SOLAR POWER TILLER

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Abstract— Project concentrate on reduction of efforts of using the manual farm equipment. The new developed soil tiller is operated on the solar power and it consist of following parts likes Solar plate, Battery 12 Volt D.C., Wiper motor, Pedestal bearings, tiller blade. In the new modified soil tiller the rotor blade is mount on shaft between the two pedestal bearings which is fixed on the frame of tiller and wiper motor is attached to the rotor blade using v-belt and wiper motor is fixed on the frame. Solar plate is fixed on the upper part of the tiller so that the sun rays will directly spread on the solar plate and solar plate output is given to the battery which supply current to the wiper motor. The rotation of the motor is clockwise or anticlockwise depend on the connection. Now the project mainly concentrates on designing a suitable operating system. project achieves high safety, reduces human effort, increases the efficiency of the soil tiller, reduces the work load, reduces the fatigue of workers and reduces maintenance cost.

Keywords: Solar Power, Solar Tiller, Cad Software, Energy Design Parameters

1. INTRODUCTION

Manual labor has been an integral part of rural agricultural systems in India for hundreds of years and is still continuing. Due to shortage of electricity and the immediate use of farm equipment, solar energy is effectively used. Neglected and improper weeding reduce the crop yield which varies from 45 to 65 % and in lot of cases whole crop yield may fail.

Inter-cultivating is the process used to remove unwanted plants to protect the regular crop in respect to soil nutrition's and wetness. Hence the crops may give high yield and more profit to farmer. Rotavator Functions are:

1. To inter-culture the soil.
2. Remove the unwanted plants in the field.
3. To increase Aeration of the soil for higher yields.
4. To Preserve moisture content by mulching the soil.
5. To sow seeds when it is provided with sowing attachments.
6. To avoid surface evaporation.
7. To encourage rapid infiltration of rain water into the soil.

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Farm machine is design is not so easy. Due to invent of innovative CAE tools which consumes less MLT as compared to conventional/ traditional design methods.

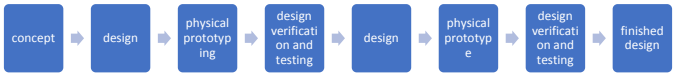

Fig. 1. Traditional and Virtual Design Process.

Structural design calculates the effects of static/steady loadings conditions by neglecting inertia and damping factors, which are dynamic/time varying loads.
A various virtual design tools are Solid Edge, Solid Works, CATIA, Auto CAD, PRO-E Creo, etc., which

have different functions used for specific applications. Many CAD tools includes kinematic simulation and structural analysis along with 2D sketches and three-dimensional models of the assembled parts /equipment's.

Parminder Kamboj [8] elaborates CAD software facilitates future expansion of geometry model by providing flexible options to modify the existing design.

Kaveh Mollazade [5] discusses analysis tool that can be adopted to predict deflection and induced stress distributions on the surface of Rotavator during tillage operations is very much essential for the design engineers and Farm machine manufacturers in producing sustainable machines.

CAD design software tools Mohan Kumar [10]. At present, foreign farm machinery companies have started to use CAD modern technology, while problems such as not precise enough, long design cycle still exist in domestic agricultural machinery companies.

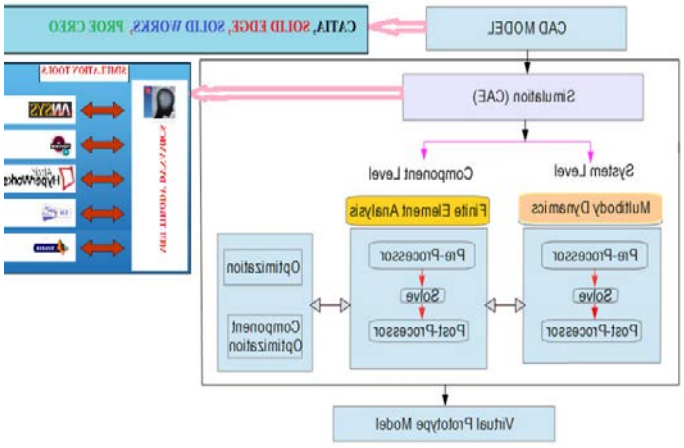

Fig. 2. Simulation and Analysis based design Process [12]

2. DEASIGN AND METHODS

Rotavator is a tool which is used for un wanted plant removal in wide row spacing crops. Rotavator blades are used to achieve advantages of better weed control and more efficient inversion and trash mixing.

Blades are the main critical parts of rotary Rotavator, engaged with the soil for weeding operation. These blades interact with soil in different ways than normal ploughs which are subjected to impact and high friction that ultimately creates the unbalancing force on the Rotavator resulting in wearing of the blades. The design optimization and manufacturing errors can be minimized by the proper design analysis of the components. Especially, the blades have to be reliable in the field performance against the operating forces. Prediction of stress distributions among the blades is important for the designers and manufacturers to optimize the power requirement.

Energy Design Parameters:

Fig. 3. Solar Plate 40 Watt.

Fig. 4. D.C Motor 12V.

Fig.5. Battery 12.8V 7.5Ah.

The electronic circuit designed helps the battery to run the D.C. motor in turn mechanical rotation of Rotavator blades.

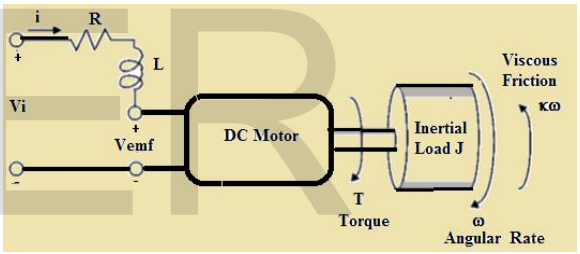

Fig. 6. Energy Model [12]

The torque of electric motor T is given by a product of the armature current, i, and torque constant K;

$T = K * i$..... (1)

The back electromotive force Vb, is a function of angular velocity

$Vb = K^* \omega = K^* d\theta/dt$..... (2)

Power consumed by motor=40 w, Rotational Speed N=100 rpm, rotor inertia J is assumed to be 0.01 and input voltage Vi=12 volts

Using the following equation=] n we will calculate the value of K,

$\omega m = Vt/K = 2\pi N/60$

then We get, K= 1.146 and ω=10.47 rad/sec

Solar battery 12.8v, 7.0 Amp can power a 20 watt for a theoretical maximum of 5-6 hours. The 30 Watt solar panel will be able to fully charge the battery in about 3-4 hours, which means it should be capable of charging the battery fully on a regular basis. I can select a slightly greater solar

panel such as the 40 W. Power consumption by Rotavator motor:

Drive Motor Voltage (V): 12v
Expected current draw (I): 1.1 amps
% of Time Motor used (T): 100

Total Power consumption by motor: (V * I) *T= 13.2 watts
From the above data we can see that it takes Solar Powered Rotavator, work around 5-6 hours.

Working Mechanism: The intercultural blades tap power from the geared Direct Current powered motor with 100rpm. The rotating blades continuously remove the unwanted plants and the Rotavator is propelled forward with help of manually. Depth of imbecilitating is adjusted by means of the screw and nut mechanism with the help of the screw rod.

Design Considerations: When soil-acting mechanical weed-control implements are used, the soil is subjected to cutting or shear forces which cause it to fail and disintegrate. The parameters which influence a soil's resistance to this failure are its cohesion and internal friction, by the angle of internal friction .

$$R_{ma} = cA_s + W \tan\alpha \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3)$$

Where: R_{max} = Shear force
A_s = C/s area of soil sheared
W = Normal loading on the soil

The angle of soil attack is around 15-16° is ideal to lift and separate the unwanted plants from the soil.

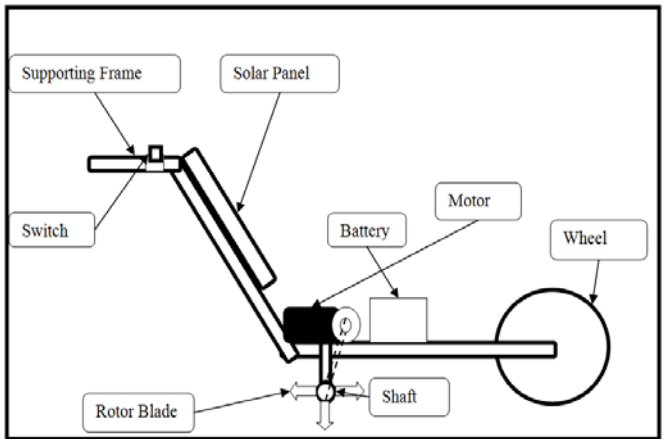

Fig. 7. Diagram of the solar power tiller

a) This Equipment will target small scale vegetable farms, which means that the work rate will be lower compared to larger, bulkier machinery targeting large scale production.
b) An effective weeding mechanism should be able to uproot, bury and cut weeds at the same time.
c) The working diameter of the weeding mechanism should be as small as possible to operate within the crop row.
d) The weeding mechanism should not be required to work at a depth more than 20-30 mm because early growth stage weeds have not penetrated deeply into the soil.
e) The average draft power availability in sustained working from male agricultural worker is consider as 60Watts while for a woman it is consider as 48Watts. Development of equipment which allows different categories of tasks: Removal of weeds, aeration of the root zone, creating soil mulch, spray the Pesticides or liquid fertilizers on the vegetables, fruits, seeds, washing /cleaning and also part of that energy is stored in the form of battery which may be further utilized by using other attachments.

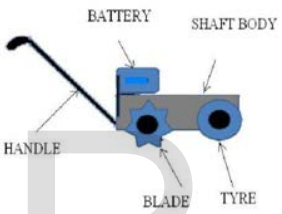

Fig.8: CATIA Model [13]
Fig.9. Bicycle power Tiller [13]

Analysis of Base Frame: The 3D model of rotary Rotavator blades were designed in CATIA tool. Then it is exported as tool.igs file to the analysis software Ansys work bench.
It was seen that, the extreme values of principal stresses for base frame were found to be 1.55e6Pa from 1.9e-10Pa respectively with a total deformation of 3.25e-3 cm. The induced stress values were less then design yield strength of the material.

Analysis of Rotavator Tool: The Rotavator tool is designed by considering various methods used in Rotavator process earlier. the tools are mounted on a disk of diameter 5 inch. there are three tools and placed in a portion such that it covers the area of 178 mm diameter and also covers the inside area of the disk. The tools are attached with the nut bolt so that it can be changed easily in case of breaking the tool. The feeding mechanism is used to feed the tool up and down. It consists of a screw rod inserted into a threaded hole and the movement of the screw rod gives the movement to the tool. The motor housing is also attached in the feeding mechanism and the screw rod is connected through the motor housing by using bearings which provided a free movement to the end of the screw rod while moving up and down.

It was observed that, extreme values of principal stresses for Rotavator were found to be 1.085e9Pa and 0.42e3Pa and a total deformation of

6.38mm. The induced stress values were very less than the yield strength of the material. Hence, the modified blades are important for an effective Rotavator.

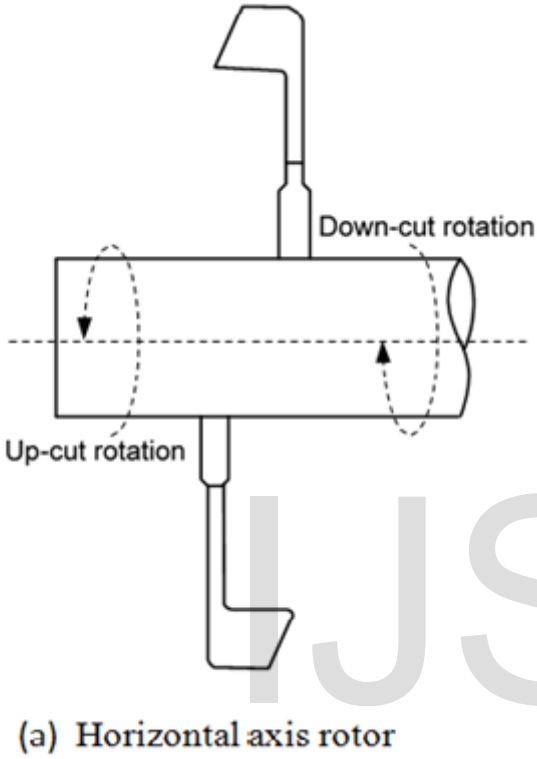

Fig.10 front view of rotor blade

3. CONCLUSIONS

Our project is successfully implemented for emphasizes on minimization of harmful efforts of using the manual rotavator. The new developed battery powered rotavator is operated.

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[9] SOLAR POWER TILLER, bicycle power tiller
[10] Front view of rotor blade