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Design and Implementation of Solar Powered Automatic functional Crop Cultivator

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Abstract: Humanity's next great leap, after the massive industrial revolutions, was the development of novel methods for harnessing the sun's energy for use in a wide variety of human endeavours. The sun will not die before Earth does, thus it stands to reason that we should prioritise renewable energy sources like this. . Food is another significant item that is essential to all communities. Agriculture is the study of farming and other methods of producing food. It seems that both items, and food production in particular, will be constrained in the foreseeable future. The food production industry's rising energy needs and output of carbon dioxide into the atmosphere will exacerbate the environmental crisis. The primary objective of this research was to provide an alternate approach to meeting the energy demands of agricultural practises on arable land. Even though the automotive industry is transitioning to electric motors and electric automobiles, diesel-powered agricultural tractors will continue to be widely used. This research examines the energy balance between solar energy production and the needs of agricultural operations in the field, under the assumption that electric farming tractors can be manufactured. The primary components of this idea are the solar array configuration, the electric tractor engine, and the battery that stores and supplies power from the panels to the tractor in the field. This paper's primary goal, beyond assessing the project's technical and financial viability, is to firmly establish the merging of the two sectors. Sustainable agriculture and environmentally sound engineering.'

Keywords: Solar Energy, Renewable, Food, Agriculture, Co2, Farming Activities, Electric Engines,Farming Tractor, Batteries

Introduction

With agriculture being India's primary economic driver, the country's attention [1] must be focused on issues such as boosting agricultural output and profitability while also lowering input costs and resolving farmers' grievances. Crop production is one of the issues that farmers face. Agricultural farmers encounter a number of challenges. Manual (or "Conventional") and mechanised (or "Industrial") agricultural equipment are both in use in India. Farmers and their workers do crop cutting in the traditional technique. Where workers put in long hours in the field and farmers must fork out money every day to keep them

employed. Costs to farmers will rise and workers' discomfort is a major drawback of this technique. Manually harvested wheat requires 185-340 man-hours/hector for almost for cutting and bundling the crop, whereas manually harvested paddy requires 170-200 man-hours/hector. [11] The engine in the mechanised approach powers the cutter; this method contributes to air pollution since the engine burns polluting fuels like petrol and diesel. The engine's vibrations are bad for farmers, and the modern mechanical cutter costs too much to run and maintain for most small-scale farmers in India. The crop cutter is a machine or robot that helps farmers harvest their crops and gather them into bundles. The prototype model is designed in this article. Because of its potential to manage several mechanisms, the crop cultivator has been dubbed the "Automatic crop cultivator." This crop cultivator is versatile and simple to use, making it ideal for a wide range of mechanised tasks including mowing grass, weeding and removing undesired crops from the field.Overpopulation now poses the greatest threat to the whole cosmos. In this world, we still have to deal with issues like pollution and power outages. This issue causes significant disruption to routine activities. We came up with a gadget that employs cutting-edge technology to combat pollution. Solar power is a viable option. Since 1954, the innovation has been in progress.Using solar energy as a renewable resource to power electronics is central to the concept of solar gathering. [2]. The current efficiency of solar energy conversion into usable energy is at least 20% [4]. Solar energy is being used in many different industries, from the textile industry and food storage to water pumping and transportation. The solar-powered lawnmower concept seen in Figure 1a of this study is presented. The automatic lawn cutter concept that was created has the dual benefits of reducing both human labour and noise pollution. The technology relies on a tiny microprocessor. Schematic of a simple solar-powered lawn cutter, shown in Figure 1b. Solar energy is commonly employed for both photovoltaic and water heating purposes. Since solar panels can generate electricity, they are increasingly being used to power houses and businesses [5]. A solar-powered, manually-operated lawnmower has been developed before. This instrument has a perfectly straight blade and works in any climate [6]. The primary goal of this development is to create a product that can be used by unskilled labourers. In this study, we present a brand-new automated farming topology. The microcontroller in the system is responsible for automating tasks and identifying any obstructions to the device's operation. The power issue is mitigated by the use of renewable energy in the form of solar electricity, which is stored in a battery and mounted on top of the tool.

We constructed a tiller powered by an electric motor and battery to address this issue. The battery may be recharged and is safe for the environment.

In agriculture, the power tiller is often used to break up the top layer of soil in preparation for planting. The power tiller has superior weed-cutting capabilities in addition to its superior soil-mixing capabilities. When using a power tiller, the soil is better able to retain water, air, heat, and nutrients. To facilitate different tilling depths, the wheel on a motorised tiller is adjustable. There are several blade options out there. Blades in the L, J, and C shapes. The IC Engine powers the power tiller on the market. The usage of petrol and diesel to power an engine is problematic for a number of reasons, not the least of which is that such vehicles produce pollution that is hazardous to human health and the environment. To address this

issue, we developed an electric power tiller. This is a low-cost option that has no environmental impact. We've included a few handy extras in our electric power tiller: a height-adjustable handle so the tiller can be used by people of varying statures, a depth-adjustable wheel so the tilling depth of the blades can be fine-tuned, and a set of wheels so the whole thing can be wheeled around with ease. It now includes the additional component, Solar Plate. In this situation, the solar plate is utilised to recharge the battery and prolong its useful life after it has been used and discharged.

Literature Survey

The focus of this study has been on developing a solar-powered rotary tiller for use in secondary and tertiary cultivation[1]. Research that contrasts

The market for handheld weeders and electric tillers in India is evaluated. Weed control in agricultural fields is also explored in detail. According to the results of this research, the vast majority of Indian farmers are small-scale farmers who can only afford to use handheld weeders. The goal of this project is to make farming easier by reducing the need for labor-intensive manual tools. The newly created soil tiller runs on solar energy and has the following components: Tiller blade, solar panel, 12V DC battery, windscreen wiper motor and pedestal bearings. The rotor blade of the new and improved soil tiller is joined to a shaft that runs between two pedestal bearings on the tiller's frame via a v-belt, and the wiper motor is also fastened to the tiller's frame.

The wiper motor receives its power from a battery that is charged by the sun's rays via a solar plate attached to the tiller's top portion. Depending on how the motor is wired, it may either rotate clockwise or anticlockwise.

The project's current focus is on developing an appropriate operating system. project accomplishes great safety, less human effort, more soil tiller efficiency, less work load, less worker fatigue, and cheaper maintenance[2].

Progress in lubricating pumps for internal combustion engines during the last two decades is summarised in this paper. Once the initial fixed-diameter gear units have been described, the working points of the gear units may be found by analysing the circuitry between them. The investigation suggests that the engine's flow requirements and the pump's feature are not a good fit. The total inefficiency of the flow producing unit causes a significant amount of fuel to be wasted. Several efforts have been made in recent years to reduce the energy required by the lubricating pump.

Different types of pumps, including ones with tunable displacement and timing, are studied here.A student's work on a motorpowered tiller for use in agricultural work is documented here, from conception to analysis, control, and testing. If we are serious about addressing the problems associated with fossil fuels, we need to investigate other energy options. We developed a solar-powered cultivator [3] to put this idea into practise.

The majority of India's population works in agriculture.

It's vital to the expansion of our country's economy. Ploughs were formerly the primary tool for aerating the soil. Tractors are widely employed in modern agriculture [5] for a variety of crops. The tractor is a mechanical vehicle developed specifically for use in farming. The tractor may be equipped with a wide variety of cultivators and other agricultural implements to perform tillage and mix the soil. It's more costly for small farmers to use the tractor. Machines with a variety of uses in agriculture are being developed and produced with the help of worm and worm wheel gearboxes. Since the machine already makes use of a worm wheel gearbox—which reduces speed while increasing torque—a chain drive is added for additional speed reduction [6]. What people often refer to as a "power tiller" is really just a two-wheeled tractor. The standard power tiller has numerous downsides. When used in agricultural applications, as like fails to generate strong torque and fails to absorb shocks. The goal of this project is to increase torque and provide new attachments for it. With this work, the plough is attached to a motorised tiller for the first time. Multipurpose equipment may be used for a wide variety of tasks, thus the term.

Many recent studies have focusedon the small scale cultivation problem. Also four wheeled machine is not suitable for inner cultivation when crops is at a height of more than 0.5feet or up to that stage. Remembering the facts of high weight and balancing problem different authors made their contribution in field of agriculture. Although there are different kinds of study they have made all have a unique identification factor. Some of the listed authors with their study are:-

F.A.Adamu et al., [2014] Tiller's performance and power are assessed in this research. Field metrics such as effective field capacity, field efficiency, fuel consumption, operating speeds, depth of cut, and breadth of cut are used in the assessment. Lightweight power tillers have been shown to be effective on both wet and dry soil..

Sarvesh Kulkarni et al., [2015] This article sheds some information on renewable energy sources that are not yet widely used. Cost-effectively powering a pesticide sprayer with solar energy is a pressing issue.

Achutha et al., [2016] The author of this study claims that new multifunctional agricultural machinery has been designed for tasks as diverse as planting, inner cultivation, spraying, transporting, and weeding. This system operates independently of the grid, thus solar power is not required.

Dipam Patel et al., [2016] Farmers' working conditions during spraying operations are discussed in this study. To use the sprayer, the user pulls a cart, the sprayer's wheels rotate, and the sprayer's pump uses that motion to generate a reciprocating motion.

Dhatchanamoorthy.N et al., [2018] This article discusses the author's efforts to construct a small, engine-powered vehicle for use in agricultural tasks including ploughing, sowing, and harvesting. This style of plough is constructed to sustain a certain load.

Shreeshayana R et al., [2020] This article presents the design of a semi-automated motorised cultivator for use in agriculture; it can plough with a gap as small as 15 inches, making it ideal for use in the narrow irrigation fields that cattle sometimes struggle to navigate..

Y Anand Reddy et al., [2020] The author of this piece sheds some insight on the ploughing machine. The 2 stroke engine gives the machine with sufficient power to generate downward force, allowing the tool to dig into the dirt semi-automatically.

Niraj B kendre et al., [2021] The primary goal of this study is to lessen the workload of farmers. The engine powers this sort of mechanical agriculture's cultivator and spraying equipment.

Objective of Solar Power Cultivator

For interior cultivation where we must operate in between standing crops, the Agriculture cultivator and spraying machine's single functioning wheel is a great asset. The rear cultivator and the front sprayer make up this multi-purpose machine. The cultivator is attached to the sprayer using a nut and bolt, so it may be detached if we just want to use the sprayer. The rear cultivator is useful for weeding and moving dirt close to the plant rows. To prevent the roots of sweet potatoes and other tubers from rotting from receiving an overabundance of water, for instance, farmers create a bridge-like design (mend) before planting the tubers. Northern areas like Rajasthan have abundant of sunshine, which is great for solar panels and helps farmers save time and energy.Farmers would no longer have to rely on outdated fuels like diesel.

Flowchart of the system

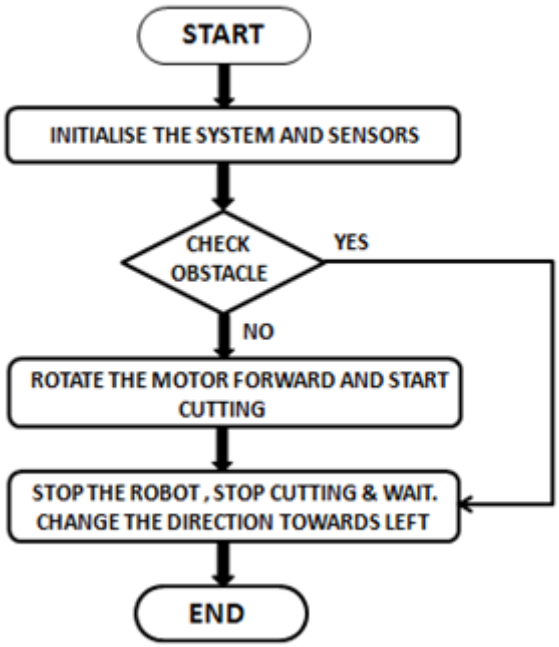

Figure 1.flow chart of solar powered Automatic functional Crop Cultivator

The diagrams below illustrate the fundamental parts required to construct a solar-powered tiller machine; the diagrams that follow provide a more in-depth look at those parts, including the 12 volt solar panel that is crucial to the project. When used as the main power source, solar energy may collect energy from the sun and store it in a battery. Here, a 12V DC Wiper Motor drives the whole tiller system, which is powered by a solar panel. Frame dimensions are around 91.4mm in length, 609.6mm in breath, and 5mm in width. The tiller is powered here by a low-speed wiper motor. The cultivator, also known as the tiller blade, can dig the soil effectively if the tiller is rotated at the right speed. This project achieves these goals with higher levels of safety, less human effort, more efficient soil tillers, less labour, less worker fatigue, and cheaper maintenance expenses.

Welded together, the square tubes provide the necessary frame. The frame's base is soldered to the U-shaped tiller blade. Clamps are used to secure the solar panel. The battery is charged and energy is stored when sunlight hits the solar panel. Wiper uses the stored energy to rotate the shaft. A chain sprocket and a seed-planting shaft that rotates back and forth are installed in the shaft. The chain is attached to the tiller wheel's rim at one end and the shaft at the other. Turning on the wiper motor causes the tiller to revolve. The tiller blade, which is attached to the rear of the wheel, works to properly aerate the soil. We may turn the soil to a depth of 2–3 millimetres. After the mixture has been well stirred, the seed-planting procedure may begin. When planting seeds, a reciprocating motion is used to lower each seed into the earth. We can save some men power by switching to the tiller. The international blades are the source of power for the 100rpm direct current motor operated by gears. Tiller blades constantly chop up weeds and other unwanted vegetation. The imbecilitating depth is adjusted via a screw and nut on the rod that does the imbecilitating. A bicycle tiller is used to power the device. A powered tiller operated by hand is now in use. The static blade of a shaver is held at a stable angle near the back of the tiller. Our modifications to the machine's tooling system now allow it to rotate consistently at 150 revolutions per minute while producing 7.2 newton-meters of torque. Powered by a battery pack, the whole mechanism of this rotary tool is designed to spin anticlockwise, making it ideal for transferring dirt between rows of crops. The panel generates solar energy, which is then utilised to power the appliance.

Execution of Programme which initialises all the memory location and pointers is the first step in the crop cutter's operation. Each component has been activated. The cropcutter's commands are evaluated, and if they're successful, the motor will start up and the relay circuit will be activated. If the crop cutter encounters a barrier, it will halt and wait for instructions. The motor and grass cutter are programmed to turn left after sensing an obstruction, and the relay driver receives this order and relays it to the motor and grass cutter. Device-to-microcontroller connection is shown in Figure 2.

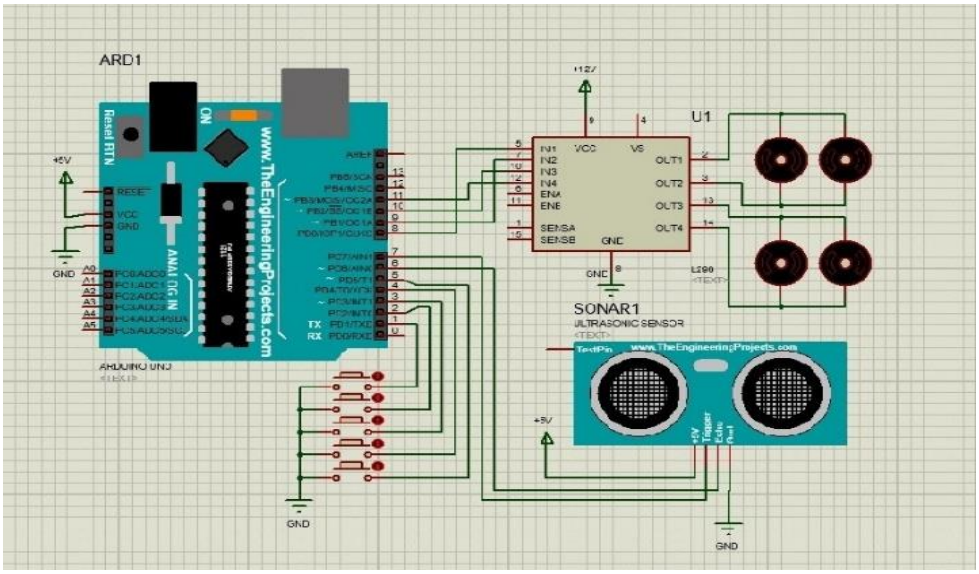

Figure 2. Microcontroller interfacing

Need of Low Cost of Crop Cutters for Farmers

The point is to make useful farm machinery at a price that even the poorest farmers can afford, while also making sure that it performs admirably so that farmers will choose it over more conventional alternatives. The availability of workers is another need, since labourers are hard to get by these days. Even if you can find them, they come with a hefty price tag and provide subpar results. This method ensures that the job is done in the allotted amount of time. The primary issue with farmers that utilise convectional machines, such as diesel machines, is the pollution they produce. The farmers' quality of life is deteriorating, and pollution is a leading source of respiratory illness. Instead of relying on the conventional, or "convectional," source of energy, we may make advantage of the plethora of nonconventional options we have right at our fingertips. Using such a model would not have any negative outcomes, such as harming the environment. Everyone can take use of solar power without ever having to pay for it. Solar energy is simple to capture and more simpler to transform into electricity. The necessary low-cost equipment to convert solar energy is widely accessible on the market.

Calculation

A Designing

SystemPower required to shear the grass is from 9.5-11.51N.This strength is provided by spiral cutting blades.

Assume

$$\text{Force} = 10\ \text{N}$$

$$\text{Force} = \text{Torque}/\text{radius}\ (1)$$

Where Torque = torque provided by shaft, radius= Radius of cutting blade=12 cm

$$\text{Torque} = \text{force} * \text{Radius} \quad (2)$$

= 10*0.12=1.2 Nm

Also shaft power is given by

$$P = T\omega \quad (3)$$

$$P = T * 2\pi N/60$$

$$\text{Where } P = \text{Power deliver by shaft}$$

$$T = \text{Torque required}$$

$$N = \text{Shaft speed in rev/min} = 10000 \text{ rpm}$$

$$P = 2 * 3.14 * 10000 * 1.2/60$$

$$P = 1256 \text{ watt}$$

B.Selection of motor

$$\text{Motor Speed} = 10{,}000 \text{ RPM}, \text{Motor Voltage} = 12 \text{ V}$$

$$\text{Motor Watts} = 1256 \text{ W}$$

C. Power Calculation

$$\text{Power} = I \text{ X } V \quad (4)$$

$$\text{where } V = 12, I = 2.3 \text{ Amp}$$

$$P = 2.3 \text{ X} 12 = 27.6 \text{ watt}$$

D. Calculation of Solar Panel parameter

$$\text{Solar panel volt} = 12 \text{ V}$$

$$\text{Solar panel watt} = 10 \text{ W}$$

$$W = V \text{ X } I$$

$$10 = 12 \text{ X } I = 0.833\text{A}$$

$$I = 833 \text{ mA}$$

E. Calculation of Battery parameters

$$\text{BAH/CI} = 7.5 \text{ ah}/833 \text{ mA}$$

$$= 9 \text{ h}$$

$$\text{To find the current}$$

$$\text{Power} = 27.6\text{W}, \text{Voltage} = 12 \text{ V}$$

$$\text{Current} = ?$$

$$P = V \text{ X } I, 27.6 = 12 \text{ X } I$$

$$I = 27.6/12 = 2.3, \text{Battery usage with 2.3 A.}$$

Conclusion

This project's overarching goal is to develop a solar-powered, fully-automated crop-cutting machine that not only decreases pollution by eliminating emissions and noise, but also greatly reduces the amount of manual labour required to harvest crops. New technologies allow for more efficient use of time. Because it is solar-powered and doesn't need to be charged every day as a traditional lawnmower does, this idea has a low environmental impact and saves money in the long run. There is a roughly nine-hour charge period for a maximum of two and

a half hours of usage. With a step-down transformer and an AC power source, it can be used even if it hasn't been charged..

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