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Design and Fabrication of Spinach Harvesting Machine

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Abstract: Over the last century and a 0.5, farming practices are revolution by the appearance of mechanical harvesters, however there's a inequality between obtainable agricultural technology and therefore the technology employed in the farm instrumentality that's cheap for operators of little farms.

The gathering practices for dish greens from little farms is simply one example of this disconnect. this can be a historical and style study of mechanical greens harvesters for tiny farms. The styles accommodates a frame with power, cutting and assortment systems mounted to the frame.

Developing a cheap dish greens harvester would facilitate little turn out farms in a way, however it's solely a step toward the general transition inventors, entrepreneurs and {makers} ought to make toward mobilization little farms with the technology that's already in use on massive farms.

The main purpose for innovating such machine is to extend the productivity likewise on scale back the time consumption for collection crops and demand of skilled labor their by reduces the general price.

Keyword: Conveyor, Design, Skilled labor, Effort, Overall cost.

I. INTRODUCTION

Recently Vidarbha has seen a shortage of practiced labor out there for agriculture. due to this shortage the farmers have transitioned to mistreatment harvestings. Cutting crop manually mistreatment labor however this methodology is incredibly time long and time overwhelming. The harvestings are out there for purchase however due to their high prices, they're not reasonable. However, agriculture teams create these out there for rent on Associate in nursing hourly basis. However the tiny holding farm homeowners typically don't need the full-featured mix harvestings. Thus, there's a requirement for a smaller and economical mix gathering which might be a lot of accessible and additionally significantly cheaper.

The mission is to make a transportable, easy and low price mini gathering machine. the concept was to make a machine that is affordable and can scale back the labor needed to reap crops.

This machine has the potential and also the amount for fulfilling the requirements of farmers having little land holdings (less than two acres). This machine is cost effective and straightforward to take care of and repair for the farmer. Many consumers have begun deliberately purchasing from local sources. it might be advantageous for farmers and makers alike if agricultural industries began deliberately addressing the demand from small farms.

Harvesting is one among the foremost labor-intensive operations in agriculture, which is required to be done at appropriate time soaps to get optimum yield. Delay in harvest will have an immediate impact not only on the yield but also on quality of produce.

Further, the tactic of harvest and wastage of produce are interlinked. Traditionally, harvesting is completed manually in rural areas and particularly in small landholdings.

However, within the situation where labor shortage is on an increase , harvesting through mechanical means has become inevitable. Though various machinery is out there , combine harvester has been widely in use. Presently the supply of combine harvesters aren't spread uniformly and thus must be transported to long distance. Therefore the model schemes intends to form the machinery available locally so on reduce the operation cost and facilitate timely harvest operation. Nationally, most of the food we eat is produced by large agricultural supply chains, which link farmers, seed suppliers, pesticide and fertilizer suppliers, transporters, distributors, wholesalers and shops. Currently the us harvests about 114.8 million acres of grain per annum worth some $15 billion (USDA Census of Agriculture, 2007). On variety of dimensions this scale of production isn't sustainable. one among these issues is that $28 billion is spent by all the farms within the U.S. on chemical fertilizer alone, which is formed primarily from non-renewable resources including fossil fuels (USDA Census of Agriculture 2007).

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II. LITERATURE REVIEW

We have studied various literature reviews related to our project "Design & Fabrication of Spinach Harvesting Machine". We have come up with the following important literature reviews. These literatures are described below:-

A. *Christopher Molica's & Team*

Has reported that base on the shelling action they can be in the form of Motor operated reaper & binder .This machine was developed concerned to the small scale grain growers.

B. *N. S. L. Srivastava*

checked in the interests of the farmers and the difficulties they face while harvesting and keeping the agriculture field. This paper was an in depth study of the farming conditions of the farmers and their basic problems. Indian Government Analysis was the survey finished by Indian Government in the financial year of 2015-16. This survey was intended to analyze and gather the data related to the problems and problems faced by the Indian farmers. Asia and Pacific Commission on Agricultural Statistics 23rd Session Siem Reap, Cambodia, 2630 April 2010.

C. *Yuming Guo's*

paper explains the relation between the stalk strength and the cutting force that is required for cutting the soybean. The paper was supportive in guiding on the calculations front. Defines the strength of various crops and compares it with the soybean. This relationship helps in giving a rough idea about the cutting speed required to cut the cotton or Pigeon pea crop.

D. *S. S. Kohli*

2015 describes Mechanical cotton cutting tools or harvesters, i.e. strippers are commercially available, but these cannot be used for cotton harvesting from varieties presently grown in India due to design constraints and ergonomic practices. Higher initial cost and field capacity make cotton cutting tools or harvesters unsuitable and unaffordable for small & medium farms. Hence, a comprehensive review of cotton harvesting mechanisms developed is carried out.

E. *A. Fujisawa & Y. Chida*

has reported about the various types of root cutting blade in that they divided the motion of blade in two categories i.e. Translation path & arc path. Also they described various calculations related to the blade speed, blade angle & position.

F. *A.O Adeodu and O.M Dada*

has reported that they set the target to create the conveyor belt. They also calculated the various parameter related to the speed, angle of inclination, belt material, no of rollers. As a result of calculation they decided to select PN450 double weave standard rubber belt with the specification mention in the literature.

III. DESIGN SPECIFICATION

A. *Dimensions*

Working height (Normal):- 3 Ft
Horizontal Length: - 2.5 Ft
Incline Height: - 3 Ft
Width: - 2.3Ft
Angle of Inclination: - 32°

B. *Technical Specifications*

Rectangular cross section pipe 1×2"
Square cross section pipe 1×1"
Wheel dia:- 7.5"
Wheel base:- 2"
Rubber bushes: - 60mm
Reel wheel size:- 18×7"
Idler dia:- 55 mm
Bearing outer dia :- 51mm

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C. Calculation of Inclination Angle

According to Dunlop Conveyor Belt Design Manual

Table no 2(a) Typical Flowability

Weight of material according to density	Angle of inclination (∂)	Coefficient of friction (μ)
Uniform weight (metals & alloys)	0° – 20°	1.26
Medium weight (clay & wood chips)	20° – 30°	0.96
Light weight (dry & wet materials)	30° – 40°	0.62

D. Calculation

$$\tan(\partial) = \mu$$

$$\partial = tan^{-1} \times \mu$$

As we use light weight material therefore, μ= 0.62

$$\partial = tan^{-1} \times (0.62)$$

$$\boxed{\partial = 31.79° \approx 32°}$$

As the ranging is between 30° – 40°then we should recommended ∂=32°

PWM speed controller to each motor 24volt each motor.

Battery Volt = 12v × 2

$$\boxed{\text{Voltage Capacity} = 24 \text{ v}}$$

Power Required To Drive Motor = 24w × 7.4

$$\boxed{P = 177.6 \text{ watts}}$$

IV. Calculation for motor power required to drive the reaper cutter

Forward speed, Vs = 3 km/hr = 3000 m/hr

Width of cut = 1inch=2.5cm=0.025m

Blade cutting Angle:- 45 degree

R= 12.5mm =0.0125m

E. Angular Velocity

$$\omega = 2\pi n / 60$$

$$= 2\pi \times 200/60$$

$$\boxed{\omega = 20.94 \text{ rad/sec}}$$

F. Cutting Speed

$$VC = r\times\omega$$

$$= 0.0125\times20.94$$

$$\boxed{\begin{aligned}VC &= 0.2617 m/sec\\ VC &= 15.705 m/min\end{aligned}}$$

G. Power Required to Operate Cutter Bar

$$N = 200 rpm$$

$$P = (2\pi\times n\times t / 60)$$

$$= (2\pi\times60\times1.14/60)$$

$$P = \boxed{7.162 watt}$$

$$\text{Motor power} = V*I$$

$$= 12*2$$

$$\boxed{\text{Motor power} = 24V}$$

H. Power Required to Move Whole Machine at a speed of 3 km/hr

$$= (32kg \times3000m \times1\ hr \times1\ min \times1\ hp /1\ hr \times60\ min \times60\ sec \times75\ kg\ m/sec)$$

$$\boxed{P = 29.502 watt}$$

I. Design an Idler for a Conveyor Belt System" has Detailed explanation About

how to calculate idlers spacing.

Carrying Capacity of conveyor:-

$$M = \rho\times Q\times(0.09B-0.05)^2\times V$$

ρ = density of conveyed material (893.1 kg/m3)

Q= 0.00025

V= linear velocity of conveyor belt (0.5 m/s)

$$M = 893.1\times0.00025\times0.5$$

$$\boxed{M = 0.0319 kg/sec}$$

J. *Belt Tension*

Coefficient of friction(f) = (0.02)

Conveyor length in meters (L) = (1.21m).

(g) = 9.81 m/sec^2

Load due to belt in (mb) = (25Kg/m).

Load due to the conveyed materials in (mm)= Kg/m (1.5kg/m).

Tb = 1.37*f*L*g*[2*mi+ (2*mb + mm)*cos (δ)] + (H*g*mm)

Tb =1.37*0.02*1.21*9.81*[2*0.833+ (2*25+1.5)*cos(32)]+(1*9.81*1.5)

$\boxed{\text{Tb=29.335N}}$

K. *Load due to the idlers in (MI)*

Load due to idlers (MI): This can be calculated as below

MI = (mass of a set of idlers) / (idlers spacing)

=1/1.21

$\boxed{\text{MI=0.83kg/m}}$

L. *Acceleration*

The acceleration of the conveyor belt can be calculated as:

Where,

A is in m/sec2

Tbs = the belt tension while starting in N.

Tb = the belt tension in steady state in N.

L = the length of the conveyor in meters.

mi = Load due to the idlers in Kg/m.

mb = Load due to belt in Kg/m.

mm = Load due to the conveyed materials in Kg/m.

A= (Tbs – Tb)/ [L(2*mi + 2*mb+mm)]*

A= (44.0025 – 29.335)/ [1.21(2*0.83 + 2*25+1.5)]*

$\boxed{\text{A=0.228 m/sec2}}$

M. *Power at Drive Pulley*

The power required at the drive pulley can be calculated from the belt tension value as below:

Where,

Pp is in W.

Tb = steady state belt tension in N.

v = belt speed in m/sec.

*Pp = (Tb*V)*

*Pp = (29.335*0.5)*

$\boxed{\text{Pp= 14.665 W}}$

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N. Belt Breaking Strength

This parameter decides the selection of the conveyor belt. The belt breaking strength can be calculated as:

Where,
Bs is in Newton.
Cr = friction factor
Cv = Breaking strength loss factor (0.75)
Pp = Power at drive pulley in Newton.
V = belt speed in m/sec.

$$Bs = (Cr*Pp)/(Cv*V)$$

$$Bs = (15*14.665)/(0.75*0.5)$$

$$\boxed{Bs = 586.6\ N}$$

IV. CATIA MODEL

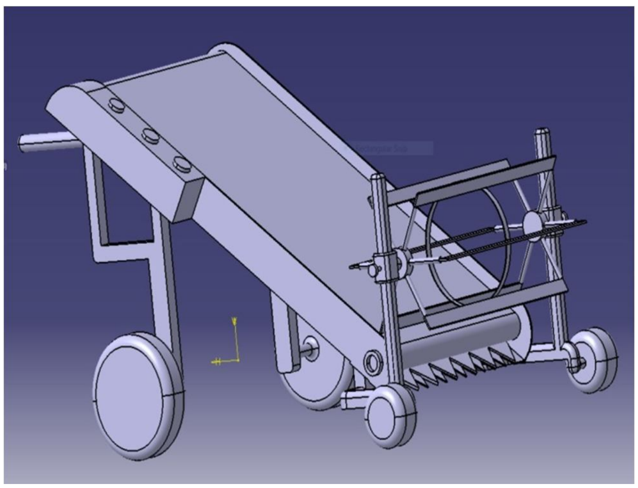

Fig. Right hand side view

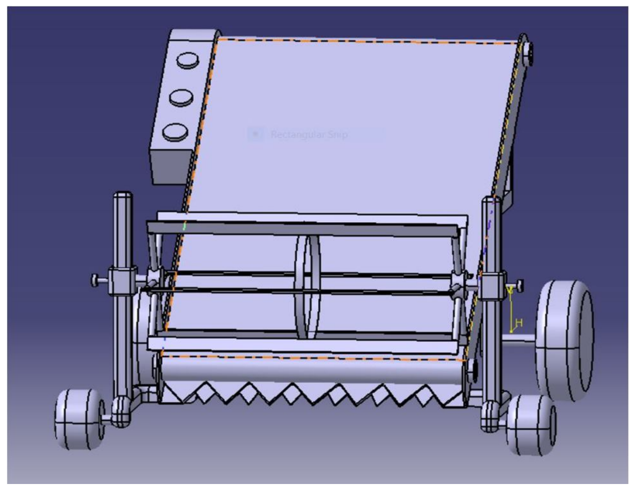

Fig. Front view

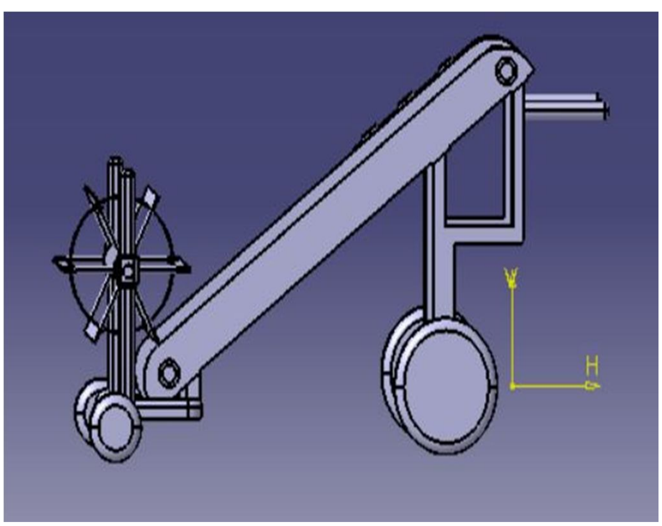

Fig. Left hand side view

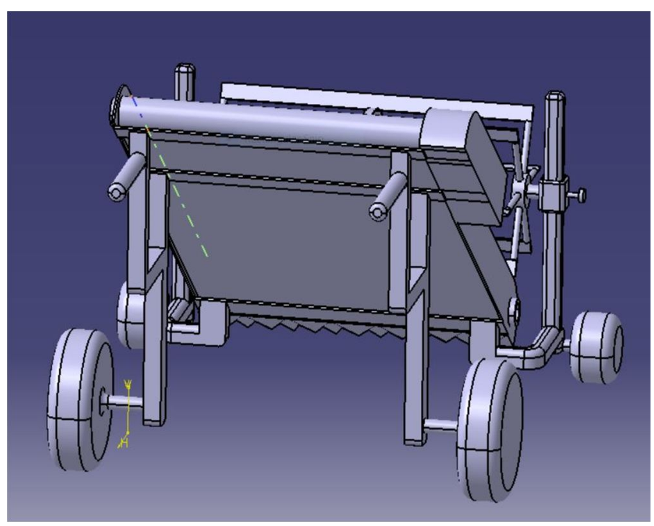

Fig. Rear view

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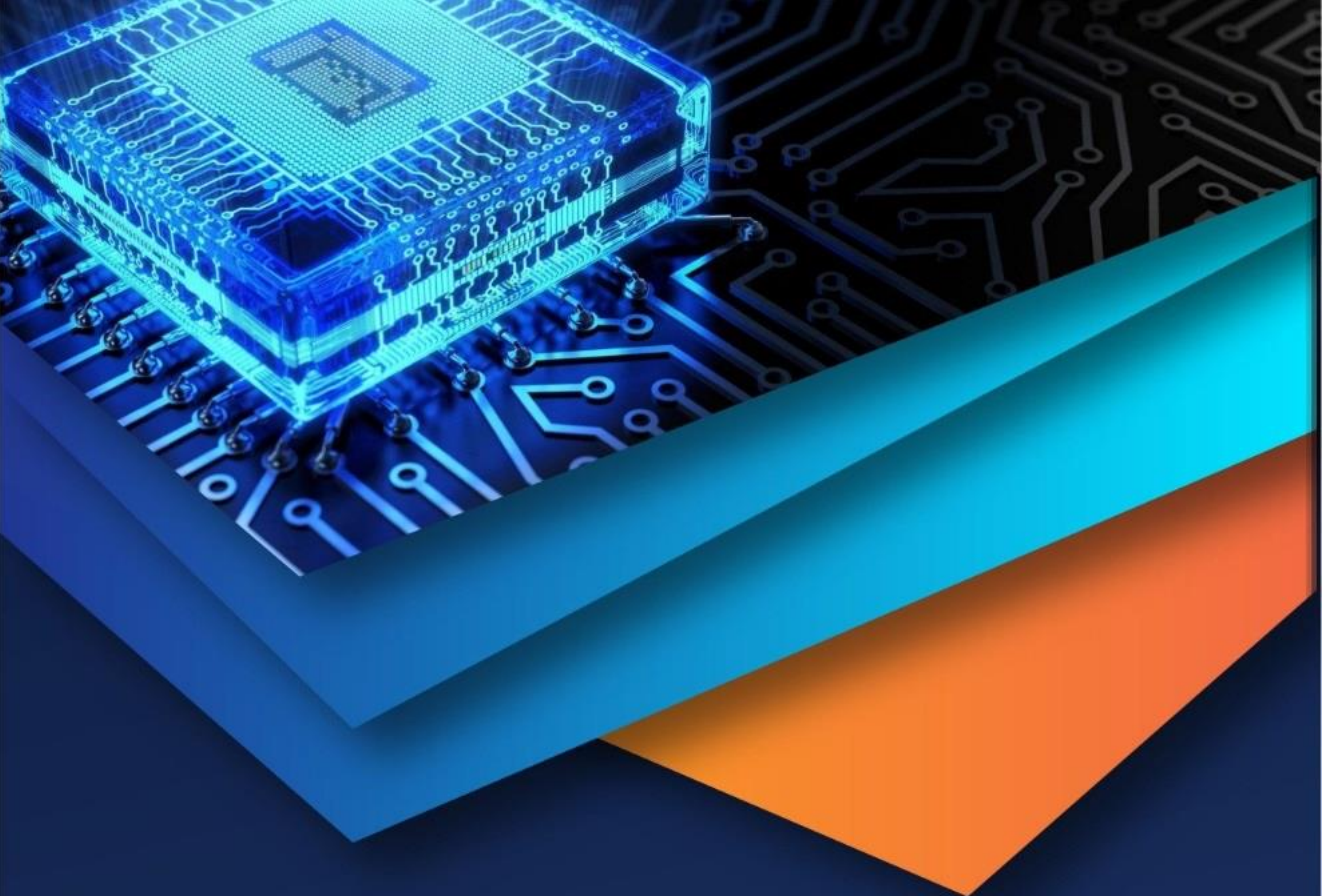

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