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Design and Fabrication of Agricultural Crops Reaper

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Abstract**: Recently India has seen a shortage of skilled labour available for agriculture. Because of this shortage the farmers have transitioned to using crop reaper. These agricultural crop reapers are available for purchase but because of their high costs, they are not affordable for small scale farmers. The idea was to create a machine which is cheap and will reduce the labour required to harvest crops. This machine is suitable for the small scale farmers who have farm area of less than 2 acres. This reaper is compact and capable to cut upto 2 rows of maize stalk / bajara stalk and 60 cm width of wheat crops rows. It has a high strength cutting blade which cuts the crops in a scissoring type of motion. It runs on an engine of 3HP, this power from engine is provided through pulley and gear box arrangement to the cutter. A collecting mechanism is provided for the collection of crops to one side of reaper after cutting. This mechanism is powered by pulley arrangement. This reaper might be solution to the problems faced by small scale farmers regarding cost and labour implementation.***
Keywords**: cutter blades, scotch yoke mechanism, belt drive.***

I. INTRODUCTION

Farming is most widely followed profession in India. Agricultural products contribute a major portion to our economy. Engineering science has brought tremendous changes in traditional methods of agriculture viz. sowing, planting, irrigation, fertilizer spraying, harvesting, etc. However to increase our economic condition, me must increase the productivity and quality of our farming activities. Nowadays very few skilled labours are available for agriculture. Because of this shortage the farmers prefer to use reaper harvesters. These reapers are costly and only available of very large scale farming. However, agriculture groups make these available for rent on an hourly basis. But the small holding farm owners generally do not require the full-featured combine harvesters. Also, these combine harvesters are not available in all parts of rural India due to financial or transportation reasons. Thus, there is a need for a smaller and efficient combine reaper which would be more accessible and also considerably cheaper. The mission is to create a portable, user-friendly and low cost mini harvester.

Taking into account the requirements of current situation, the idea was created to prepare a machine which is cheap and will reduce the labour required to cut crops. This machine has the capability and the economic value for fulfilling the needs of farmers having small land holdings. This machine is cost effective and easy to maintain and repair for the farmers.

The machine model is designed based on the demand for a compact and economical reaper.. This demand is taken into consideration by consulting farmers in person, for their problems and requirements. Taking into account the present scenario of corn harvesting we decided to prepare a model of corn reaper with compact construction which will be mostly suitable for farmers having small land for agriculture. The machine prototype will be economical and most convenient for cutting corn stalks and other similar plants having same or less shear strength than corn.

A. Conventional method s of Reaping

1) *Manual Reaping (By Hand):* Hand reaping is done by various means, including plucking the ears of grains directly by hand, cutting the grain stalks with a sickle, cutting them with a scythe, or a scythe fitted with a grain cradle. Reaping is usually distinguished from mowing, which uses similar implements, but is the traditional term for cutting grass for hay, rather than reaping cereals. The stiffer, dryer straw of the cereal plants and the greener grasses for hay usually demand different blades on the machines. The reaped grain stalks are gathered into sheaves (bunches), tied with string or with a twist of straw. Several sheaves are then leant against each other with the ears off the ground to dry out, forming a stook.

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Fig.1. Manual reaping (By Hand)

II. MECHANISM

Two mechanisms available for this are

A. Trimmer Mechanism

This mechanism is used in portable trimmers. If the size of cutter is increased it can be used for cutting stalks with moderate diameter.

Fig.2. cutters for trimmer mechanism

B. Scotch yoke Mechanism

Scotch yoke mechanism is most suitable mechanism for our application. It gives optimum cutting requirements and is also easy to implement for our purpose of cutting small stalks.

Fig.3. Scotch Yoke Mechanism

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III. SHEAR TEST ON UNIVERSAL TESTING MACHINE

In order to obtain precise values from calculations we performed a test on several stalks of corn plant to obtain shear strength. The shear test was performed on a universal testing machine using suitable fixtures. Stalks were tested for both single and double shear.

Fig.4.Specimen under Test On UTM

TABLE I RESULT TABLE

Sr. No.	Appearance (in Time New Roman or Times)			
	Type of shear	Sample Diameter(mm)	Shear Force(kN)	Stress(N/mm^2)
1	Single	15	0.6	3.0
2	Double	20	2	
3	Single	20	1	2.95
4	single	20(without cover)	0.6	1.91

It is observed from the table that shear stress value of $3N/mm^2$should be taken for design purpose.

IV. DESIGN

A. Selection of Engine

For selection of engine, engine power is to be determined. We have taken following parameters for design purpose:

Diameter of stalk = 30mm

Area= $(\pi/4)30^2$ = 706.85 mm^2

Shear strength= 3 N/mm^2

Force Required for cutting 1 stalk = Shear stress x Shear Area= 3 x 706.85 = 2121 N

For cutting two stalks, Force required= 4242 N

Stroke of cutting = 70 mm

But, stroke= 2 x radius

Radius = 70/2 = 35mm

= 0.035m

Torque = Force x Radius=148.47 Nm

Cutter velocity=v= 0.5m/sec

V=ωxr   0.5=ω x 0.035

ω= 14.28 rad/sec

ω=2πN/60   N=140RPM

Power = 2πNT/60= 2.84= 3 hp

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B. Selection of Belt Drive

Now engine RPM= N1=3000RPM
Output of belt drive required=N2=720RPM
Diameter of input pulley= D1=2.5’’
Diameter of output pulley = D2= 10’’
Selection of belts
Power to be transmitted=2.2KW

1) Service factor=Fa=1.2
2) Design power=Fa x Power to be transmitted = 1.2 x 2.2 = 2.64 KW
3) Section of belt : A Section
4) Pitch length of belt : Center distance = 2x D2 = 2 x 10’’=20’’ L= 2C + π(D+d)/2 + $(D-d)^2$/4C =60.33’’
5) Preferred pitch length = 60’’
6) Correct center distance: L= 2C + π(D+d)/2 + $(D-d)^2$/4C   C= 19.828’’
7) Correction factor for belt pitch length= Fc=0.94
8) Correction factor for arc of contact = Fd α_S=180 – 2Sin-1(D-d)/2C $\alpha_S=158.2^0$
9) Power rating of single V-belt: Pr=1.46+0.36=1.82
10) Number of belts required= P x FA/(P_rx F_C x F_D) = 1.62 =2

C. Forces on Worm Wheel

For worm and worm wheel
Z_1= Number of starts on the worm = 3
Z_2= Number of teeth on the worm wheel = 15
q = Diametral quotient=10m = module=10mm
d_1= diameter of worm wheel
d_1= q x md1=10 x 10
d_1=100mm
d_2=diameter of wormd_2= z_2 x md_2=15 x 10
d_2=150mm
$(P_1)_t$= 2849.4 N
$(P_1)_r$= 2664N
$(P_1)_a$= 6790N

D. Main Shaft Design

Let P_1 and P_2 be the tension and tight and slack side respectively.
P_1=2414N P_2=5264.14N
Material of shaft= 45C8
S_{ut}=650 N/mm^2S_{yt}= 450 N/mm^{2}F.O.S.=3
Bearings are mounted at B and D to support the shaft.
Bearing reactions R_B= -4002.3 N(downward) R_D=10102.36N
Maximum bending moment occurs at c,M_c=753820Nmm

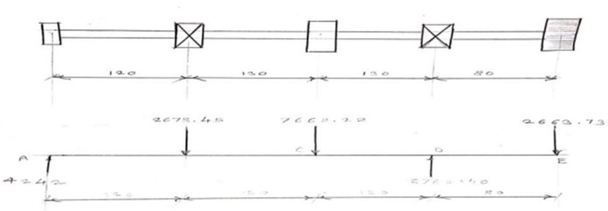

Figure 5. Loding of Shaft

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τ_{max} = 75 N/mm^2

$\tau_{max} = (16/\pi d^3) \times ((K_b M_b)^2 + (K_t M_t)^2)^{1/2}$

$75 = (16/\pi d^3) \times ((753820 \times 2)^2 + (142.47 \times 10^3 \times 1.5)^2)^{1/2}$

d= 48.65 = 50mm

V. MODELLING

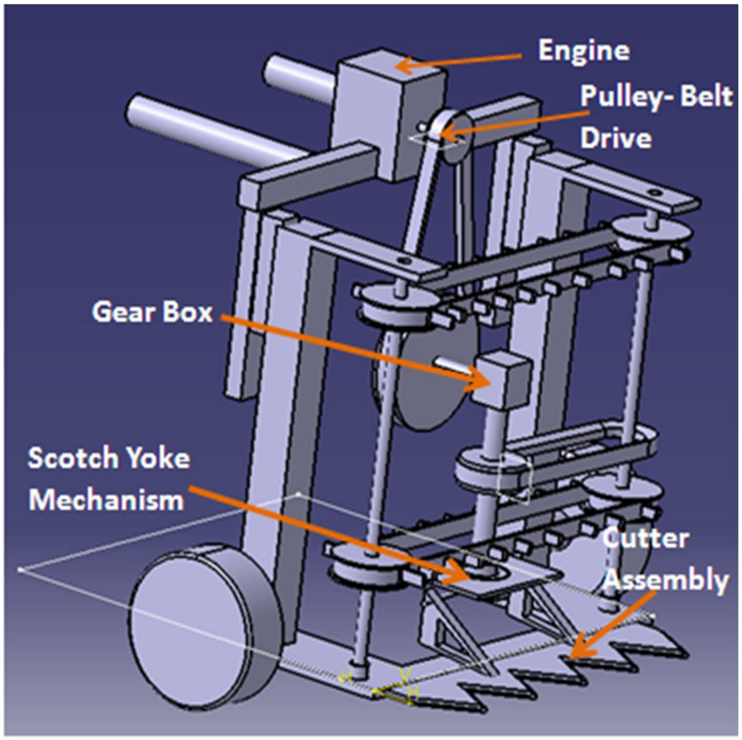

Fig. 6 CATIA Model

The power is taken from Engine which is transmitted with suitable speed reducton using belt drive and Gear Box. The change in direction of travel of driving force is obtained using Gear Box which is placed on output shaft of belt drive . Main shaft bears the output of gear on one end where as scotch yoke mechanism is mounted on the other shaft. Main shaft also carries belt drive for transmitting power to side shaft. Scotch yoke mechnism results in conversion of rotary motion to translatting motion. This mechanism is connected to cutter assembly. Plants are cut by trimming mechanism by the cutter assembly. The cut Plants are swept away from the direction of travel by swapping belt mounted on side shaft. Thus cut plants are collected on one side of the travel.

VI. CONCLUSION

This designed efficient reaping machine which will counter the problem of cutting corn plants manually for small scale farms. It can be concluded that the machine is comparatively compact and easy to handle. This machine is able to run of field effortlessly and efforts of farmer are reduced. The cost of reaping using this machine is considerably less as compared to manual reaping. The reapers available in market are suitable for large farms so this can be best reaper for the farmers with small field.

REFERENCES

[1] S. C. Jain, “Farm Machinery- An Approach”, PP- 5, 36, 45.
[2] D. S. Sharma and Mukesh Sharma, “Farm Machinery Design Principles and problems”, PP- 225-245
[3] L.P.Raut, Vishal Dhandare, Pratik Jain, Vinit Ghike, Vineet Mishra, ‘Design, Development and Fabrication of a Compact Harvester’, International Journal for Scientific Research & Development, vol.2, Issue 10,2014, Department of Mechanical Engineering GHRCE, Nagpur, India.
[4] Arvind C Shivashankar, Vikas R, Vikas V, ‘Design & Development of Mini Paddy Harvester’, International Journal for Scientific Research & Development, vol.3, Issue 05,2015, Department of Mechanical Engineering, BNM Institute of Technology, Bangalore, Karnataka, India.
[5] A.R. Womac , M Yu, C. lagthinathare, P. Ye, and D. Hayes, “Shearing Characteristics of Biomass for Size Reduction”.

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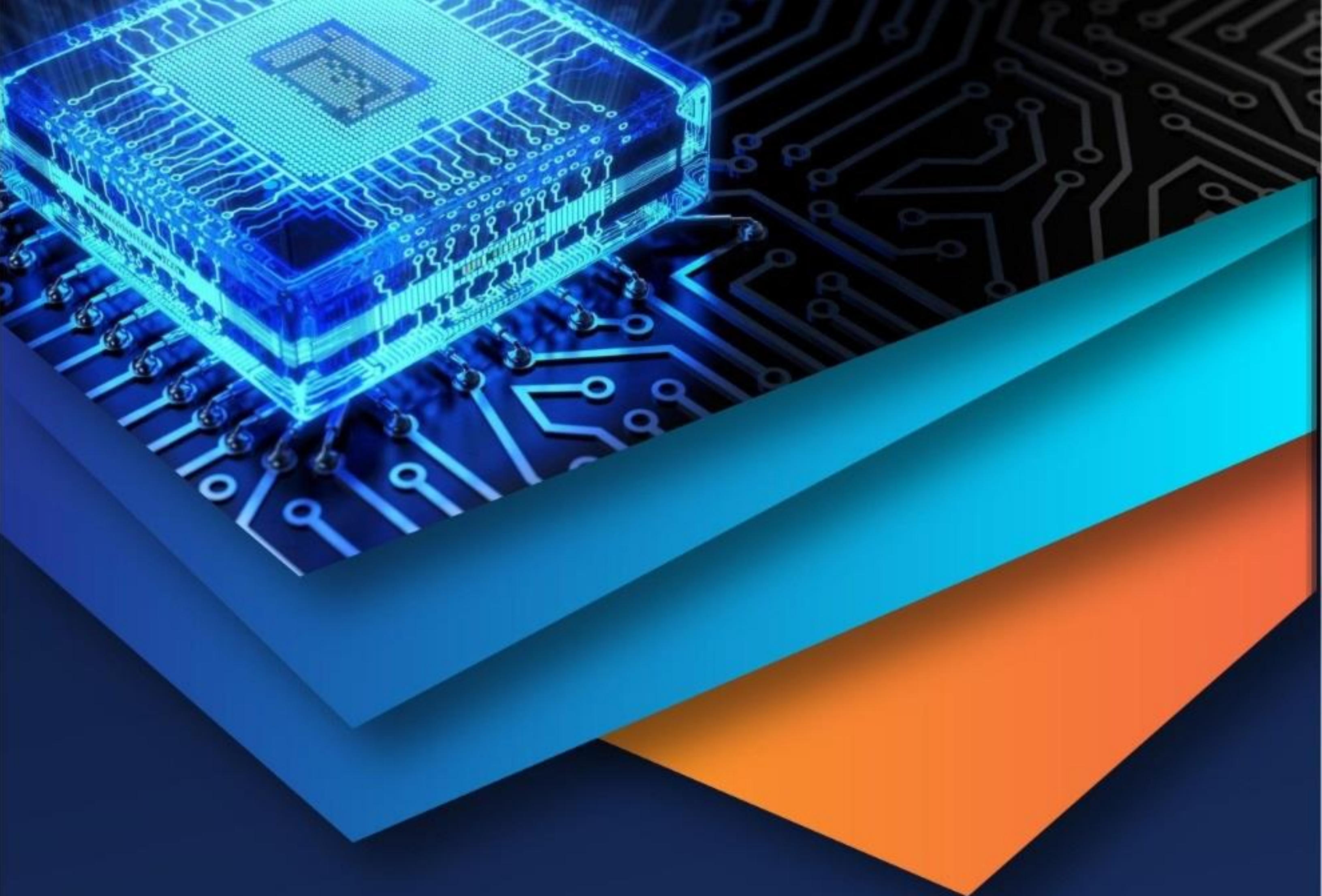

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