Design and Fabrication of Remote Operated Farm Equipment

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Abstract— Agriculture is a very important aspect of development. Crops are grown throughout the year and also are an important raw material for many industries like alcohol, oil, starch, beverages and others. The largest percentage of land here in India is not ideal for farming. Hence people still use conventional method for sowing and cultivating the crop instead of heavy machines because they are costly in operation, complex in maintenance. They are less popular in India, but on introducing a small, cheap and light weight solar operated machine sowing and cultivation of crop can be done efficiently and effectively. We can apply a single labour and single machine to operate on all the crops. Labour charges Rs400 per day and approximately 6 hours are needed to complete. The design of machine is simple and easy to operate. A labour pushes the reaper and a motor operated cutter cuts the maize plant about 12-14 inch from the ground and falls near the root which can be later collected and maize can be separated then gathered. Thus a large amount time and money can be saved each season and can be spent on other crops. Also this machine is less harmful to the supplementary crops grown.

Key words: Design and Fabrication, Labour

I. INTRODUCTION

The technology used in modern day farming is not that different which is used in last century. Though modern planters may do a better job or be slightly tweaked from their predecessors, they do the work same way as it has been done in past. However, technology is changing the way that humans operate the machines, as computer monitoring systems, global positioning system base devices to detect the exact location, and the automated driving farm equipments such as tractors has been more precise and less wasteful in the use of fuel, seed, or fertilizer. In the foreseeable future, these automatically driven advanced equipments with electronic sensors will be mass produced.

We have fabricated a unique machine which can cultivate as well as sow the seeds and is applicable to various types and ranges of plants as well as field. It uses solar power to operate and thus is cheap and economical to operate. We have implemented bakelite belt and wheel as maintenance is easy and the weight is also less so that as compared to regular wheel. Hence we have reduced the power output of the battery and also the sinking of the wheel is prevented. Also the durability of the machine is high. One of the most interesting feature of the machine is that it is remote operated hence the cost and weight of driver is excluded increasing the efficiency of the machine.

II. METHODOLOGY

Our methodology implies more than simply the methods we intend to use to collect data. We also included a consideration of the concepts and theories which underlie the methods. For instance, we highlighted the specific feature of a sociological theory or test an algorithm for some aspect of information retrieval, or test the validity of our system. We have to show that everyone understand the underlying concepts of the methodology. We also have described the way we have addressed the research step and/or hypotheses. With enough detail for the study or to be replicated or at least repeated in a similar way in another situation. Every stage is explained and justified with clear reasons for the choice of your particular methods and with materials. There are various ways to approach the research that fulfils the requirements of a dissertation. We have considered the expectations and possibilities concerning research in our field (mechanical). We have also discussed this with our guide and former students.

III. COMPONENTS

These are the main components of our machine. The research and calculation were according to these components and they comprise of 95% of the machine and are mostly the movable parts including parts necessary for support.

SR NO	DESCRIPTION	QUANTITY	MATERIAL
1	Frame	1	Aluminum
2	Wheels	4	Bakelite
3	Spur Gears	8	Cast Iron
4	Pinion	8	Cast Iron
5	DC Motors	6	14.4 W
6	Flat Belt	2	Bakelite
7	Cultivator	1	Iron
8	Seed Contaier	1	Sheet Metal
9	Battery	1	12 V/1.2 A
10	Solar Panel	1	Polycrystalline
11	Transmitter Module	2	Copper
12	Receiver Module	2	Copper

Table 1:

IV. CALCULATION

A. *Flat Belt*

N1=N2= 24 rpm
Power = 14.4W
D1=D2= 80mm
C= 280mm

Design power

$Pd = PR \times Kl \times K\theta$
$=14.4 \times 1.15 \times 1$
$=16.56W$

Pitch line velocity (Vp)

$Vp = \pi D2N2/60$
$=\pi \times 80 \times 24/ 60$
$=100.53m/s$

Belt Tension

$F1-F2 = Pd/Vp$
$=16.56/100.53$

F1-F2 = 0.1647
Belt Tension Ratio
πD2N2 = (1-S)πD1N1)
π×80×24=(1-0.01)×π×80×24
=0.99
Angle of lap (θ)
= π- D2-D1/C
= π
=3.14
In Bakelite belt
Take μ= 1
F1/F2 =eμ θ
=e1×3.14
=22.88
Length of the belt
L= π/2 (D1+D2)+2C+(D1-D2/4C)2
=π/2 (160)+560
=458.60

B. Gear Design

Tooth profile =20^{O} full depth bteeth
No. of teeth on pinion (Tp) =8
No. of teeth on gear (tg) =27
Velocity ratio (Vr) = tg/tp
=27/8
=3
Pitch dia of pinion (Dp) =15mm
Pitch line velocity in m/sec
=πDp×Np/1000×60
Vp = π×15×63/1000×60
Vp = 0.05m/sec
Calculation design power
Pd = Pr×Kl
= 16.5×1.15
=16.56W
Tangential tool load (Ft) in tearm on module
Ft =Pd/Vp
= 16.56/0.05
= 331.2N
Now by Lewis equation
Bending strength
Fb=So×Cv×b×y×m
So=456MPa
Yp=0.126
Yg=0.3787
(SoY)p=57.456
(SoY)g=172.6872
(SoY)p > (SoY)g
Module
Fb= 456×0.3×5×0.126×m
=173.36
Equate Fb & Ft
331.2=172.36m2
m=2mm
Fb > Ft
Calculate dynamic load by Buckinghams theorem,
Fd= Ft
Fd=Ft+(21Vp (Ceb+Ft))/(21Vp+√(Ceb×Ft))
C=11800……..for steel
E =error in profilr
e = 0.05
Fd
=331.2+(21×0.05×(11800×0.05+331.2))/(21×0.05+√(11800×0.05×0.5+331.2))
Fd=381.81N
Calculate wear load
Fw=Dp×b×k×Q
Q=1.54
Now take Fw=Fd
381.81 = 15×0.5×k×1.54
K=33.05
Gear = 600 BHN
Pinion = 600 BHN
Fw=387072N
Fw>Fd

C. Dimension

1) No. of gear on pinion = 8
2) No. of gear on teeth = 27
3) Module = 2mm
4) Addendum =2mm
5) Dedendum =2mm
6) Clearance =0.5mm

V. WORKING

As per our construction the solar panel is placed above the chassis. The solar panel captures the heat from the sun and coverts it into electrical energy. Solar panel generates 12 V DC voltage. The electricity produced by solar panel charges 12 V battery. This power is used to operate the equipment. There are two transmitter receiver modules which operate the movement of the wheels and the movement of cultivator and seed container. Two receiver circuits are attached to the chassis which receives signal from transmitter circuit. The transmitter circuits are attached to remote which also has four mechanical switches. With the help of these mechanical switches we can operate the equipment. The transmitter circuits in remote and receiver circuits on the chassis are RF (Radio Frequency) type. One transmitter-receiver pair operates on 434 MHz frequency and the other transmitter-receiver module operates on 315 MHz There is encoder IC in the remote which encodes the RF signal and Transmits the signal to the receiver module. The receiver module contains decoder IC which decodes the signal. The command given by the operator is followed and the equipment is operated. The battery provides the current to the DC motors connected to the wheels. The motor here is DC geared motor. The DC motor works in some range of voltage. The higher the input voltage more is the RPM (rotations per minute) of the motor. For example, if the motor works in the range of 6-12V, it will have the least RPM at 6V and maximum at 12 V.

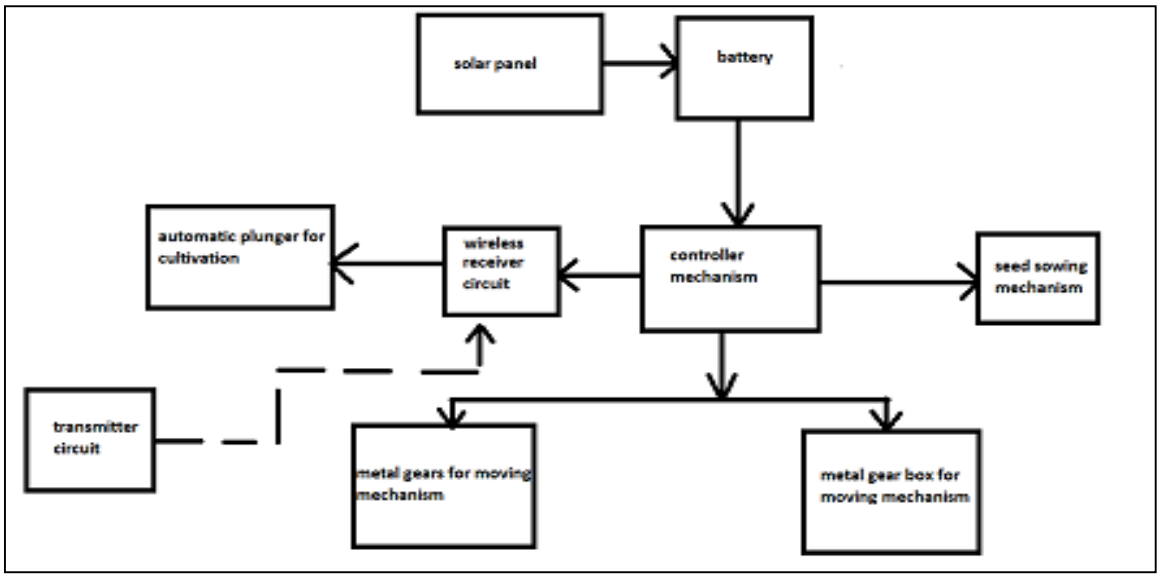

Fig. 1: Block diagram of remote operated farm equipment

VI. ADVANTAGES

1) This machine reduces the human effort as only human effort is to operate using remote. Other work is done automatically.
2) It reduces the time consumed in whole process making it efficient.
3) It increases the agricultural productivity.
4) Human may not be able to work in hazardous environment machines can.
5) It will save time and money of the owner.
6) It is a driverless machine no need for the driver because in case of a tractor sometimes the owner has to pay his salary.
7) Seed sowing work will be done automatically no need for the labours.
8) No need to hire extra labor for carrying out the work of seed sowing.

VII. RESULT

We applied all these techniques to reduce the process time, cost and human efforts of the farmer. The system helps to reduce time as farmer do not have to depend on anyone to operate the vehicle. It also helps in reducing labours for seed sowing. It increases the agricultural productivity. After fabrication of prototype for remote operated farm equipment for cultivating and seed sowing, the result obtained that if the system utilization will be executed in proper way by taking and concerning all the relevant according to the project demand the process time, cost and human efforts can be reduce in a great manner. We have got the idling power for the equipment is 14.4 W, rpm of the motor without load 600 rpm and with load 24 rpm and torque of the equipment is 78.45 N-m.

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