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IMPLEMENTATION OF A USER FRIENDLY ELECTRO-MECHANICAL CONOWEEDER FOR AGRICULTURAL APPLICATION

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***Abstract* -- In today's world everything is getting modernized. Agriculture fields are slowly destroying, and these lands are used for some other purpose. This is because the income from agriculture is less although the work involved is high. Most of the field work is done manually and so the farmers depend on the field workers for doing it. Because of the higher pay offered in other sectors like construction, workers prefer those jobs and so agricultural sector takes shortfall of manpower. This being the scenario, workers are not available for the works such as plucking out the unwanted grass and weeds growing in between the plants. It is very important to pluck out the grass and weeds to obtain fruitful results from the cultivation, as the grasses and weeds observe a part of nutrition given to the plants. Given the present situation, removing weeds becomes a costlier affair. To address this problem, this project proposes a simple, economical, and efficient machine to remove the weed, which would be operated by a single person – savings of labor as well as time.**

***Keyword* – Electromechanical Conoweeder, Solar Energy, simulink**

I. INTRODUCTION

With agriculture facing a shortage of manpower, need for automating the various activities in the field arises or it is becoming the need of the day. A simple machine has been designed and fabricated for removal of weed and unwanted plants between the rows of paddy plants. As the machine is moving the weed remover removes the weeds present between the plants. This machine can be used effectively in the agricultural fields such as paddy field. To use this machine in agriculture, field the seeds should be sowed at a distance equal to or more than the width of this machine. This machine is of simple design without using any engine. Only a belt and pulley arrangement are used. This machine eliminates the need for many workers and makes the work easier, economical, and efficient.

II. WEED CONTROLLING METHOD

Controlling weeds in forage crop production may Manual weed removal technique was a conventional method which requires a lot of muscle power. To minimize human effort weeder is mechanized by a battery driven motor drive which will make farmers to work with better comfort and operation is very simple. The mechanized electro-mech Conoweeder is planned to be operated by solar power further reducing the cost in future. Involve a wide range of techniques. Nevertheless, virtually all weed control methods may be classified into one or more of five main categories. The 5 general categories of weed control are:

- Preventative Weed Control
- Cultural Weed Control
- Mechanical Weed Control
- Biological Weed Control
- Chemical Weed Control

III. LITERATURE REVIEW

Going through the undertaken survey we can say that weed removal is the major problem during the production of crops due to non-availability of labor force for the weed removal and cost for the weed removal through this method is also quite expensive. If went through chemical method of weed removal, then there is a risk of soil losing its fertility and harming the crops by its chemical composition. The existing manually operated machine also is not helpful to that extent because of the force required and duration of work depends on the person. So, the operation the machine can be made easy by mechanizing it which reduces the human effort and makes the job quite simpler in the removal of weeds.

Removing the weeds by using this method is difficult, time consuming and cost is also more. In this project we have designed and fabricated a weed removing Machine of mechanism which is innovate and which is not available in the market.

IV. METHODOLOGY

Manual weed removal technique was a conventional method which requires a lot of muscle power. To minimize human effort weeder is mechanized by a battery driven motor drive which will make farmers to work with better comfort and operation is very simple. The mechanized electro-mech Conoweeder is planned to be operated by solar power further reducing the cost in future.

V. WORKING

The problem of agricultural weeds is that they cannot be eliminated in cultivated lands because there is no special machine available in the fields. The weed elimination is done by human effort, it can be reduced in our design of machine, and it will minimize human effort at low cost.

The rotary motion of the shaft is transmitted to the blades by using BELT DRIVE, the handle is provided for turning the direction of machine the forward direction movement of the

Circumference of wheel

Condition to be fulfilled

Blade spacing one and half inch gap on circumference

30-35 degrees inclined from vertical

Helical to axis of drum

Separate fixing of blade

Bolt in on wheel

Force = shear stress of grass ×$\pi d2$×avg no of weeds

Where d=avg diameter of blade drum,

Shear stress of grass to be from 5-10MPa

Average No. of weeds to be taken 30-50

Therefore,

Force = $10 \times \pi \times (9.5 \times 10{-}2)2 \times 30$

= 8.505 N

Torque = Force × radius of blade drum× no of

grass per

machine is done on the wheel shaft connected to the motor, the blades are rotated in clockwise direction and weed is removed perfect to near the plants. In the design minimize the time of weed elimination in the field of agriculture. The machine is operated without harming the main crops.

CALCULATION

Factors to be considered for the calculation of force and torque on the motor:

Diameter of cutting wheel

Speed of the blade

Speed of movement

Driven length

= 8.505× 9.5 × 10−2 ×8

= 6 Nm + 2 (safety factor)

= 8 Nm

T×W = Power

Where T = Torque of the motor

W= angular speed

Power = $8 \times (2\pi n/60)$

= $8 \times (2\pi \times 300/60)$

= 251.32 W

Rounding off to next nearest value according to market design standards we have

~ 375 Watts= 0.5 HP

RPM of motor = 300 rpm checked through trial run

Length of belt=2c + 1.57(d+D)+$(D-d)2/4c$

Where c= center distance between the pullies

D,d = diameters of the pulley

= 2×210 + (36 +36)×1.57

= 533.04 mm

= 53.304 cm

Available standard belt is of Sec B 25.[3]

Distance between

Pulley 1- pulley 2 =26 cm

Pulley 2 –pulley 3 = 23 cm

Length of the belt between pulley 1 and pulley 2

= 2C + 1.57 (D+d) + ((D-d) ^ 2)/ 4C

= 2 * 26 + 1.57 (3.6+3.6)

= 63.304 cm

Length of belt between pulley 2 and pulley 3

= 2 * 23 + 1.57(3.6+3.6)

= 57.304 cm

Available standard belt is of sec B 24.[3]

Battery requirements:

Output energy= W*h=380*2

=760 Wh

Input energy = output energy/ efficiency

= 760/0.8= 950 wh

Assuming battery deep discharge to be 70%

Motor power: 380W

Input voltage :24V

Efficiency : 80%

Operating time of motor: 2 hrs Therefore

Battery capacity = 950/0.7 =1357.14 Wh

Total ampere hour = battery capacity/voltage

= 1357.14/24

= 56.54 Ah

= 60 Ah (Approximately)

Electrical input Pi= VI

=24*19 = 456 W

Output power Po = 0.5hp = 0.5*746 = 373 W

Efficiency of the motor = Po/Pi = 373/456

= 81.8 %

As the power is to be transferred from the motor to the drive, there would some transmission losses due to belt drive

By referring to the design data handbook transmission losses for the belt of section 'B' Is given by

Transmission losses = [(1.08v^-0.09) -(69.68/de)-(1.78*10^-4 V^2)]*0.7355V

Here

V- speed of the belt in m/s

de=d*kd equivalent pitch diameter

kd- Small diameter factor

d- pitch diameter of the smaller pulley in mm

AS we have used pulley of same diameter then kd=1

D= 25mm

de=260*1 = 260mm

Referring to the table speed of the table speed of the belt=205 rpm

Rps= 205/60 = 3.42 rad/ sec

V=W*r where r- radius of pulley in m

r = 0.13m

therefore

V = 2.8 m/s

Transmission losses = [(1.08{2.8)^-0.09)- 69.68/260 – (1.78*10^-4 *(2.8)^2)]*0.7355*2.8

= 1.5 watts approximately

Overall Output Po2 = Po1- Transmission losses

=373-1.5 = 371.5 watts

Overall efficiency = 371.5/373

= 99%

Solar power requirements:

E=A*r*H*PR

Where,

E= energy required

A=total area of the solar panel

H= annual average solar radiation on titled panels

PR= performance ratio

Load parameters

Load= 500 w, I= 20A , V= 24 V

Let us consider required backup time of battery is 2 hours

If we install 60Ah, 24 V battery then

P= 24*60 =1440 wh

For this battery backup time required=

1440 wh/500w= 2.88 hours

Which meets our required backup time of 2 hours.

Now the required charging current for the battery is = 60 Ah*1/10 = 6 Amps

Note – charging current should be 1/10 of Batteries Ah

Charging time required for the battery

= battery Ah/charging current=60 Ah/6A= 10 hours

Note- The charging time can be reduced by increasing the charging current value

For ex, If we take charging current to 8A then the charging time will be reduced to 7.5 hours.

Calculation of required no. of solar panels:

Condition 1: motor load is not connected only for battery charging.

P=VI

P= 24*20 = 480 watts

480W of solar panel required only for battery charging and then battery will supply power to the load

i.e, direct load is not connected to solar panel.

'Condition 2: motor load is connected as well as battery charging

I= 20A, charging current Ic= 20+6= 26 A

Therefore, required power is P

P= 24*26= 624 watts

i.e., we need 624 watts solar system for battery charging as well as motor load

VI: SIMULATION

Simulation models of charging and discharging of battery powered by solar PV system for the electromech cono-weeder is shown below.

The MATLAB -2020 software has been used to develop a simulink model for the proposed system to implement the charge controller design for charging and discharging of battery used for the application of weed removal machine in the agricultural land.

The battery used here is Lead acid type of battery, to maintain greater efficiency of battery the charging and discharging cycles of the battery need to be monitored. The battery has a SOC of 80% and DOD of 20%.

The charge controller device will continuously monitor the health condition of the battery. It will regulate the charging current and discharging current from the solar PV system and motor respectively.

Here there are two type of battery charging methods have been used i.e.

1. Constant current method

It's a simple form of charging of batteries, with the current level set at approximately 10% of the maximum battery rating. Charge time are relatively long.

2. Constant voltage method

It allows the full current of the charger to flow into the battery until the power supply reaches to its preset voltage. The current will then taper down to a minimum value once that voltage is reached.

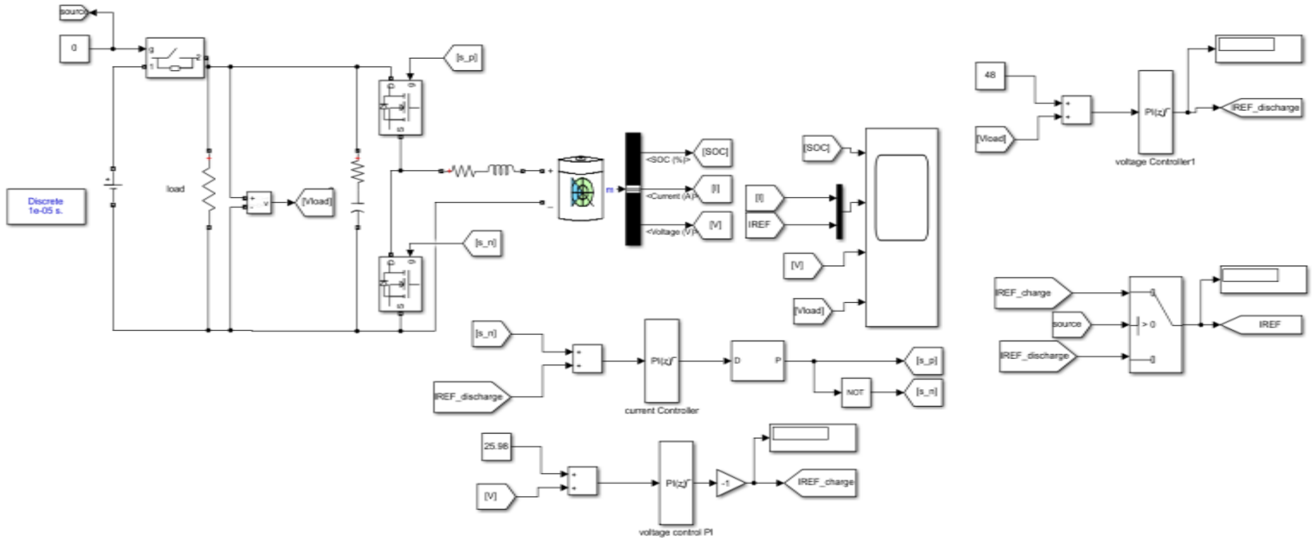

Fig2. Simulation model of battery charge controller

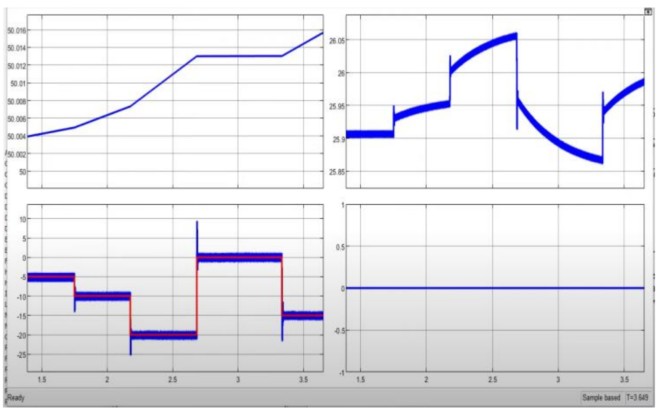

Fig.3 results of battery charging with constant current method

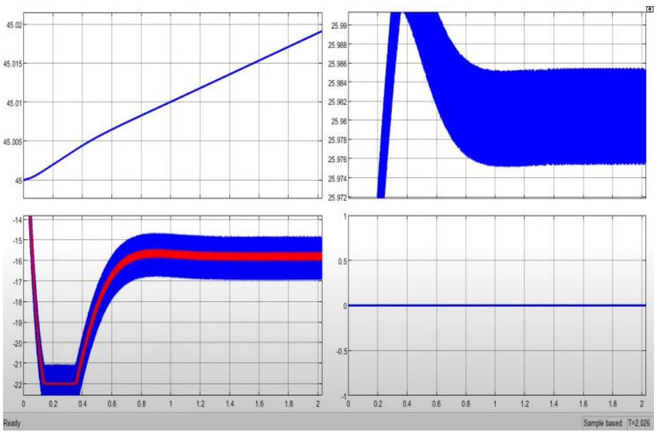

Fig.4 results of battery charging with constant voltage method

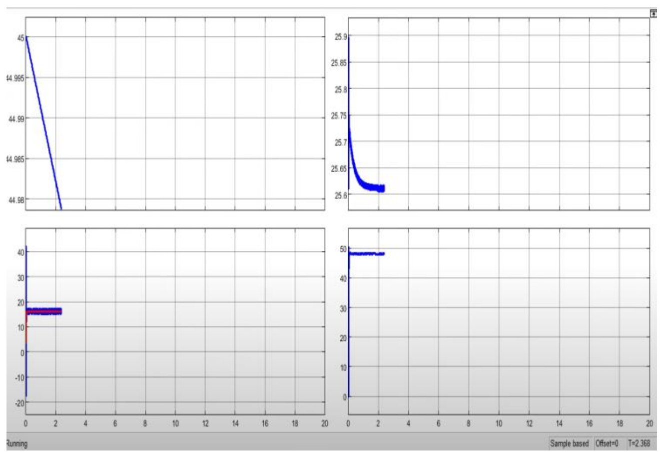

Fig.5 discharging of battery

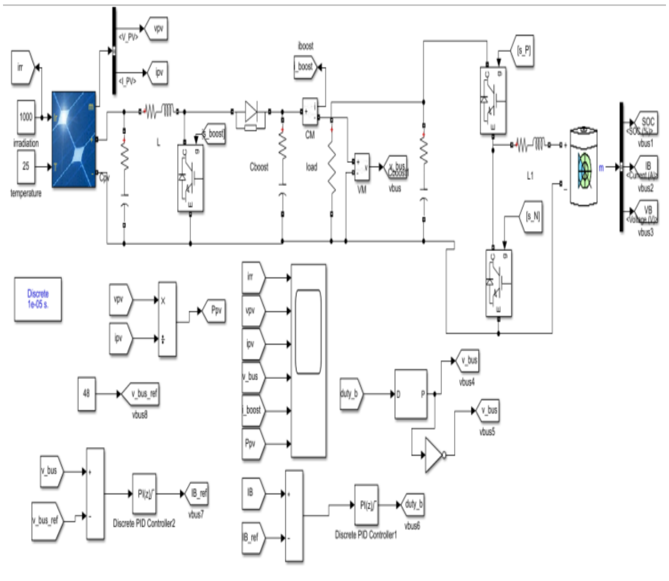

Fig.6 simulation model of solar PV integrated with the battery charging and discharging system

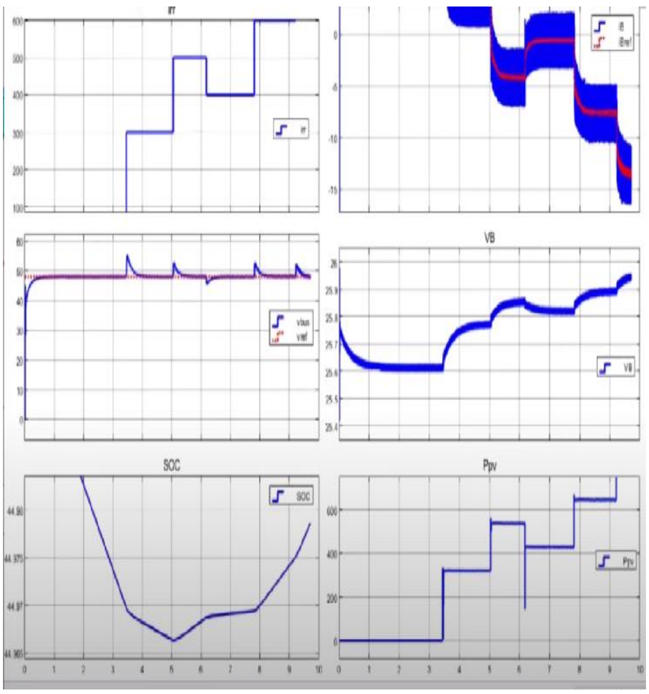

Fig.7 battery charging and discharging

VII. RESULTS

Voltage in (Volts)	Current in (Amps)	Speed in (rpm)
9V	5.96A	90rpm
12V	6.2A	128rpm
15V	6.6A	165rpm
17V	6.7A	227rpm
20V	6.9A	241rpm
22V	7A	256rpm
24V	7.2A	270rpm

VIII. CONCLUSION

The ancient method of weed removal was very time consuming and had a major problem of availability of labour force and the developed manually operated weeder required a lot of human effort. So, the manually operated machine was motorized to reduce the human effort and to make the job simpler. The proposed system proves to be more efficient when compared with fuel operated machineand ancient method of weed removal technique with negligible maintenances cost. Also has a impressive payback period of factor less than one shows the system is efficient. The workload is reduced and the duration of the time to work also increased. Therechargeable battery makes the system more advantageous. Hence the proposed system can be used at a commercial level as a product.

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Model of electromechanical conoweeder

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