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Design and Development of Pneumatically Operated Automatic Seed Sowing Machine

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ABSTRACT: In the Indian nurseries, often used conventional seeding operation takes more time and more labour. The seed feed rate is more but the time required for the total operation is more and the total cost is increased due to labour, hiring of equipment. The conventional seed sowing machine are less efficient, time consuming. Today's era is marching towards the rapid growth of all sectors including the agricultural sector. To meet the future demands, we have to implement the new techniques will increase the overall production. As day by day the labour availability becomes the great concern for the farmers and labour cost is more, this machine reduces the efforts and total cost of sowing the seeds and fertilizer placement. Theoretical studies regarding pneumatic equipment for sowing small seeds in cups, highlighting the advantages of this type of equipment with superior parameters obtained from the considered crops. Equipment can be used in narrower spaces, being easily to handle and use, of driving the vacuum generator can be done electrically. By using this equipment, the productivity will increase, the space of establishing the seedlings will reduce, and the seeds norm will diminish. The germinating, rising and development space of plants is assured, equipment can be automated and built by minimum costs.

KEYWORDS: Seed sowing machine, Seed, Nurseries, Pneumatic

I. INTRODUCTION

After the advent of green revolution, more emphasis is laid on the quality of the agricultural product along with the quantity of production to meet the ever-growing food and nutritional requirements. Both these demands can be met when the environment for the plant growth is suitably controlled. The need to protect the crops against un-favourable environmental conditions led to the development of protected agriculture. Greenhouse is the most practical method of achieving the objectives of protected agriculture, where natural environment is modified by using sound engineering principles to achieve optimum plant growth and yield. Our country is self dependent on food grain production but to fulfil the nutritional security, the gap between increasing demand of horticultural produce has to be filled. This gap cannot be filled by the traditional horticulture which required large area under horticulture to increase the production for the ever growing population. Green house technology has potential to produce more produce per unit area with increased input use efficiency.

Though India have 2nd largest man-power in the world, it is very difficult to find the workers for planting seeds in nursery as well as in Farm. Also there is loss of seed while sowing it in seed planting tray; it leads to loss of self property and ultimately loss for nursery as well as for farmers. The existing sowing machine is too costly. It is not abundantly available in India. It has a complex design.

In India traditional farming is prevalent but now new farming technology like poly house farming provides better income in a short period of time with fewer labours. Polyhouse farming is an alternative new technique in agriculture gaining foothold in rural India. It reduces dependency on rainfall & makes the optimum use of land and water, seed resources. Polyhouse farming can help the farmer generate income around the year growing multiple crops with an efficient machine called "SEED SOWING MACHINE"

Main Objective of new technology:

1. Arrangement for depth control.
2. Uniformity in the distribution of seed placement.
3. Proper utilization of SEEDS.
4. Time Reduction in Planting.
5. Per HECTOR Production increase.
6. Placement of seeds at proper depth.
7. Reduction in Man-Power.

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II. CONSTRUCTIONS AND DESIGN OF AUTOMAIC SEED SOWING MACHINE

Construction of Automatic seed sowing machine:
Part List

1. Frame
2. Motor (1.DC Motor 2.Stepper Motor)
3. Vacuum Pump and Nozzle
4. Conveyor Belt
5. Pulley
6. Seed Tray and Seedling Tray

Design of Automatic seed sowing machine:
Material Selection: Material selection is a step in the process of designing any physical object. In the context of product design, the main goal of material selection is to minimize cost while meeting product performance goals. Systematic selection of the best material for a given application begins with properties and costs of candidate materials. Cost of materials plays a very significant role in their material. Cost of materials plays a very important role in their selection. We initially considered various materials for building of the PT such as mild steel, aluminium, stainless steel etc. We took in consideration following properties of the material. The performance of an engineering component is limited by the properties of the material of which it is made, and by the shapes to which this material can be formed. Under some circumstances a material can be selected satisfactorily by specifying ranges for individual properties, and then the best material is selected by maximizing one or more 'performance indices'. Since cost is our most significant priority M.S was selected for the purpose of fabrication of Personal Transport.
Motor Selection: Choosing a motor that is suited to the task at hand is one of the most important part of planning a robotics project. There are categories of electric motors that are used in practical application and are easily available for purchase. They are: Conventional DC motors, Stepper Motors, Servo Motors, BLDC. Each of these classes has several variants and each has their advantage and disadvantage. We have selected motor on the basis of torque requirement and the cost. Hence we selected conventional DC motor for the movement of conveyor belt. A stepper motor is an electromechanical device which converts electrical pulses into discrete mechanical movements. The shaft or spindle of a stepper motor rotates in discrete step increments when electrical command pulses are applied to it in the proper sequence. Since stepper motor is very reliable, it has precise positioning and repeatability of movement so we have selected stepper motor for the vacuum pump motion.

Specification: 1. DC motor specification: 1) 12 V DC supply 2) 6000 rpm, 150 rpm at output 3) 20 kg-m torque
2. Stepper motor specification: 1) 12 V 2) 1.2 Amp 3) 10 kg-m

Design Calculation of Vacuum Pump: Vacuum pump works on the Bernoulli's principle. Due to formation of vacuum in pump seed gets sucked through nozzle. Entry of seed in nozzle is avoided by proper selection of nozzle. As nozzle is selected in such a way that nozzle diameter is less than seed diameter.
Diameter of seed = 7.7 mm …….. (Measured using vernier caliper)
Area of nozzle is calculated as follows A = $4\ \pi \times d^2 = 4\ \pi \times 0.0077^2 = 0.0465$ mm
Mass of seed is measured by using electronic weighing machine which is given as follows Mass of seed = 0.2 gm
Weight of seed = $0.2 \times 9.81 = 1.96 \times 10^{-3}\ N$
Force required (F) = weight = 1.96 ×10-3 N
Pressure required = 0.4215 MPA
As the diameter of seed changes pressure (Vacuum) required also changes. Thus we have selected Vacuum Pump having operating pressure of 0.1-0.6 MPA.

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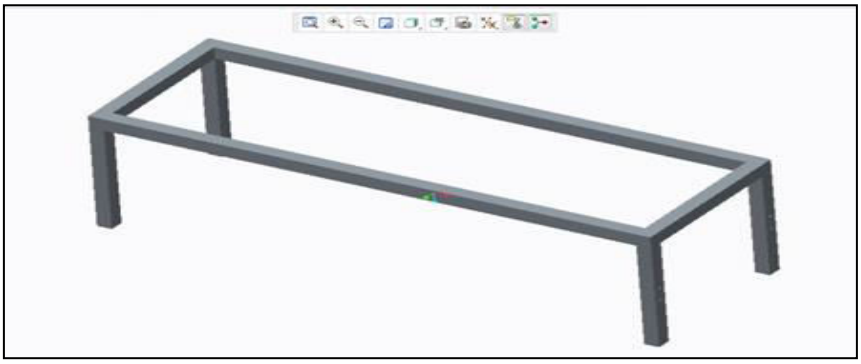
CAD model of important part of Automatic seed sowing machine:

1.Frame



(i)Frame

The frame is made by welding mild steel rectangular pipes. Electric arc welding technique is used for all the manufacturing of frame.

Specification: 1) Material : Mild steel
2) Dimension of pipe : 25.4mm x 25.4mm(Square cross-section pipe)
3) Thickness of pipe : 1 mm
4) Centre to Centre Distance : 1000 mm
5) Manufacturing process : Welding (Electric arc welding)

2. Conveyor Belt

(ii)Conveyor Belt

A conveyor belt is the carrying medium of a belt conveyor system (often shortened to belt conveyor).

Specification: 1) Description : 2100 mm
2) No. of plies : 2
3) Material : Synthetic Rubber
4) Quantity : 1

3.Pulley

(iii)Pulley

A pulley is a wheel on an axle or shaft that is designed to support movement and change of direction of a taut cable or belt along its circumference.

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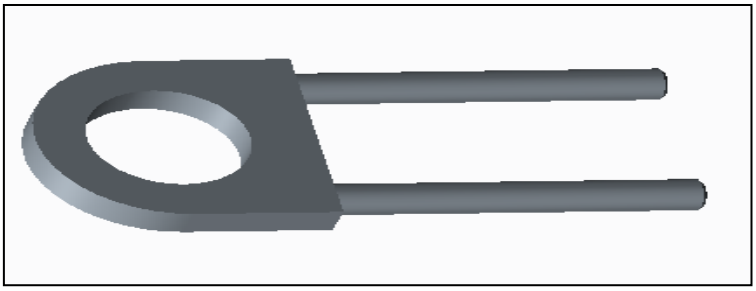
It consist of A Shaft, Two Circular Disc and a Circular Roller of Sheet.

Shaft :	i. Material	:	Mild Steel
	ii. Size(Diameter)	:	10 mm
	iii. Length	:	350 mm
Circular Disc :	i. Material	:	Mild Steel
	ii. Size (Diameter)	:	47 mm
	iii. Thickness	:	1 mm

4. Bearing Housing

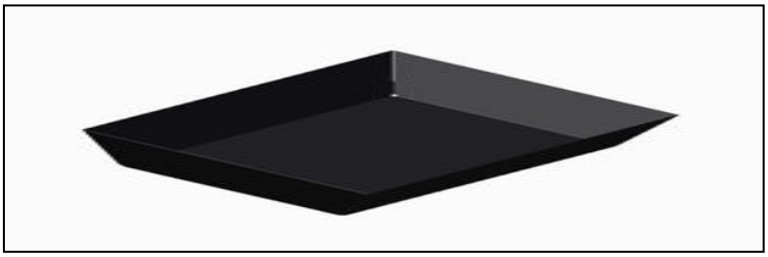


(iv) Bearing Housing

Bearing housing consists of two parts such as body and threaded screw. Body and threaded screw are joined by welding process. In this way bearing housing is manufactured and then bearing is mounted in it.

Bearing Housing :	1. Material	:	Mild Steel
	2. Quantity	:	6

5.Seed Tray



(v) Seed Tray

Seed tray is specific container which is used for holding the seeds before it gets placed in proper planting tray. Seed tray can be of any shape such as circular ,rectangular ,etc , but for it's convenience in handling in seed sowing machine ,seed tray of following shape is selected , designed and manufactured.

Specification :	1.Description	:	0.5 mm thick
	2.Material	:	Mild Steel, Acrylics
	3.Manufacturing Process	:	Laser cutting & bending

III. ELECTRONIC CIRCUIT

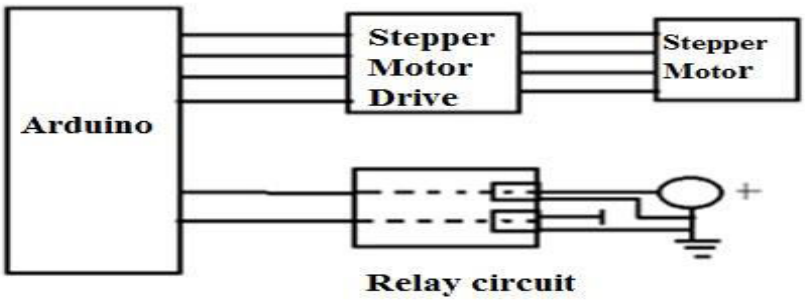


Fig 2: Electronic Circuit

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Working of Electronic Circuit:
Electronic circuit is operated with the help of Arduino Software. Electronic system consists of three electronic boards which consist of Arduino UNO board, Stepper Motor Driver and Relay Circuit. Arduino UNO board provides the signal to the Stepper Motor Driver and Relay Circuit in the form of 1 or 0. When 1 signal is provided by the Arduino UNO board to the stepper motor it starts running clockwise direction. Solenoid valve is also operated by the relay circuit which gives ON or OFF signal to the solenoid valve. At the start of the operation solenoid valve is ON, which provides vacuum at the tip of the nozzle. After that stepper motor starts rotating in clockwise for certain degree. Then solenoid valve goes to OFF and seed falls into the seedling tray. Again stepper motor rotate anti-clockwise direction and return to same position from where it starts to rotate. This whole operation is performed by Arduino UNO board, Stepper Motor Driver and Relay Circuit.

IV. PNEUMATIC CIRCUIT

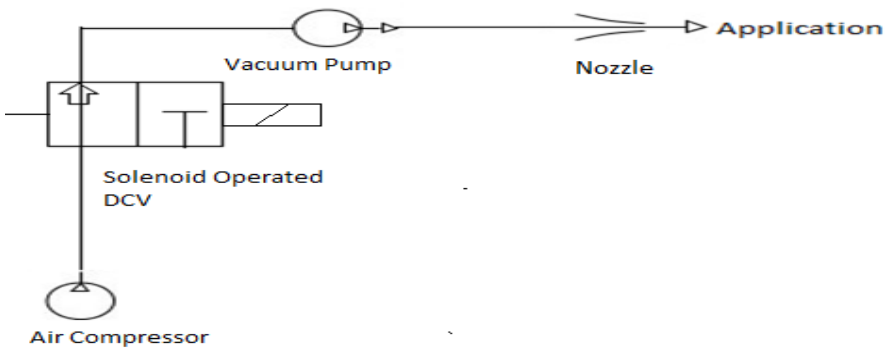

Fig 3: Pneumatic circuit for automatic seed sowing machine.

Working of Pneumatic Circuit:
Compressed air from Air Compressor is supplied to the vacuum pump through solenoid valve. Solenoid valve is operated (ON-OFF) by Arduino Software. Nozzle is connected to the vacuum pump. Compressed air is supplied to the vacuum pump and vacuum is generated at the tip of nozzle. Due to vacuum generation, Seed get sucked at the tip of the nozzle as nozzle inlet diameter is smaller than diameter of the seed. As the solenoid valve is ON vacuum generation keeps on. After the rotation of stepper motor vacuum pump also gets rotate and after certain rotation of vacuum pump with the help of electronic circuit solenoid valve gets OFF. So the seed will fall into the cup of seedling tray. This cycle will continue further.

V. MANUFACTURING AND ASSEMBLY

The design of structure and hardware was an organic process throughout the planning and fabrication stages. The initial designs were primarily based on the basic specifications that had been decided on early in the year. The hardware and structural designs evolved to better satisfy these specifications.
The main steps during manufacturing were:

1. Frame Manufacturing
2. Pulley Manufacturing
3. Pulley Mounting
4. Motor Mounting
5. Vacuum Pump attachment
6. Conveyor Belt Mounting
7. Electronic Circuit Mounting

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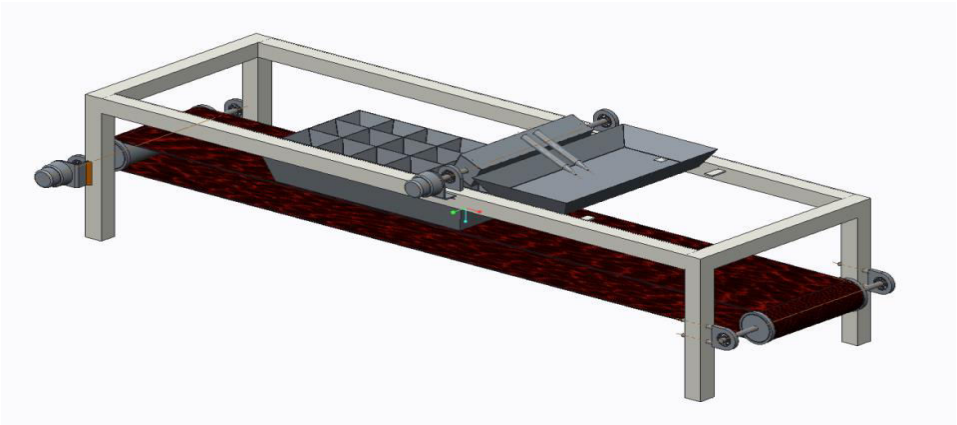

Fig 4: Assembly

During all fabrication processes arc welding technique was used. Initially square channel was cut into pieces of exact size and then all pieces were welded to manufacture frame. Pulley consists of a circular sheet of MS, circular disc at the end and shaft placed at the center. Then conveyor belt mounted on pulley and it is placed in the bearing. Bearing is supported with the help of bearing housing which is welded to the frame. DC motor is attached to the pulley shaft with the help of bolts. Stepper motor is connected to the shaft with the help of bolts and a hosing is provided to the mounting of motor. Two bolts are welded to the stepper motor shaft and vacuum pump is attached to the bolts with the help of nut. With the help of Arduino UNO board, stepper motor driver and relay circuit electronic circuit was prepared. Whole electronic circuit is mounted on Acrylic Sheet and it is bolted to the main frame. Arduino UNO board, stepper motor driver and relay circuit are mounted on Acrylic sheet with the help of Double tape. The air control valve is mounted in frame side with the help of two bolts. Pneumatic pipes are connected to the valve and vacuum pump by air fittings. The pneumatic pipe coming out of air control valve is connected to the solenoid valve. Solenoid valve is mounted on frame by providing it a support on frame. Support clip is welded to the frame and solenoid valve is bolted to the support clip. To define a starting point of vacuum pump a square rod is welded to the bearing housing. So seeds will be properly picked from the seed tray. This square rod helps the electronic circuit which provides precise motion to the vacuum pump.

Fig 5: Actual Vacuum pump with pneumatic pipe and conveyor belt

Actual assembly of automatic seed sowing machine in figure showing the vacuum pump with nozzle and conveyor belt with tray mounted on it. Also pneumatic hoses are connected to vacuum pump. Vacuum pump is operated by stepper motor.

VI. CONCLUSION

As the existing problem regarding the availability of machine at low cost, workers availability and wastage of seeds in agriculture sector are eliminated with the help of Automatic seed sowing machine. Seed picking and placing of seed at

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the proper seedling tray is achieved with this machine. Also area consumed by Automatic seed sowing machine is very less that allows the machine to work easily. Precise placing of seed also helps in proper growth of plant. Variety of seeds can be easily placed by adjusting the nozzle inlet diameter.

VII. FUTURE SCOPE

More number of nozzles can be used in a large Machine for increasing productivity. It will increase productivity and less time will required for plantation. Telescopic cylinder can be use in large machine for coverage of more number of seedling trays at a time. Telescopic cylinder will provide the ability to vary the number of plantation.PLC can be used for the Automatic seed sowing machine for large scale plantation, where number of seeds can be planted in a single rotation. PLC will provide the most accurate positioning of nozzle for proper plantation of tress. Wheels can be provided to the machine which will be helpful for the easy transportation of machine. Sometime it is important to move the machine due portability issues, in that case portable machine will be useful.

REFERENCES

1. Olimpia Pandiaa, Ion Saracinb, Ion Bozgaa, Eliza Tanasiec “Studies regarding pneumatic equipment for sowing small seeds in cups” (February 2015).
2. A.Kannan, K. Esakkiraja, S. Thimmarayan “Design Modifications In Multipurpose Sowing Machine”
3. (Jan. 2014)
4. Gholap Dipak Dattatraya, More Vaibhav Mhatardev, Lokhande Manoj kumar Shrihari, Prof.Joshi S.G “Robotic Agriculture Machine”.(April 2014)
5. Kyada, A. R ,Patel, D. B. **“**Design And Development Of Manually Operated Seed Planter Machine**”**5th International & 26th All India Manufacturing Technology, Design and Research Conference (AIMTDR 2014) December 12th–14th, 2014, IIT Guwahati, Assam, India.
6. Aditya Kawadaskar, Dr. S. S. CHAUDHARI, “Methods Of Seed Sowing And Concept Of Multi-Purpose Seed Sowing Machine, 2013”International Journal Of Pure And applied Research In Engineering And Technology.
7. Roshan V Marode, Gajanan P Tayade and Swapnil K Agrawal, “Design And Implementation Of Multi Seed Sowing Machine”, International Journal of Mechanical Engineering and Robotics Research.,2013
8. Robert G. Holmes “Seed Planter & Method of Picking up And Discharging Single Seed”, United States Patent-4,515,291(1985)
9. Ralph L. Tweeiiale, “Vacuum-Type Seed Planter, 1964”,United States Patent-3156201.