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Seed Sowing Machine

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***Abstract*—Seed sowing is one of the most important activities in agriculture and currently the methods that are being practiced are either too costly or way too inefficient for the farmers especially for the poorer. Thus, it is important to address this issue concerning farmers with fewer resources and help them sow their crops efficiently at cheaper costs. Hence, the fabrication of a device that should be well equipped for achieving the required results with desired accuracy as well as a minimal cost is the task at hand. The device that we have design deals with high torque applications with precise seed to seed spacing and for that we have used computer-aided software like Autodesk fusion 360 and Catia. This helps in analysing the mechanical structure along with the material properties. Thus, in order to get the outcome, the proposed the two-stage gearbox using chains and sprockets and for seed delivery has been proposed along with the size adjustable seed picker fitted with a quick whit-worth return mechanism has been used. While experimenting we observed the amount of seeds picket at one go and while delivery the approximate gap between the seeds. This helps in analysis of various external factors which affects the outcomes of the results.**

***Index Terms*— Agriculture, seed sowing, tricycle, gear box, chain and sprocket.**

I. INTRODUCTION

Agriculture contributes 17% -18% in India's GDP and employs more than 50% of the total Indian workforce. The wave of mechanization and automation is spreading in the agriculture sector and it is definitely affecting the way traditional farming is performed. But the effects of this modernization are often experienced only by the ones who can afford it. Large farm owners have the means to utilize this opportunity whereas small scale farmers have to be dependent on their orthodox slow and inefficient methods. Also, because of the small land holdings owned by the farmers, it is not affordable and feasible for them to rent machinery like tractors for their small-scale operations. Amongst such operations is seed sowing, which is a time-consuming operation and demands labour. The main reason for being so time consuming is that the methods which has been used for such a long time requires high human efforts. The following seed sowing methods are:

A. *Drilling***:** In this method dropping of seeds are being practiced after that the seeds are then covered properly.
B. *Broadcasting:* This method is one of the earliest and widely used where the seeds are spread on the farmland and for some crop it is being covered and mightn't for another.
C. *Dibbling:* It involves the placing of seeds inside the holes or pits at equally measured distances and depths. This is being done either by dibble, planter or by hands.

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D. *Planting:* This method is about placing the seeds or propagules firmly in the soil for germination and growth purpose.
E. *Sowing in the ploughed furrows:* This method involves in placing the seeds into the furrows that are ploughed in the field either continuously or at specific distance.
F. *Transplanting:* This method involves practice of planting seedlings in the main field after taking it out from the nursery.

II. Literature Survey

The vital role of seed sowing operation is to place the seeds in defined rows at measured depth and spacing. In most of the practices seeds gets a proper covering as well. The well-defined row to row spacing, seed flow rate, seed to seed spacing and depth of the placement varies from crop to crop and with different weather conditions to attain the desired results. When a tricycle moves on paved surfaces and roads it consumes energy to overcome the rolling resistance, gravitational and inertial forces between the tires and the ground [1]. Rolling resistance between the tire and the ground is attributed to tire slip, scrubbing in contact patch, deflection of the road surface and energy losses due to tire adhesion on the road and hysteresis. Rolling resistance varies with the type and material of tire thread, velocity of tricycle, and environmental parameters, such as temperature and humidity [2]. The functions to predict the ideal pod length and ideal seed size were created and all of the equations were derived from commonly used mathematical concepts. Hence the formula for the surface area of a cylinder (SA=2(pi) r 2 + 2(pi)hrh) allows the prediction of total pod surface area per plant when pod length is varied [3].
According to the invention in seed delivery the device is properly placed in particular place. The seed distributing section has been constituted by a vertical rotating disc with a circular row of perforations each having dimensions smaller than that of the seeds to be sown. One face of disc there is a wall for an enclosure called a seed box. This box contains the seed to be sown and the other face serving as a wall for an enclosure called a suction box which is in communication with means for forming suction [4]. The vacuum is being created for holding the seeds at its position and while seed is being delivered there is a sensor attached to the delivery pipe which helps in counting the numbers of seed and also gives the information of gap between seeds by calculating their flowing speed. So, through the digital monitoring systems these all functions are being monitored and can be controlled and manipulated with respect to the desired results [5&6].

III. Market Survey

Conducting of market survey was a necessary task, as it would reveal the current technology associated with seed sowing and their costs. For the market survey, it was necessary to visited nearby farms to gather information about the machinery and methods that the farmers use. Together with this, searching took place online for different products that are available either as a seed sowing device or as an assistance for such an operation. Hence, the following data that has been gathered are:
A. Equipment such as seed drill costs up to Rs. 36,000.
B. Renting a tractor and equipment costs Rs.1000- Rs.1200 per acre as well as the cost of fuel consumed.
C. Manual labour costs vary from Rs.800-Rs.1000 per acre.
D. Standalone seed sowing equipment cost varies from Rs.4800-Rs.6000.

IV. Objective

A. To make a pedal-powered tri-cycle as shown in figure.2 and figure.3
B. To make a size adjustable seed picker depending on the seeds.
C. To make a smooth seed delivery as shown in figure. 4
D. To make it cheaper.

V. Constraints

In order to make the device more user oriented it is necessary to focus on its qualities and limitations which has been explained in figure 1. The following constrains are:
A. Human driven
B. Limited power and speed
C. Implementation for small scale fields.

D. Operable in dry soil that is very shallow ploughed.
E. Keeping the total cost below Rs. 4000

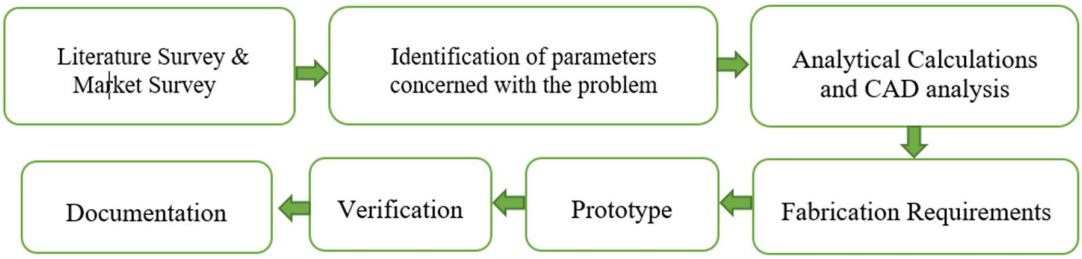

Figure. 1 Project activities

VI. Methodology And Experimentation

The project deals with various elements in order to make it work in the conditions where it is very challenging. Those elements are the centre of gravity of the model, the force required to move the rear wheel, friction between wheels and soils that are both soft and hard, delivery of seeds, pod length for seed sizing and its spacing, movement of seed-picker in hopper, machine design for finding the right combination of gears and lastly machine & mechanism for quick-whit worth return mechanism [7]. When it comes to mounting the chains it was important to calculate its length with respect to the gap that has been already there, Also for gearbox design using chains and sprockets, its placement was a difficult task as the whole mechanism would have easily got unstable. Thus, to get the precise calculations following equations have been used:

$$r = \{(\text{Volume})/ ((4/3) * (\text{pi}))\} \wedge (⅓) \quad (1)$$

Radius of a seed (r): the radius of a seed is found by using the formula for the volume of a sphere (volume = $(4/3)*(\text{pi})*r^3$) and solving for the radius.

$$F=[(\text{mu})*M*g]/3 \quad (2)$$

Force at rear wheel (F), Net mass of tricycle (M), Coefficient of friction (mu),Acceleration due to gravity (g)

$$N=(Z)/(z) \quad (3)$$

Gear ratio (N), no. of teeth in gear no.1 (Z), no. of teeth in gear no.2 (z).
With the help of the values mentioned in table I, table II and table III, we have calculated the required values.

Table I. Details Of Parameters

Sr. No	Parameters	Values
1	Time	1 hour
2	Area	0.5 acre
3	Speed	65 rpm
4	Coefficient of friction	0.15
5	Net force	47 Newton
6	Seed size	8-12 mm
7	Gear ratio	1.5
8	Pod length (average)	60 mm (peas)
9.	Seed density	1.176 g/cm^3

VII. Fabrication Requirements

TABLE II. LIST OF COMPONENTS' COST

Sr. No.	Components	Cost (Rs.)	Dimensions
1	Cycle (2nd Hand)	600	Length-2620mm
2	Wheels	240	Dia-660mm
3	Axle Shaft	170	Length-600mm, Dia-22mm
4	Bearing	120	Dia-20mm
5	Utensil	60	Dia-100mm
6	Plastic Container	130	Dia-220mm
7	Chains	150	Chain 1=1358.9mm, Chain 2 =720mm
8	Sprocket cassettes	250	14/32 teeth (7sprockets each)
9	Nuts	26	M5
10	Bolts	26	M5
11	Steel container	60	Dia-120mm
12	M-seal	60	-

TABLE III. LIST OF MACHINING COST

Sr. No.	Processes	Total cost (Rs.)
1.	Turning	1000
2.	Drilling	100
3.	Welding	200

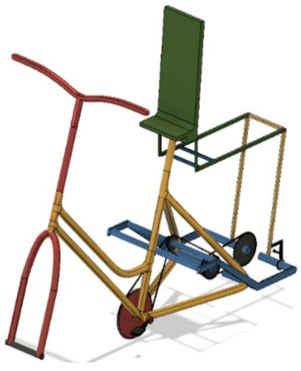

Figure 2. Tricycle bike frame

Figure 3. Seed sowing assembly

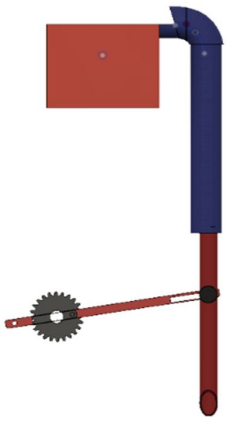

Figure 4. Seed delivery

Figure 5. Actual model of pedal powered seed sowing machine

VIII. PROTOTYPE

With the help of traditional technology of seed picker, it requires to make it adjustable with respect to the size of the seeds just by rotating the knob attached to the shaft as shown in figure.5. For the operation of deliver in a way such that the distance between the successive seeds must be the uniform throughout the sowing process. Hence for this purpose the seed-picker shaft is directly connected to the output shaft of the wheel by chain and sprocket. As the seed-picker rotates the seed enters the delivery pipe from which it directly travels into the soil. For covering the seed a plate has been designed that consists of thin metal sheet using a hook attached to it.

IX. RESULTS

After conducting the test on agricultural field, the following results have been obtained:

A. Actual time taken to cover 0.5 acre of farming field is 1 hours and 22 minutes.
B. Due to irregular ploughing surface the expected depth of seed delivery was found uneven.
C. With increase of time the average angular velocity also reduced and hence the spacing between seeds increases by fraction of few centimetres.
D. Over the course of testing we often found the sometimes more than 2 seeds were coming out of the delivery pipe due to sudden jerk occurring in the tricycle.
E. Overall quantity of seeds required was approximately 5 kg with spacing of 30cm (for Peas).

X. CONCLUSION AND FUTURE SCOPE

The fabrication of a seed sowing mechanism which was installed on a tricycle deals with many upgradations. For that, the modification of a bicycle into a tricycle took place and further designed it according to the dimensional requirements of a small farm. The idea was to make it a pedal-powered device to make it easy to operate and cheap to buy.

From the literature survey the inputs that has been took was what seed size should be selected in order to have delivery of seeds with the least friction in the pipe. Based on the necessity to design and fabricate a device that fulfils the current needs of the customer, the planning took place with the following scope:

A. 2-stage gear box using chains and sprockets.
B. Quick whit worth return mechanism for seed delivery at a specific depth.
C. Detachable attachment of Rotavator for ploughing.
D. Adjustable spoon size by rotation of knob placed on the shaft.
E. Modified seed picker design for making a limiting channel.

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REFERENCES

[1] Thorat Swapnil V, Madhu L. Kasturi, Patil Girish V, Patil Rajkumar N, "Design and Fabrication of Seed Sowing Machine", International Research Journal of Engineering Technology, (e-ISSN: 2395-0056, Volume: 04 Issue: 09), Sep -2017, page number 3.

[2] Petritsenko, A.; Sell, R., "wheel motion resistance and soil thrust traction of mobile robot", 8th, International DAAAM Baltic Conference Industrial Engineering -19-21 ,April 2012, Tallinn, Estonia, page number 3.

[3] Girishkumar G S, Vivek C S, Ravichandra N, Vikas B C, Sahan S Bhusgunde, "Design and Fabrication of Seed Sowing Machine", International Research Journal of Engineering Technology, (e-ISSN: 2395-0056Volume: 05 Issue: 06), June 2018, page number 1.

[4] R. Kathiravan, P. Balashanmugam, "Design and fabrication of manually operated seed sowing machine", International Research Journal of Engineering Technology, (e-ISSN: 2395-0056), Volume: 06 Issue: 06, June 2019 p-ISSN: 2395-0072, page number 5.

[5] John Deere, "John Deere Exact Emerge, Virtual Tour", youtube video on seed sowing mechanism, retrieved from https://www.youtube.com/watch?v=XebeXoHOI_0, published on 12th February,2014.

[6] Thorat Swapnil V, Madhu L. Kasturi, Patil Girish V, Patil Rajkumar N, "Design and Fabrication of Seed Sowing Machine," International Research Journal of Engineering Technology, (e-ISSN: 2395-0056, Volume: 04 Issue: 09), Sep -2017, p-ISSN: 2395-0072, page number 2.

[7] Dean R. Freitag, "Wheels on Soft Soils an Analysis of Existing Data", U. S. Army Engineer Waterways Experiment Station corps of engineers, Technical Report NO. 3-670, page number 5,10,12.

[8] "Sprocket and Chain Guide", Created by REV Robotics 2016, Licensed Under CC BY-SA, page number 3,4,5,6.10.