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DESIGN AND DEVELOPMENT OF AGRICULTURE MULTIPURPOSE MACHINE

ANKIT N. KALAMKAR
Student, Department of Mechanical Engineering, Dr. D.Y. Patil College of Engineering and Innovation, Varale, Pune, M.S., India

SUHAS D. DEVKAR
Student, Department of Mechanical Engineering, Dr. D.Y. Patil College of Engineering and Innovation, Varale, Pune, M.S., India

SAURABH V. SALUNKE
Student, Department of Mechanical Engineering, Dr. D.Y. Patil College of Engineering and Innovation, Varale, Pune, M.S., India

BABASAHEB A.DESHMUKH
Student, Department of Mechanical Engineering, Dr. D.Y. Patil College of Engineering and Innovation, Varale, Pune, M.S., India

PROF. SATYAJIT S. DHORE
Department of Mechanical Engineering, Dr. D.Y. Patil College of Engineering and Innovation, Varale, Pune, M.S., India

ABSTRACT:

Technological developments leads to solution of many problems associated with farming. The machines are designed by researchers to complete the task associated with farming effectively. Many industries in India have come up with the products related to farming operations. The labor cost is one of the major expenses to the farmers as many tasks are performed manually in conventional operations. We have developed the machine for carrying out multiple farming operations such as seed sowing and spraying of pesticide. A CAD design of agricultural machine for performing various tasks is presented in this paper. The design calculations for standard designing is carried out and included in the paper. The design is unique and the machine is suitable for the small farmers in India.

KEYWORDS: Agriculture, Agriculture Machines, Multipurpose Agriculture Machine, Sowing Machine, Spraying machine, etc.

INTRODUCTION:

India is a country of farmers. Farmers are contributing the most to Indian society through cultivation of various crops. Most of the Indians are dependent on Indian farmers for vegetables, fruits, rice, wheat, maize and many more. The main food for the Indians is coming from farms. The contributions of farmers to Indian economy is of the order of 20% and near about 70 Crores Indians are dependent on farming and other allied businesses in India. This is a huge population who is earning money for their day to day activities with farming activities.

The basic operations carried out manually in farms. Most of the labors working in farms do not undergo any training and hence they do not have all skills required. Whatever skills are developed in labours are due to their work on field. The work like sowing of seed needs to consider the size of seed and according to its size and type the distance between two seeds must be maintained in order to get good results of cultivation. There are always the chances of human error when this task is carried out manually and hence there will be chance of loss. The basic methods of sowing the seed are shown in pictures below.

Fig.1: Line Sowing Technique

Fig.2: Broad casting

In line sowing the conventional equipment is used with manual interface to insert the seeds through the machines. This again needs coordination of man on multiples tasks such as maintaining the supply of seeds. Controlling self-balance and controlling the bulls. Another method is conventional and manual method called broad casting where seeds are spread over the farm.

OBJECTIVES OF WORK:

The work is carried out with following objectives:

- Designing unique machine to complete multiple tasks in farming.
- Developing CAD model for agriculture machines.
- Developing the hardware for machine with design considerations.
- Improving the cultivation with by reducing wastage of seeds due to improper distance in sowing.
- Improving area covered by spray in minimum time.

SYSTEM DESIGN:

Frame:

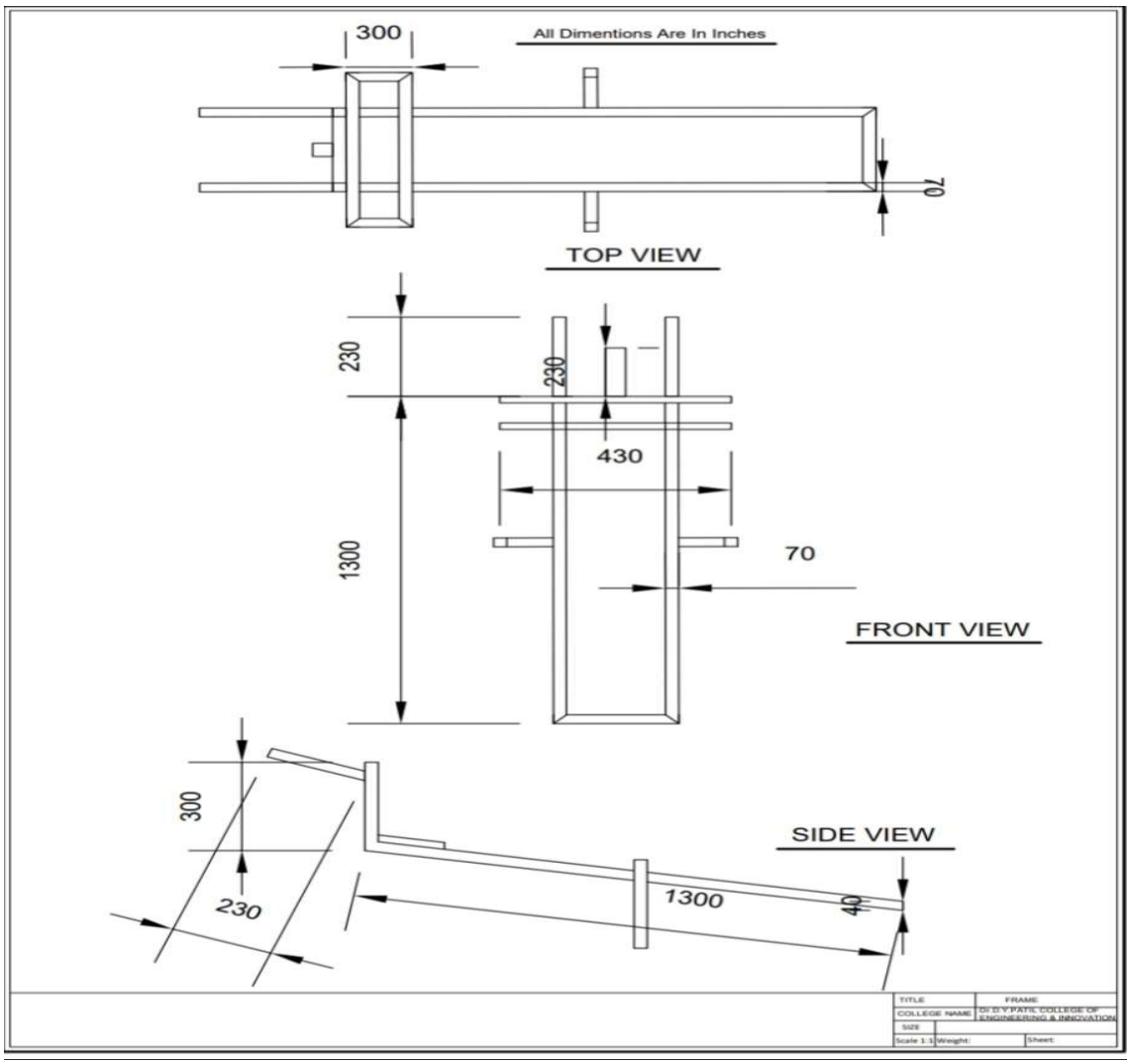

Fig.3: Design of Frame in CAD

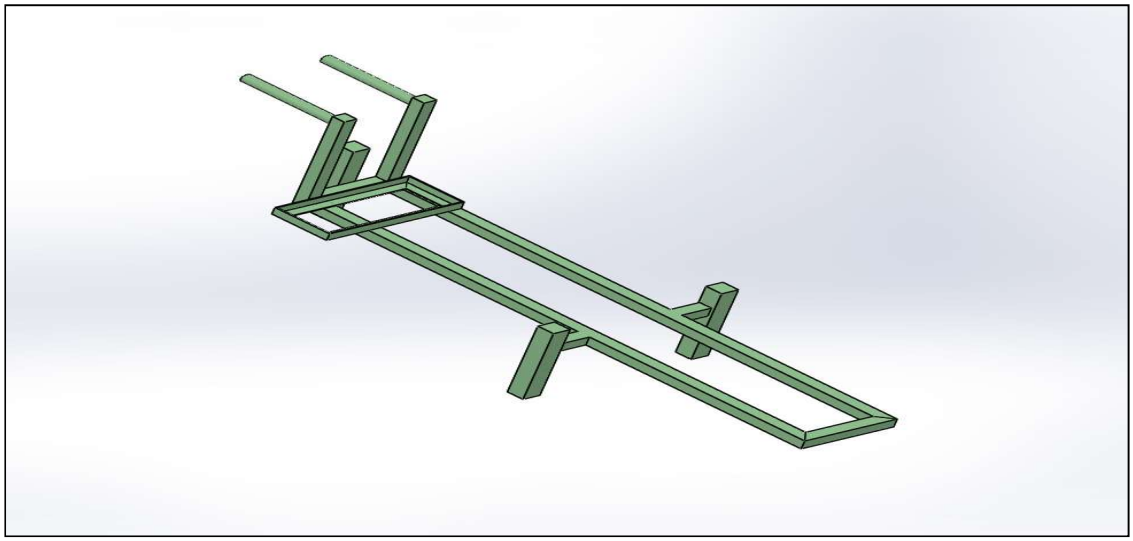

Fig.4: 3D View for Design of Frame in CAD

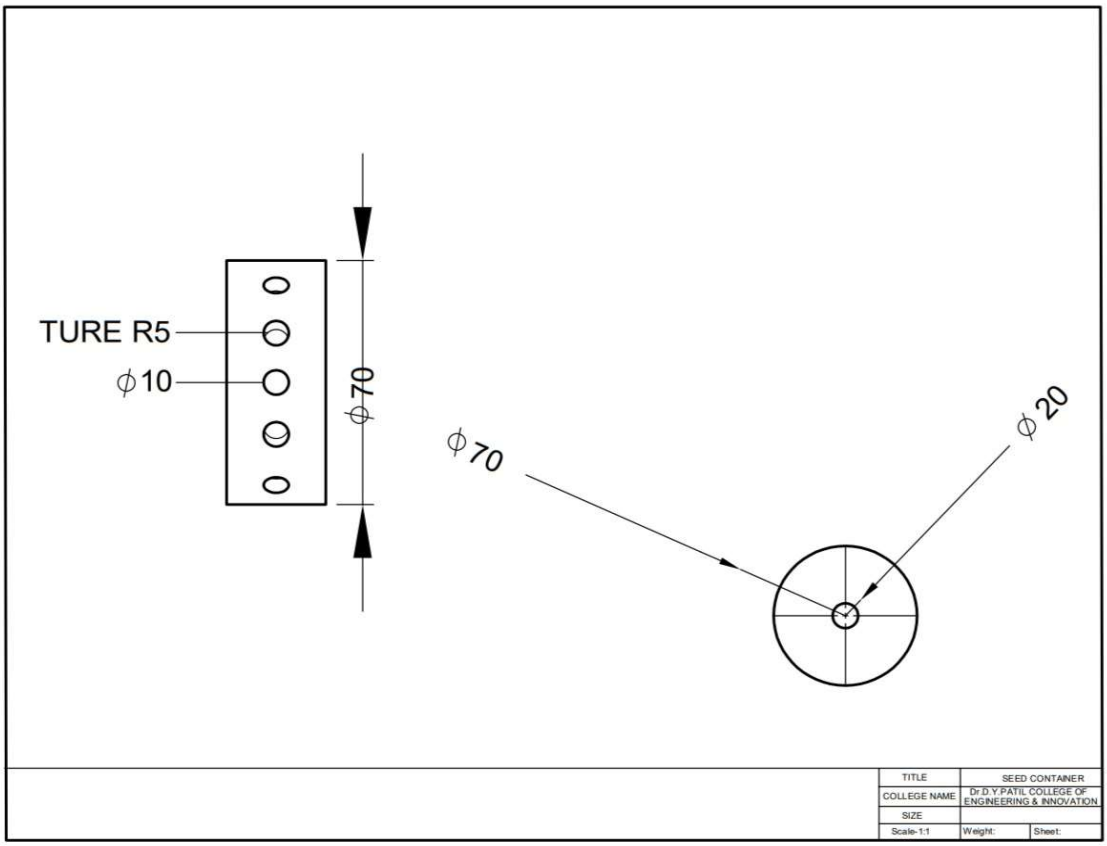

Fig.5: Design of Seed Holder in CAD

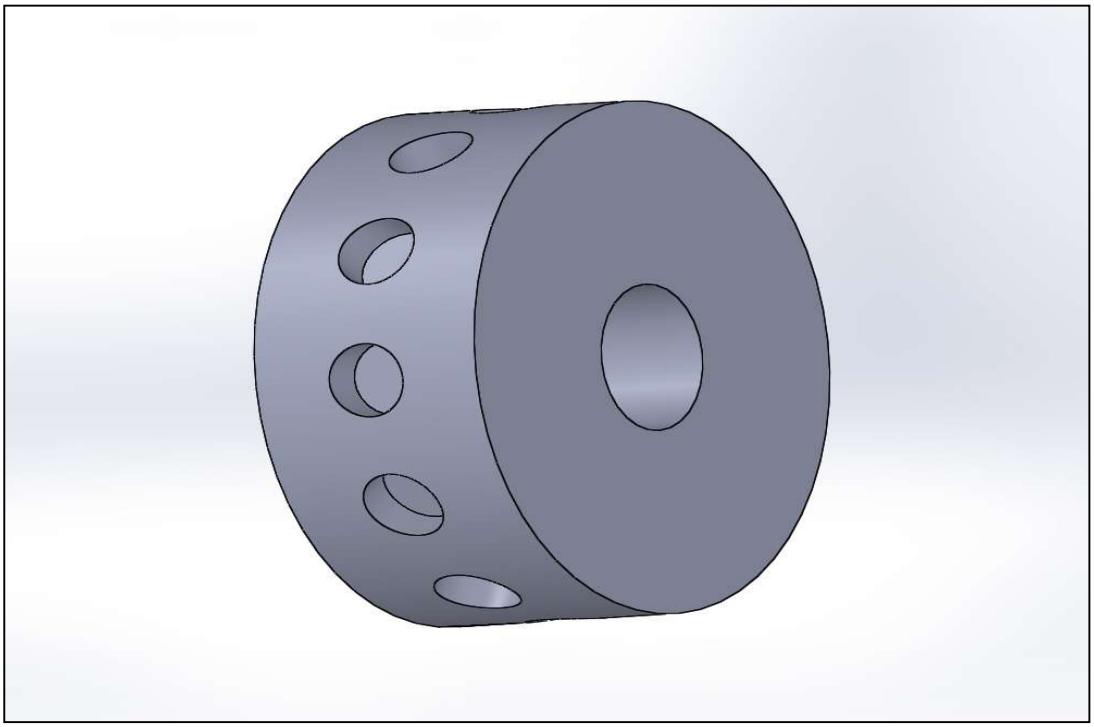

Fig.6: 3D Model for Design of Seed Holder in CAD

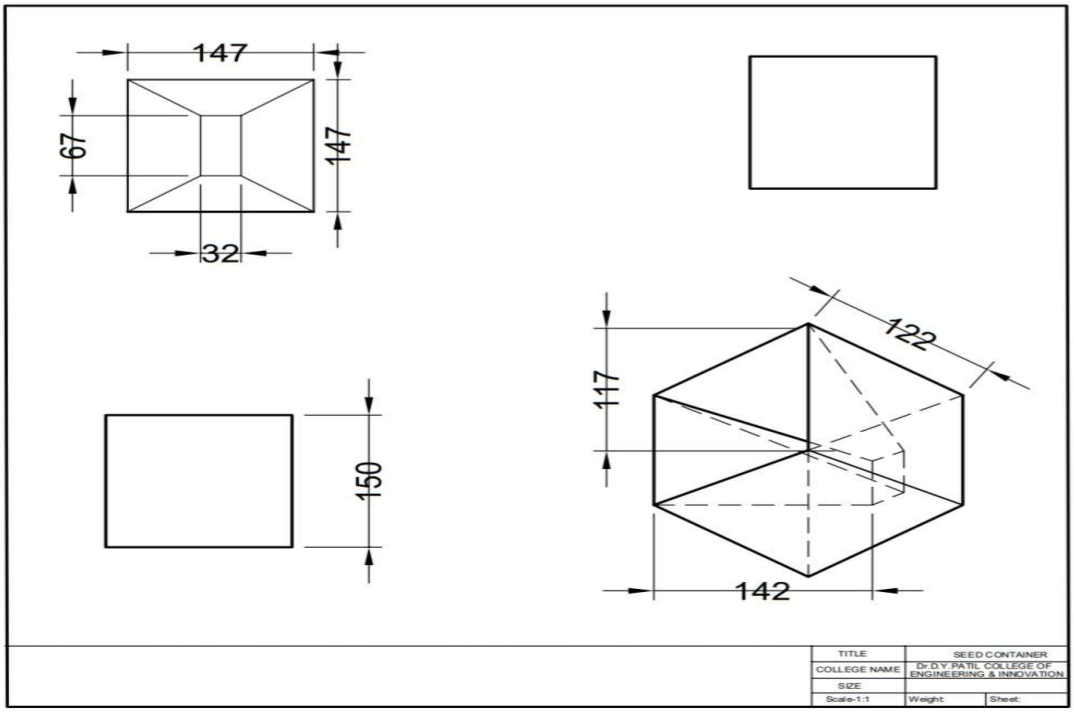

Fig.7: Design of Seed Container in CAD

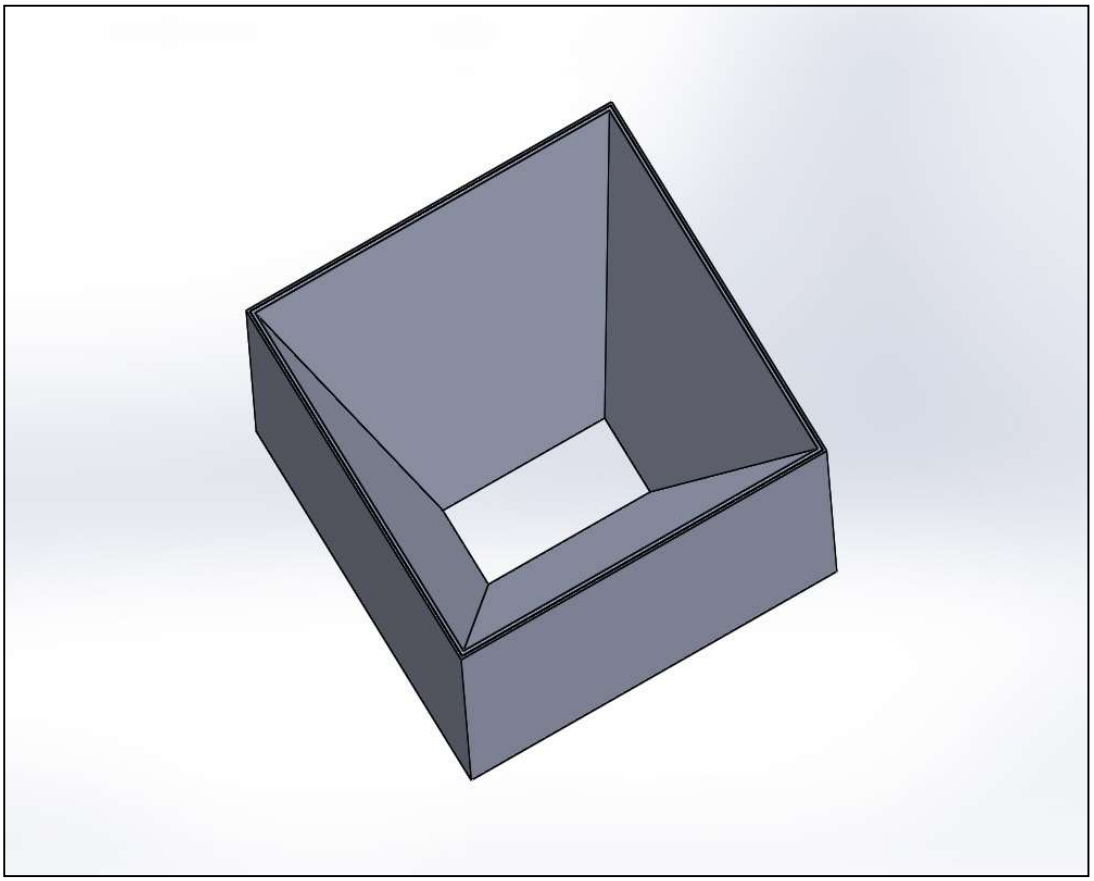

Fig.8: 3D View of Design of Seed Container in CAD

Discharge Calculation:

Discharge=Area of piston× stroke length× r.p.s

$Q= \pi/4\ d^2 \times L \times r.p.s$

$=\pi/4\ (0.9)^2 \times 0.42 \times 0.44$

$= 0.11756\ mm^3/s$

Discharge (Q)= $0.000117\ m^3/s$

Frame Material:

Material = C 45 (mild steel)

Take F.O.S= 2

$\sigma_t = \sigma_b = 540/fos$

$= 270\ N/mm^2$

$\sigma_s = 0.5\ \sigma_t$

$= 0.5 \times 270$

$= 135\ N/mm^2$

Design of Seed Sowing Machine:

Let the walking speed of person sowing the seed be 3 km/hr = 0.833 m/s

Diameter of wheel is 600mm

$V= \pi DN/60$

$V = 3.142 \times 0.6 \times N / 60$

$V = 0.833$ m/s

1 m/s = 3.6 km/hr

So, V = 3 km/hr

N2= 26.51 rpm

Torque Required for Seed Sowing Machine:

$T = F \times R$

Let, the force applid by person to push the machine be 10 kg = 98 N

$T = 98 \times 160 = 15680$ N-mm

So wheel shaft will fail under combine twisting and bending

Load Required For Seed Sowing Machine:

Load of mechanism and machine be 30 kg = 300 N

The total weight on shaft coming is 300 N

W= 300 N

M= WxL/4

M= 300x110/4=8250 N-mm

$T_e= \sqrt{M^2+T^2}$

$= \sqrt{8250^2+15680^{\ 2}}$

T_e=17717 N-mm

$T_e=\pi/16\ x135xd^3$

$d^3=17717\ x\ 16/\pi x135=668$

$d=3\sqrt{668}=8.74=9mm$

d=10 mm

But the shaft is 15 mm so design is safe

Chain Drive Calculations:

Material used for chain drive is high chrome steel

Now chain drive of 44 and 18 teeth is used here

$\frac{T1}{T2} = \frac{N2}{N1}$

So ratio is 2.44

Seed Sowing Calculations:

Diameter of seed holding disc is 70 mm and 12 no of holes are there of 10mm diameter

$\frac{44}{18} = \frac{26.51}{N1}$

So rpm of seed disc will be = 10.86 rpm

C = π x d C = 219.9 mm

Total 12 slots are there

So seed sowing distance will be 18.32 mm

SOFTWARE MODELLING:

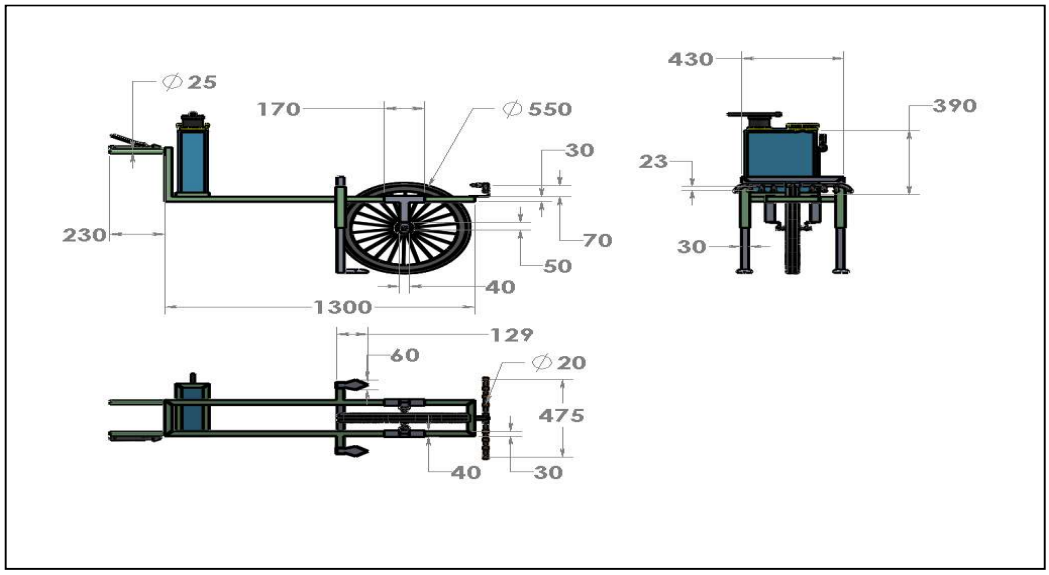

Fig.9: Various views of Working Model

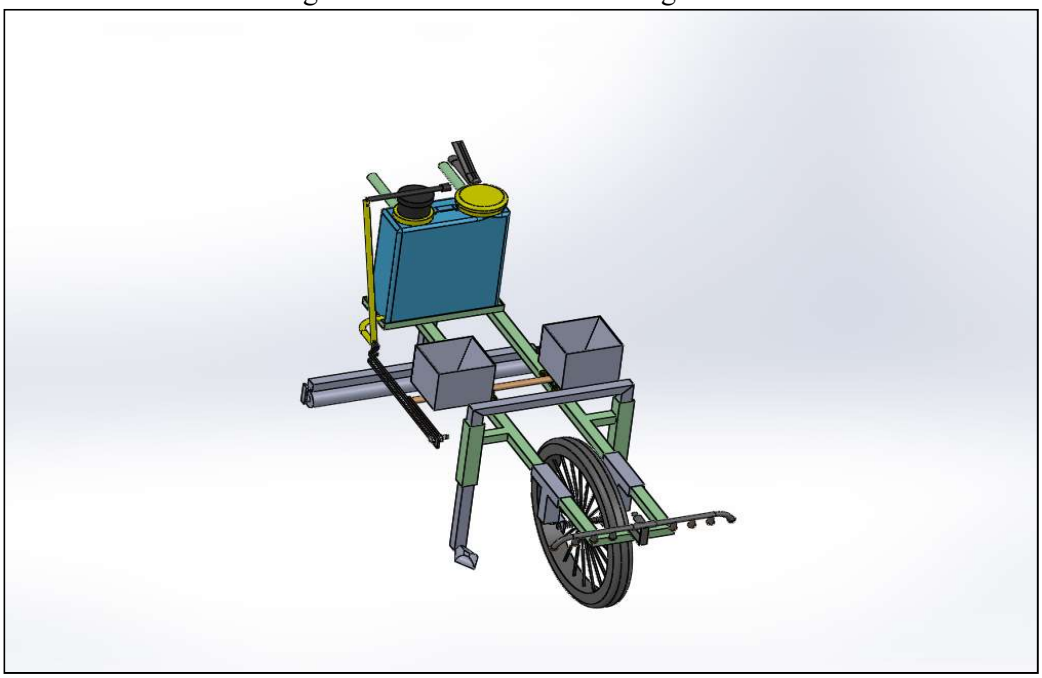

Fig.10: Working Model of Machine in 3D View

FUTURE SCOPE:

The unique agriculture multipurpose machine is developed by the authors. The design calculations are done on the basis of requirements of task to be completed. Further in future there are possibilities of automation for this machine. Development of assembly with Arduino and motors is possible with battery power supplied to automate the working of this machine completely. Need of mechanism to reduce the cost of machine with modifications in design are possible along with use of other low cost material substitutes to develop this machine.

CONCLUSION:

Unique machine designed to carry out the task of spraying the fertilizers and sowing of seeds is developed by authors. The complete calculations along with the software model are presented in this paper. The study of performance parameters of the machine is scope of future work to be completed by the authors. It overcomes the problem associated with conventional spray such as back pain due to weight carried on back on person. The care is taken during the design to provide proper distance between two seeds in sowing operation. This machine is suitable for the farmers working on small scale. This is a handy machine which will be helpful to improve the performance during farming operations. It also covers the seed with soil in order to avoid loss of seeds eaten by birds.

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