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Design and Fabrication of Solar Powered Agri Weeder

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Abstract: ***A solar operated power weeder was developed to reduce dependency on fossil fuel, harmful emissions and cost of operation. The developed weeder was tested on maize crop having row to row spacing of 600 mm. Three different width of cutting blade (50, 60 and 70 mm) were selected with two, three and four number of blades per flange to evaluate its performance. The operational width of developed weeder was 240 mm and blade penetrated into soil up to the depth of 35 mm. Maximum field capacity and weeding efficiency was found to be 0.175 ha/day and 88.03 per cent, respectively. Minimum plant damage was 1.96 per cent and the average performance index obtained was 841.***

Keywords: SolaR, Power weeder, Fossil fuel, Emissions, Performance.

I. INTRODUCTION

Weeder is a mechanical implement used to take away the unwanted plants in the field. Indian agriculture is reliant on human power and also animal power. It is a time-consuming process. Most of the Indian farmers are having small agricultural land. Farmers still follow the conventional methods in the cultivation for weeding purpose. These methods require high labor force to perform the operations. The main disadvantage of the modern equipment is its cost effectiveness because most of them are mechanized and driven by fuel. So, they can hardly afford such costly equipment's. Single row weeder was developed for weeding purpose but are not used widely in the agricultural operations. This is because lack of awareness on the newly invented single operated weeders. Weeding operation was done mostly by the hands. The weeding performance of the hand tools are good but mostly time consuming. These tools may have the chances of injuring the performer. The different postures of the workers have been studied on the basis of their working conditions on the field. Agriculture is not an easy task which includes
different stages. Different working postures have been studied to develop an ergonomically suitable weeder for workers.
Different types of weeders have been studied to understand the weeders in a better manner. The comparisons of the weeders helped to understand the present weeding tools which perform better operation.
But mostly fuel operated weeders are available in for the wet land cultivation. The performances of the equipment's are efficient but the fuel rates are going up in the present situations. Soli tillers and weeders are non-traditional tools used for weeding. The mechanical implemented tools play major role in the weeding process helps to achieve the high
productivity of the crops yields but they are labor intensive. In order to overwhelm this, a new type solar powered rotary weeder is designed based on mostly available nonconventional energy. This motorized agricultural equipment works with the support of blades that breaks the soil to cut the weeds. This
machine helps to minimize the expenses caused by labor.

II. DESIGN OF PROJECT

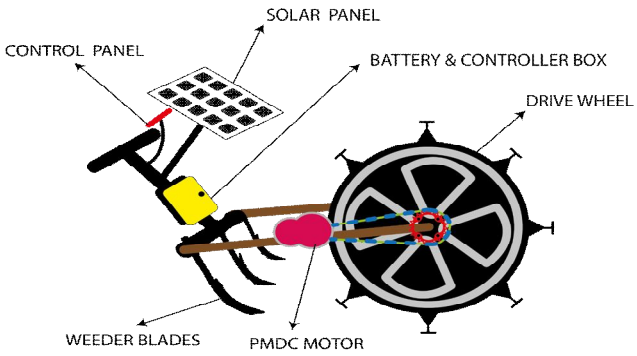

Fig.1Project Design Idea

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In the above figure we can get idea of actual representation of project in which we can see the complete system will work and how all the individual blocks as discussed above are combined to get the desired output. In the figure shown above we can se that solar panel is place above near to the handle to serve two purpose first to generate ample amount of energy to drive system as well as to create a housing for other environment sensitive or delicate system components. The weeder idea is taken from tradition type hand controlled weeder which uses users weight for maintaining weeders blades inside ground it also shows the arrangement of handle, the main circuitry box drive motor and main drive wheel.

A. Main Hardware Ratings

Motor & Controller

1) 24 Volt DC Operation Permanent Magnet DC Motor Geared
2) No Load RPM: 3850
3) No Load Current: <2.2 Amps
4) Rated Wattage: 350W (0.50 Horsepower)
5) Rated Load RPM: 400.
6) Rated Torque: 40(NM), {407.88 (Kg-cm)}
7) Rated Current: 19 Amps
8) Efficiency: 78%
9) Reduction Ratio: 9.78:1
10) Max Controller Output Current – 21Amp
11) Rated Power (Controller) – 350 Watts
12) Ratted Voltage (Controller) - 24Volts

B. Solar Panel

1) VOLTAGE – 12-13V (at appropriate sunlight)
2) Wattage – 50Watts (at appropriate sunlight)
3) Current – 4.1667Amp
4) Efficiency – 20-35% Max (Input sunlight compared to output power)
5) Type – Polycrystalline

C. Battery

1) Type – Lead Acid (Pb) 6 cell
2) Terminal Voltage (Charged) Max – 12.7 Volts
3) Min Safe Discharged Voltage – 9.0 Volts
4) Specific Gravity – 1.277
5) Max Discharge Current – 25Amp
6) Battery Capacity- 25 Ah
7) Charging Time (as per given solar rating) – 6 Hrs. / 7.269Hrs. Approx.
8) Charging Current – 4-5 Amp

D. Main Frame

1) MS Square Bracket – 1.2mm Thickness, 20ft Length (Main Frame)
2) Main Wheel Diameter Galvanized MS – 24/36 inches Spoke Type
3) Weeder Blades – 3 Nos of Cast Iron 3.5X1.25 inches Arrow (Blunt Type)
4) Main Shaft – 20mm with Standard Bearings inbuilt on shaft
5) MS Rods – 8Mmm Thickness 12ft Length (Solar Housing Brackets)
6) Industrial Anti Rust Hammer-Tone Paint Coat

III. CALCULATIONS

A. *Detailed Calculations*

Solar Panel Power Rating = 50 Watts
Solar Panel Voltage Rating = 12 Volts
Hence Max Approx. Current output will be = Watts/Volts
= 50/12 Amps
= 4.1667 Amps
Battery Capacity = 25 Ah
Battery Voltage = 12 V
Charging Time of Battery = Battery Ah / Charging Current
TCHARGING = Ah / A
TCHARGING = 25 / 4.1667 Hrs.
TCHARGING = 5.999 Hrs.
A C- Rate is a measure of the rate at which a battery is discharged relative to its maximum capacity.
Hence, From C Rating (given by standard manufacturers) Max Safe Discharge Current (1C) = 25 Amp
Hence, From C Rating (given by standard manufacturers) Max Safe Charging Current (0.2C) = 5 Amp
Now, In Case of Controlled Charging Depending on Internal Resistance,
Controlled Charger Efficiency = 95%
Battery Charing Losses = (50% Charged) 5%
Battery Charing Losses = (60% Charged) 7%
Battery Charing Losses = (70% Charged) 15%
Battery Charing Losses = (80% Charged) 25%
Battery Charing Losses = (90% Charged) 35%
Battery Charing Losses = (100% Charged) 40%
(*Note – Values Referred & Taken from Standard Loss vs Charging Curve Provided by Indian Standards for Lead Acid /Industrial Batteries)
Average Battery Charging Losses = 127/ 6
= 21.1667 % Approx.
Hence, if the given charging loss is taken in account in case of controlled charging then the time required will be given by Nominal Time (TCHARGING) + Time Compensation for Losses (TCHARGING-LOSS).
= 5.999 + (5.999*0.211667) Hrs.
= 7.269 Hrs.
For Motor Calculations,
(All Data referred from date sheet given by manufacture and the references [1],[2])
24 Volt DC Operation Permanent Magnet DC Motor Geared
No Load RPM: 3850
Given Gear Ratio Pre-Fitted for reduction = 9.78:1
Hence Output Speed after reduction is given by = 1/9.78 *(3850) rpm
= 393.661 rpm
Hence percentage decrease in speed = 89.775%
As torque is inversely proportional to the speed hence the given torque increased by 89.775% Approx.

Rated Max Torque After Conversation: 40NM, {407.88 (Kg-cm)}
Original Motor Torque will be given by = {(100 – 89.775)/100} *40 NM
= 0.10225 * 40 NM
= 4.09 NM
Rated Wattage: 350W (0.50 Horsepower)

No Load Current: <2.2 Amps
Rated Current: 19 Amps
Efficiency: 78%
Max Controller Output Current – 21Amp
Rated Power (Controller) – 350 Watts
Ratted Voltage (Controller) - 24Volts
Controller Efficiency = 92%
Hence Total Losses (Heat & Harmonics) combining both motor and speed controller = 30%
Hence Total Consumption by the Drive system will be = 350W + Losses
= 350 + (350*0.3)
= 455 Watts
Hence with the given capacity of battery the system can run for time TRUN on one single full charge is given by = Capacity Ah / Consumption in Ah.
= 25 / (455/12) hrs.
= 25 / 37.167 hrs.
= 0.6726 Hrs.

IV. CONCLUSION

The project main purpose was to enhance the performance of traditional weeder by making it run on renewable energy which will also help to reduce pollution caused by IC engine operated weeders also the challenge was to keep it economical and comparatively cheap, by designing & Fabrication of this project as a solution to discussed problem we have achieved certain conclusions:

A. The Weeder is designed to operate on the renewable solar energy which is free of cost and also nonpolluting hence the fuel consumption & other maintenance cost was nullified compared to traditional weeders.
B. The system is self-sustainable self-powered and designed as per standards hence it can be utilized universally.
C. The project as a solution to the above discussed problem is comparatively cheap and more feasible as compared to the traditional available in exitance.
D. The Machine is designed using powerful Drive and sufficient battery backup and fast charging for long and continuous work cycles. Hence it is capable of giving desired output to complete the task.

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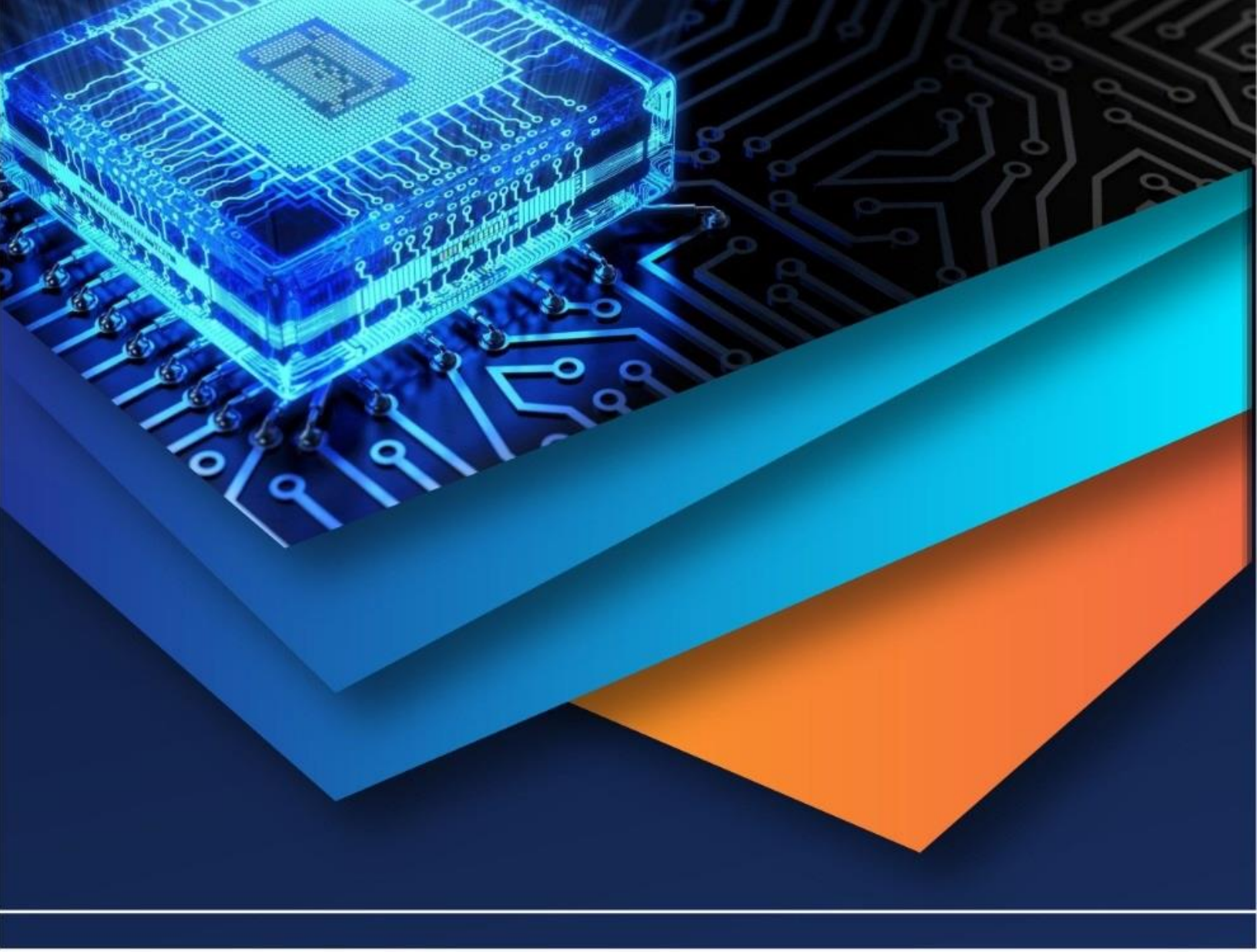

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