intensive activities in agriculture. Manually tiling fields is an arduous labor, but tractors need substantial investment and incur significant fuel expenses. This economical, battery-operated portable electric cultivator is a contemporary, comprehensive answer for enhancing traditional agricultural practices, as it diminishes manual labor at little expense via a motorized tillage system. The electric cultivator minimizes processing time and expenses with its intelligent portable design, hence enhancing production and efficiency in agriculture. The apparatus employs a wheel with fused corners to provide an effective traction on the surface. The wheel design was created to provide a robust hold on the ground sufficient to pull the cultivator prongs during tillage. A switch located on the handle is used to deactivate the machine. The apparatus is operated by an electric motor that utilizes a toothed chain to propel the driving wheel. A battery powers the motor, enabling it to lift the forks off the ground. The three tines of the cultivator provide precise and efficient agricultural operations. The lightweight and portable design facilitates precise directional control of the equipment during operation. It may be conveniently moved by vehicle or manually for the conveyance of machinery. Consequently, the electric tiller offers a sophisticated and unique fuel-free solution for cultivating fields and gardens.

Keywords*: Electric Tiller Machine, Motor, Frame Design, Wheels, Bearings, Battery's, Dynamo.*

INTRODUCTION

The need for electrical energy is increasing in all nations globally. Renewable energy sources are anticipated to be prioritized in energy planning. Wind power has emerged as the most economical form of new power production and has a significant growth rate in installed capacity. The modularity of photovoltaic and wind systems is of much greater significance. Renewable energy offers sustainability and is fundamentally clean and ecologically benign. A hybrid energy system integrates two or more power generation technologies together with an energy storage system to provide electricity to the load.

Currently, Indian farmers are dissatisfied with the expenditure on seedbed preparation due to the increase in gasoline prices. To address this issue, we developed an electric power tiller powered by an electric motor and battery. The battery is environmentally sustainable and rechargeable. The power tiller is mostly used in the agricultural sector for the preparation of a seedbed in the top soil layer. The power tiller has superior soil mixing capacity relative to other machines, as well as effective weed cutting capability. The power tiller enhances the soil's water retention, aeration, thermal properties, and nutritional content. A motorized tiller has an adjustable wheel to accommodate different working depths for soil bed preparation. Various types of blades are available on the market. The blade is shaped like L, J, and C. The power tiller on the market is powered by an internal combustion engine. The operation of engines requires fuel and diesel, which is a significant issue since they contribute to environmental pollution, adversely affecting human health. In response to this issue, we developed a solution and created an electric power tiller. This is cost-effective and generates no pollutants. In the electric power tiller, we incorporated additional beneficial accessories, including an adjustable handle for modifying the height relative to the operator and an adjustable wheel for regulating the tilling depth of the blades in the soil. Furthermore, the wheel facilitates the transport of the machine, bearing its total load for ease of movement from one location to another. A Solar Plate has been added to it. When the battery discharges during operation, the solar panel is used to recharge the battery and extend its lifespan.

Agriculture has consistently been a component of the human ecology. Conventional agricultural methods, however, require substantial labor and are time-consuming. Farm tilling is one of the most labor-intensive agricultural practices. Manual field tiling is a very labor-intensive endeavor, whereas using tractors necessitates considerable initial capital and substantial fuel costs. It is an agricultural implement mostly used for land cultivation. It effectively operates by rotating and tilling the soil simultaneously. Regarding upkeep, it is more economical, prudent to use, and necessitates less space. The Power Tiller may perform the functions of several

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agricultural instruments such as a rotavator, harrow, and harvester. A two-wheeled horticultural cart equipped with spinning turners that provide seamless protection during agricultural operations is referred to as a power tiller. In reality, it has several applications and benefits. Power tillers facilitate soil preparation, seed sowing, and crop planting. This economical, battery-operated tiny electric power tiller serves as a comprehensive contemporary solution to improve traditional agricultural practices by significantly minimizing human labor at a minimal cost using motorized tilling mechanisms. The electric power tiller minimizes the time and expenses associated with tilling with its intelligent, portable design, ultimately enhancing production and efficiency in agriculture. The motorized tiller is really easy to use. It just requires adjustment, and it operates appropriately. It facilitated the collecting of all conceivable types of produce. The electric power tiller, with a creative and adjustable design, minimizes the time and costs associated with tilling, hence enhancing its use and efficiency in agriculture. Upon evaluation, the Mini Electric Power Tiller is a notable investment. The reduced allocation helps farmers by producing revenue. Agriculture is the economic foundation of India. As a developing nation, agriculture and enterprises reliant on agricultural goods are essential to the Indian economy. Agriculture and agriculture-related businesses and companies sustain the bulk of India's population. Among the several agricultural mechanization implements are the soil tiller and the weed eater. Soil tillers and weeds are non-traditional in terms of labor displacement as compared to tractors. In enhancing soil tillage and weed management, especially considering that most farmers own restricted land areas. Consequently, they are unable to purchase more costly tractors. Consequently, the soil tiller and weeder should serve as effective machinery for the internal cleaning of crops and soil excavation in close proximity, such as groundnuts, sugarcane, soybean, and notably paddy agriculture, as well as other crops in general, benefiting small-scale farmers. Energy is a fundamental need for human life on Earth. We rely on several forms of energy to meet our requirements. One kind of energy is derived from fossil fuels. We use energy from these sources for power generation, operating autos, etc. The primary drawbacks of fossil fuels are their lack of environmental friendliness and their destructive effects. We must explore alternative energy sources to address the issues associated with fossil fuels. To actualize this notion, we developed a solar-powered electrical tiller. The vehicle is designed for two-wheel drive and may be used for shuttle service and short-distance travel. All sectors, including agriculture, are seeing rapid growth in the contemporary era. Farmers must use novel practices that preserve soil texture while enhancing overall crop production to meet future food needs.

Literature Review

V. N. Mujbaile, P. R. Kaware, A. G. Umare, S. S. Taksande, S. S. Malot, M. N. Lanjewar. Invalid input; please provide text for revision. The engine shaft may be connected to the frame wheels. The cultivating tool is affixed to the frame. The engine's power will drive the tool downward into the dirt. Additionally, the handle may be used to facilitate the appropriate steering of the machine by altering the wheel directions as needed. Seed sowing operations may be conducted by placing sowing pans next to the instrument. Thus, when tools dig simultaneously, seeds may be sown as needed. In their experiments, they noticed that the depth of the tool is entirely contingent upon the molecular structure, soil condition, and moisture content of the soil.

Waghmode R.S., Shinde S.R., Dixit A.K., Chanchure A.A., Jadhav K.H. [2]: This research study addresses the design of a solar-powered rotary tiller.

This report discusses a comparative analysis of small weeder machines and power tiller machines in the Indian market. This document also addresses several approaches used for weed eradication in agricultural fields. Their analysis found that the majority of Indian farmers are small-scale and can only afford portable weeders. The soil tiller and weeder are among the several agricultural mechanizations that enhance soil cultivation and weed management, particularly given that most farmers own tiny plots of land. It diminishes human exertion. The operation of their idea relies on solar panel electricity, which creates power to operate the mechanism that drives the cutter or tiller.

It is a time and cost saving in field operations. Consequently, it will have very effective applications in agricultural fields for both tilling and weeding. The development of energy-efficient, adaptable machines may enhance worker productivity, lower unit operational costs, and improve operational timeliness.

Po Niu, Jian Chen, Chenjun Hu, Jindou Zhao. This study work aims to enhance the comfort of electric micro tillers based on numerous field experiments.

Numerous studies have been undertaken in the field to enhance operational comfort; nonetheless, the results have been below expectations. A new kind of electrical small tiller machine was created as an alternative. To enhance operational comfort, field tests were conducted by these researchers to minimize the vertical force and vibration RMS values at the handle. The experimental findings indicated that when the center of gravity (C.G) was shifted 19.78 cm towards the handle, the vertical force diminished from 154.24 N to 0 N, and the vibration RMS values decreased by 20.16% under operational conditions.

Ashish Kumar, Rajat Gethe, Sattyendra Pethe Patil, Akshay Waychal. The primary purpose of their work is to

minimize the effort required for operating manual farming equipment. Their suggested concept for a soil tiller machine operates on solar power and consists of components such as a solar panel, motor, 12 V batteries, pedestal bearings, and a tiller blade. In this revised soil tiller machine, the rotor blade is affixed to a shaft positioned between two bearings, which are secured to the tiller frame. The wiper motor is connected to the rotor blade by a belt and is mounted on the frame. A solar panel is affixed to the top portion of the tiller, ensuring that sunlight directly strikes the panel, which converts solar energy into electrical energy for the battery that powers the engine. The motor's spin is either clockwise or counterclockwise, depending upon the connection configuration. The project primarily focuses on the creation of an appropriate solar power tiller machine. The project attains elevated safety standards and diminishes human labor requirements.

Ryss (Rythu Sadhikara Samstha, Andhra) Pradesh Community-Managed Natural Farming Tillage is a practiced method. often to aerate the soil for enhanced rainfall absorption and enable seedlings to develop deeper roots. However, this Practices adversely affect the soil in several ways as outlined below.

This study focuses on the design of a solar rotary tiller for use in primary and secondary tillage using a power tiller. A comparative analysis of portable weeders and power tillers in the Indian market is presented. Different techniques used for the eradication of weeds in agricultural crops are also examined. This research indicated that the majority of Indian farmers, mostly small-scale cultivators, can only afford portable weeders. The project focuses on minimizing the labor associated with manual farming equipment. The newly created soil tiller operates on solar power and comprises the following components: solar panel, 12-volt DC battery, wiper motor, pedestal bearings, and tiller blade. The newly updated soil tiller has a rotor blade mounted on a shaft situated between two pedestal bearings, which are affixed to the tiller's frame. A wiper motor is connected to the rotor blade by a V-belt, and the wiper motor is secured to the frame. The solar panel is affixed to the top section of the tiller, ensuring direct exposure to sunlight, and its output is sent to the battery, which powers the wiper motor. The motor's rotation, whether clockwise or counterclockwise, is dependent upon the connection. The project primarily focuses on the creation of an appropriate operating system. The project enhances safety, minimizes human labor, improves the efficiency of the soil tiller, lessens the workload, alleviates worker fatigue, and decreases maintenance costs [2]. The paper summarizes the advancements achieved in the development of lubricating pumps for internal combustion engines during the last two decades. The operational points of gear units are established by analyzing their circuit interactions after a description of the original fixed-diameter gear units. A discrepancy exists between the engine's flow requirements and the pump's specifications, as shown by the query. A significant amount of fuel is wasted due to the overall inefficiency of the flow-generating unit. In recent years, several attempts have emerged to reduce power consumption by the lubricating pump. This research examines pumps with variable displacement and variable timing. This paper outlines a student's design, fabrication, analysis, control, and testing processes for a motor-powered tiller intended for agricultural work. We must explore alternative energy sources to address the issues associated with fossil fuels. To actualize this notion, we developed a solar-powered cultivator [3]. Agriculture is the main source of livelihood for the Indian populace. It is vital to the economic development of our nation. In ancient times, plows were used to cultivate or till the land. Currently, tractors are used for various agricultural cultivations. The tractor is an engineering vehicle specifically designed for agricultural use. Numerous implements or agricultural machinery are affixed to the tractor for soil cultivation and aeration. The use of tractors incurs higher costs for small-scale farmers. Design and manufacture of multifunctional agricultural machinery using worm and worm wheel gearboxes primarily for inter-agricultural applications. A worm wheel gearbox is used to generate reduced speed and increased torque; thus, additional speed reduction is achieved by a chain drive [6]. It is only a two-wheeled tractor sometimes referred to as a power tiller. The traditional power tiller has several disadvantages. It inadequately provides high torque and fails to absorb shocks during agricultural operations. The project involves enhancing torque and designing various attachments for it. This project introduces the plough implement to the motorized tiller. The multipurpose machine is used for pump sets, material handling, pesticide spraying, and similar applications.

Power System

A. Solar Energy

Solar energy is the most primordial source and the foundation for almost all fossil and renewable energy kinds. In a solar power generating system, solar energy is immediately converted into electrical energy. A solar power generating system consists of one or more photovoltaic panels arranged in series or parallel to provide the necessary voltage and current. The output power of the solar array is contingent upon the array's area, solar irradiation, and its efficiency.

Hybrid System

A hybrid energy system is more efficient and offers users continuous electricity with more dependability than a

system reliant on a single source. Wind-solar hybrid power systems effectively complement one another in energy generation and collaboratively deliver electricity to the load. A wind-solar hybrid power system exhibits enhanced stability and dependability, resulting in a more consistent output.

The total power produced by this system is the sum of the power generated by the solar photovoltaic panel and the power generated by the wind turbine. It may be mathematically expressed as,

PT = NWPW + NSPS

Where

PT = the total power generated

PW = the power generated by wind turbines

PS = the power generated by solar panels

NW = the no of wind turbine

Ns = the no of solar panels used

Fabrication of solar powered mini electric tiller:

The essential components required for the fabrication of a Solar Powered Tiller machine include a detailed overview of the project's elements. It features a 12-volt solar panel, which is pivotal as solar energy serves as the primary power source. The solar panel absorbs energy and transfers it to the battery, which functions as the power source. We use a 24V DC wiper motor to operate the whole tiller system powered by a solar panel. Frame length, breadth, and width.

A low-speed wiper motor is used to operate the tiller. Rotating the tiller will enable the tiller blade to appropriately cultivate the soil. This project achieves enhanced safety, reduced human effort, increased soil tiller efficiency, lowered workload, less worker weariness, and cheaper maintenance expenses. The square tubes are welded to provide the necessary frame. The U-shaped tiller blade is riveted to the bottom of the frame. The solar panel is secured with a clamp. When sunlight traverses the solar panel, the battery is charged and energy is stored. Once the power is stored, it is used in the wiper to actuate the shaft. The tiller wheel is installed in the shaft. When activated, the switch causes the wiper motor to spin the tiller wheel.

At the rear of the tiller wheel, the tiller blade is affixed and oriented to plow the soil appropriately. We may till the soil to a depth of 5 to 6 mm. The use of a tiller may decrease manual labor. The gear-driven direct current motor with a 100 RPM pulls power from the intercultural blades. Undesired vegetation is consistently eradicated by tiller blades. The depth is adjustable using the screw rod and nut mechanism.

Working Of Fabricated Solar Powered Mini Electric Tiller:

The square tubes are welded to provide the necessary frame. The U-shaped tiller blade is riveted to the bottom of the frame. The solar panel is installed in a clamp. When sunlight passes through the solar panel, the battery is charged and energy is stored. Once the power is stored, it is used in the wiper to actuate the shaft. The chain sprocket and the reciprocating shaft for seed sowing are installed. The shaft is separated at one end and linked to the rim of the tiller wheel at the other end. When the switch is activated, the wiper motor tries to revolve the tiller wheel. At the rear of the tiller wheel, the tiller blade is affixed and effectively cultivates the soil in an appropriate way. We may till the soil to a depth of 2-3 mm. The churning phase is completed, and the seed planting procedure begins. Seeds are sown under the earth using a reciprocating motion. Utilizing the tiller, we can decrease the manual work required. The gear-driven direct current motor operating at 100 RPM gets power from the intercultural blades. Undesirable vegetation is consistently eradicated by tiller blades.

The depth is adjusted using the screw and nut mechanism with the assistance of the screw rod. This apparatus utilizes a bicycle-powered tiller. A motorized tiller with manual propulsion is now in operation. At the back of the tiller, a shaver is used with a stable static blade. We modified the tooling mechanism in this machine to provide a continuous rotating motion driven by a 150 RPM electric DC motor. mand 7.2 nm of tor que. This engine is powered by a battery pack. This rotating tool rotates counter clock wise throughout the whole mechanism, which is effective for displacing dirt between two rows of agricultural crops. Solar energy is generated by the panel and used to power this gadget.

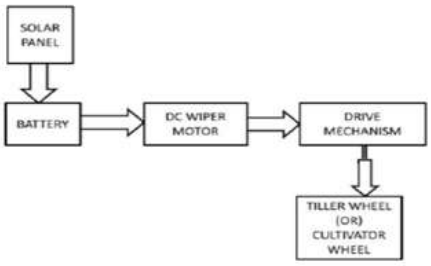

Fig-1 Working Diagram of electric tiller

RESULT:

The electric power tiller aerates the soil by excavating a specified area and eliminates weeds along with their roots. The tilling depth is adjustable with the assistance of the front wheel, allowing for a depth of up to 1–2 inches. Assessing the efficiency of a solar-powered electric tiller entails evaluating the conversion of solar energy into mechanical labor. Here is a simplified formula to measure efficiency:

Efficiency (%) = (Mechanical Work Output / Solar Energy Input) x 100.

• Mechanical Work Output: This refers to the work performed by the tiller, often measured in joules or watt-hours.

• Solar Energy Input: This denotes the solar energy harnessed by the solar panel and transformed into electrical energy, often quantified in joules or watt-hours.

Mechanical Work Output: Wiper Motor Watt-hours = 30 Watts × 2 hours = 60 watt-hours Solar Energy Input: Panel Input = 10 Watts × 8 hours = 80 watt-hours

Efficiency (%) = (Mechanical Work Output / Solar Energy Input) × 100 Efficiency (%) = (60 watt-hours / 70 watt-hours) × 100 = 85.714% The completely charged battery operates for 2 to 3 hours. The fabrication of the body frame has been successfully finished and operates smoothly. It is simple to use and manage. The project is effectively executed to stress the minimization of the detrimental effects associated with the use of manual rotavators. The newly built battery-powered rotavator is in operation.

CONCLUSION

The solar power tiller is proficient in effectively tilling soil during agricultural processes. Primarily in small-scale agricultural processes. Utilizing Solar Power Cultivator, we eliminate. Superfluous flora from flow. We are effectively crushing all sorts of dirt to get a soft consistency. The most effective method to diminish emissions is via the use of renewable energy. The exploitation of various nonrenewable energy sources. Multiple sources lead us to the conclusion that solar. In comparison to other energy sources, energy consumption has more benefits. Solar electricity is absorbed by solar panels, stored in batteries, and then used to energize various gadgets. We subsequently decided to construct solar-powered blade harrow technology, which is beneficial for farmers in their agricultural activities.

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