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Multipurpose Manually Operated Automatic Spraying and Fertilizer Throwing Machine

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Abstract- India is a land of agriculture which comprises of small, marginal, medium and rich farmers. Small scale farmers are very interested in manually lever operated knapsack sprayer because of its versatility, cost and design. But this sprayer has certain limitations like it cannot maintain required pressure; it lead to problem of back pain. However this equipment can also lead to misapplication of chemicals and ineffective control of target pest which leads to loss of pesticides due to dribbling or drift during application. This phenomenon not only adds to cost of production but also cause environmental pollution and imbalance in natural echo system. This paper suggests a model of manually operated multi nozzle pesticides sprayer pump which will perform spraying at maximum rate in minimum time.

in normal spray pump work on electrical battery operated or using manpower to operate lever for spraying pesticides. In push operated spray pump a one trolley is there in which specially mechanism for translating rotary motion into reciprocating motion this reciprocating motion used to operate the pump lever. This lever operates pump increase the pressure of pesticides and pesticides will be sprayed. It is a device which is used to sprinkle pesticides without more efforts.

Keywords- weeder, spraying, fertilizer, row spacing

I. INTRODUCTION

Agriculture plays a vital role in Indian economy. Around 65% of population in the state is depending on agriculture. Although its contribution to GDP is now around one sixth, it provides 56% of Indian work force . The share of marginal and small farmer is around 81% and land operated is 44 % in 1960-61.

As far as Indian scenario is concerned, more than 75 per cent farmers are belonging to small and marginal land carrying and cotton is alone which provide about 80 % employment to Indian workforce. So any improvement in the productivity related task help to increase Indian farmer's status and economy.

The current backpack sprayer has lot of limitation and it required more energy to operate. The percentage distribution of farm holding land for marginal farmers is 39.1 percentage, for small farmers 22.6 percentage, for small and marginal farmers 61.7 percentage, for semi-medium farmers 19.8 percentage, for medium farmers 14 percentage and for large farmers 4.5 percentage in year 1960-61.Clearly explain that the maximum percentage of farm distribution belonged to small and marginal category.

II. LITRATURE SURVEY

A. Seed-Throwing of Fertilizer Machine: A Review by Mahesh. R. Pundkar and A. K. Mahalle

Mahesh R. Pundkar and A. K. Mahalle are presented review provides brief information about the various types of innovations done in weeder machine available for plantation. The weeder machine is a key component of agriculture field. The performance of weeder device has a remarkable influence on the cost and yield of agriculture products. Presently there are many approaches to detect the performance of seed-throwing of fertilizer device. Depth of seeding has shown to be an important factor affecting seeding vigour and crop yield. Seed metering device is a heart of weeder machine which is evaluated for seed distance, seed size between seed varieties.

B. Design, Development and Fabrication of Agricultural Pesticides Sprayer with Weeder by Laukik P. Raut, Smit B. Jaiswal and Nitin Y. Mohite

Laukik P. Raut and et. al., studied to meet the food requirements of the growing population and rapid industrialization, modernization of agriculture is inescapable. Mechanization enables the conservation of inputs through precision in metering ensuring better distribution, reducing quantity needed for better response and prevention of losses or wastage of inputs applied.

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Mechanization reduces unit cost of production through higher productivity and input conservation. Farmers are using the same methods and equipment for the ages. In our country farming is done by traditional way, besides that there is large development of industrial and service sector as compared to that of agriculture.

C. Agriculture Weeder Equipments: A Review by D. Ramesh and H. P. Girishkumar

D. Ramesh and H. P. Girishkumar presented review provides brief information about the various types of innovations done in weeder equipments. The basic objective of throwing of fertilizer operation is to puwt the seed and fertilizer in rows at desired depth and seed to seed spacing, cover the throwing of fertilizer with soil and provide proper compaction over the seed. The recommended row to row spacing, seed rate, seed to seed spacing and depth of seed placement vary from crop to crop and for different agro-climatic conditions to achieve optimum yields. Weeder devices plays a wide role in agriculture field.

D. Development of Single Wheel Multi Use Manually Operated Weed Remover by Sridhar H .S

Sridhar H, studied the every year in INDIA, an average of 1980 Cr of rupees is wasted due to weeds. The mechanical weeder was made of two implements attachment i.e. the primary cutting edge which is in front to loose soil above and the secondary cutting edge which is behind to do cutting and lifting of weeds. The blade is thin but very sturdy and tough besides, it is very safe to use and offers zero threat of hurting to the user, Other than the wheel, there is nothing mechanical in this single wheel weeder but, it works wonderfully under the condition where it is put into. This hassle free equipment requires no special maintenance. It is necessary to design the weeder which minimize the human effort and provide efficient work output.

E. Development of Agriculture Seeding Equipment by D. Ramesh and H .P. Girishkumar

D. Ramesh and H .P. Girishkumar discussed the information about the various types of innovations done in weeder machine available for plantation. The weeder machine is a key component of agriculture field. The performance of weeder device has a remarkable influence on the cost and yield of agriculture products. Presently there are many approaches to detect the performance of seed-throwing of fertilizer device. Depth of seeding has shown to be an important factor affecting seeding vigor and crop yield.

III. PROBLEM DEFINITION

A. Problem summary

The farmers who use these types conventional backpack sprayer faces many types of problems like fatigue, tiredness, pain in spiral cord and muscles etc. Following problems can take place by use of this conventional type of pump.

B. Common Problems

1) Heavy in weight causes difficulty in lifting manually.
2) Fatigue to the operator due to heavy weight.
3) Due to heavy weight during spraying, operator feel very tiredness and fatigue which reduces his efficiency.
4) Big size of pump cause inconvenience to the operator.
5) Poor selection and quality of equipment.
6) These problems combined with a lack of awareness and technical knowledge and inadequate maintenance and poor field use of equipment has led to unacceptable risks to environment and human health.

IV. METODOLOGY

A. Working of Model

When the equipment is push forward by using handles, front wheel rotates and the gear is mounted at the axle of wheel is start to rotate and its rotation is then transferred to the pinion through the chain drive. The rotary motion of the pinion is converted into the reciprocating motion by the single slider crank mechanism, due to this arrangement the connecting rod moves upward and downward which then reciprocate the piston of single acting reciprocating pump mounted at the top of storage tank. During the upward motion of the connecting rod the pesticide is drawn into the pump and during the downward motion of connecting rod the pesticide is forced to the delivery valve, the delivery is connected to the pipe carrying the number of nozzles. The fertilizer is stored in bucket and controlled the fertilizer by using clutch mechanism in multiple lines of crops.

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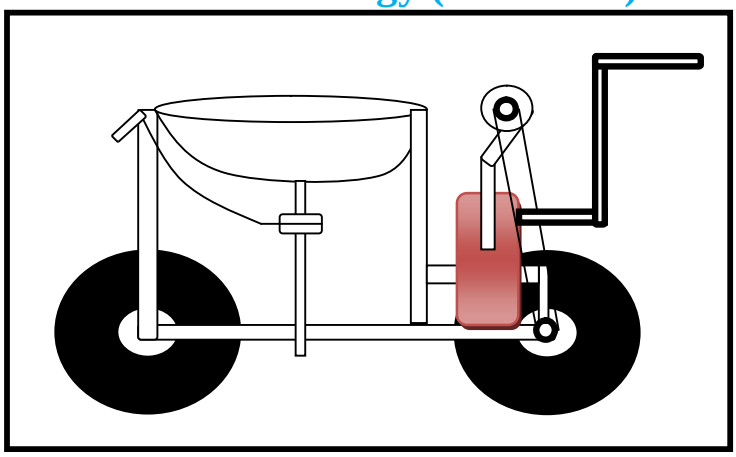


Figure 1- Block diagram of working model

V. DESIGN METODOLOGY

A. Concept of Working Mode

1) Concept Generation: Five concepts were generated considering various factors which meets the PDS like functionality, safety and cost. Final concept selected and build the working prototype model.

a) Concept 1: Features of this concept like hand operated hydraulic pump and lever is connected to crack by link. Use the existing tank (10-16 litters) focusing on new mechanism as shown in Fig.2.

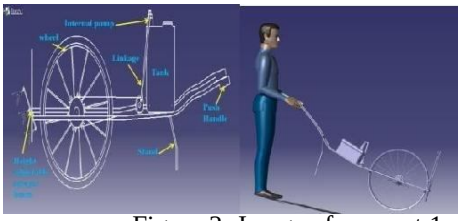


Figure 2- Image of concept 1

b) Concept 2: In this concept to solve the existing problem like back ache and shoulder pain. We design the height adjustable stand with two support wheel to easily pull forward as shown in Fig .4.

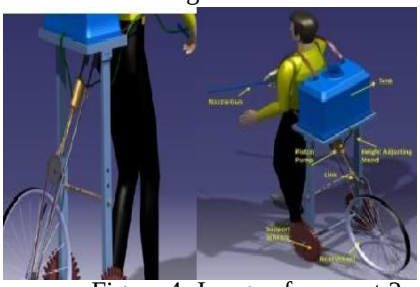


Figure 4- Image of concept 2

c) Concept 3: Concept 3 has pushing type frame design. Sprayer pump tank capacity is increase to 30 litres cover the more area of land and save the time as shown in Fig. 4.

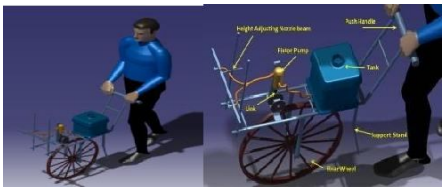


Figure 4- Image of concept 3

d) Concept 4: Concept 4 has like concept 3 but change frame design to increase aesthetic look of the product and adjustable height support stand as shown in Fig.5.

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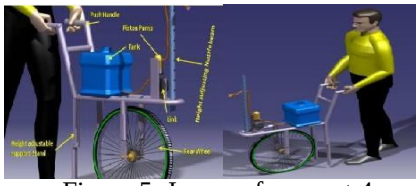


Figure 5- Image of concept 4

e) Concept 5: Concept 5 has look like concept 4 but for easy movement and support two small wheels included. Easy to spray for any height crops because Adjustable height support stand will included as shown in Fig. 6. The product can spray pesticide over multiple rows of plants in one pass there by reducing manual effort.



Figure 6- Image of concept 5

2) Concept Selection: Weighted ranking method was used (Table 1) to select the final concept for further development of the product.

Table 1-Concept selection chart

Design Factor	Concept 1	Concept 2	Concept 3	Concept 4	Concept 5
Safety	2	3	3	3	4
Functionality	3	4	3.5	4	4
Weight	4	2.5	3	3.5	3.5
Mechanism	2	3	3	3	4
Cost	2.5	2.5	2	3.5	4
Total	13.5	15	14.5	14	15.5
Ranking	5	2	3	4	1

Concept 5 has selected for further development of the product and this will meet the PDS.

3) Final Concept Detailing : To overcome from all issues faced during spraying methods, we have designed a model running without any fuel and also easy to operate for a user. In this model I find that we have simply used a cam mounted on rear shaft which will actuate piston inside cylinder (Fig. 7).

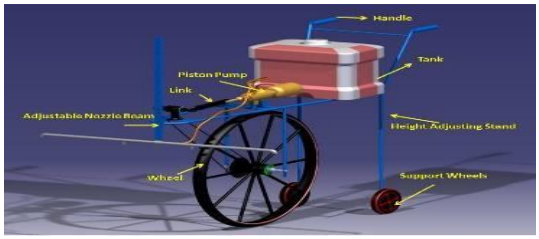


Figure 7- Image of final concept

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B. Structural Analysis of Frame in ANSYS Workbench16.2

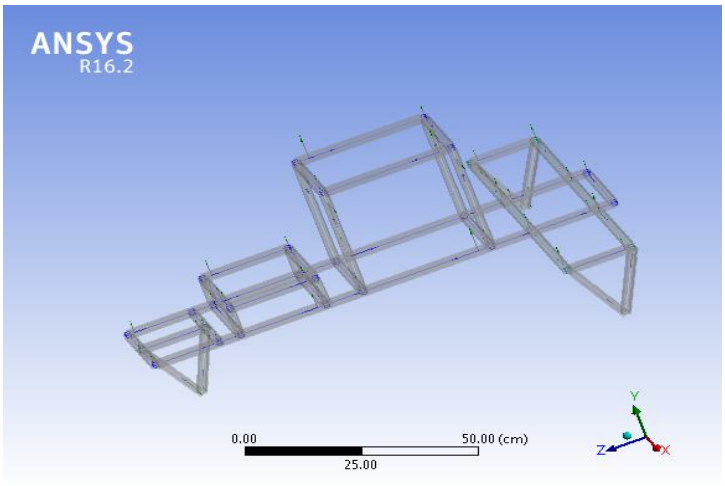


Figure 8-Image of geometry

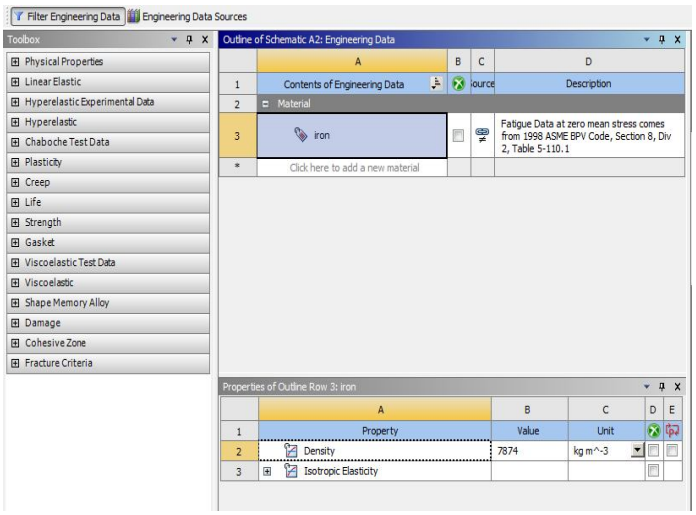


Figure 9-Image of engineering data

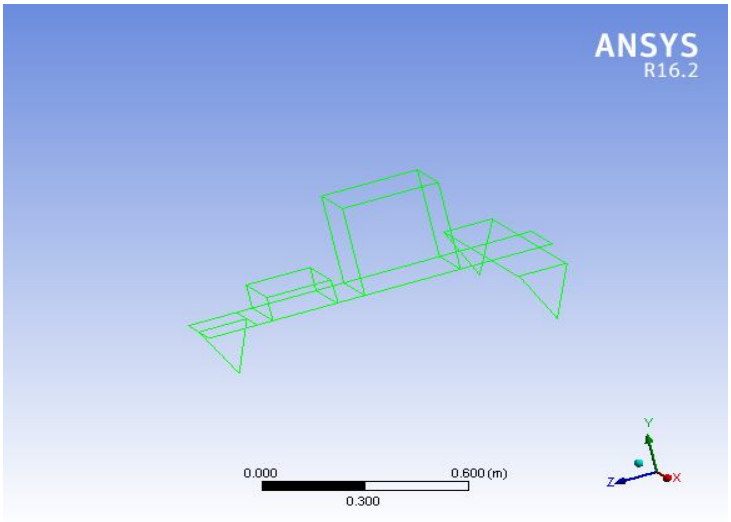


Figure 10-Image of line model

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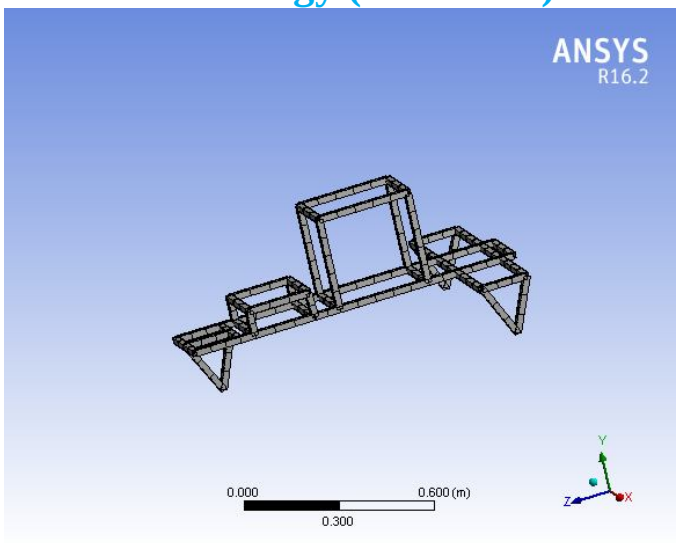


Figure 11-Image of meshing

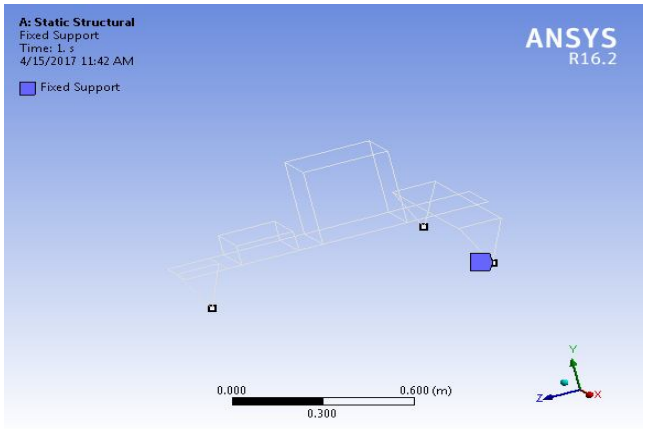


Figure 12-Image of boundary conditions (fixed support)

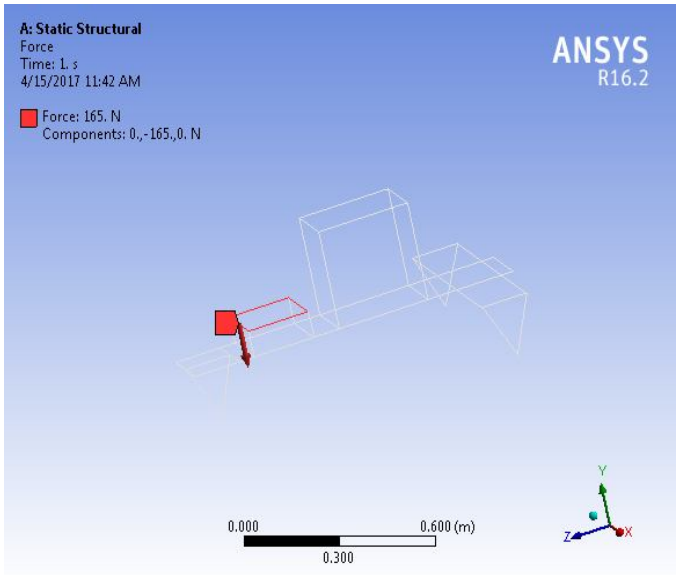


Figure 13-Image of boundary conditions (force)

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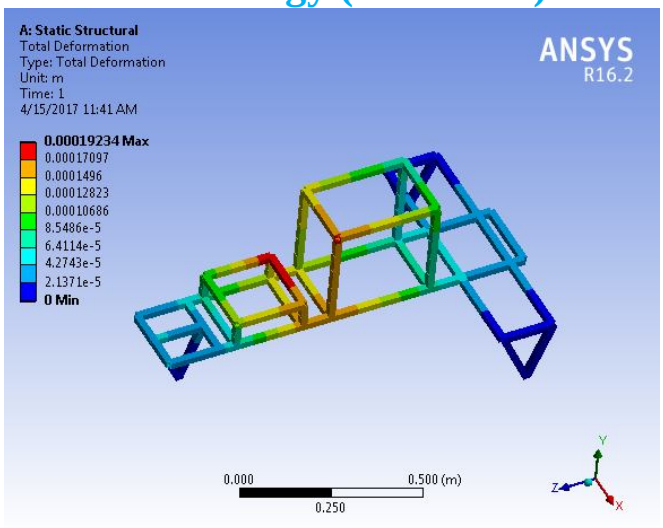


Figure 14-Image of total deformation

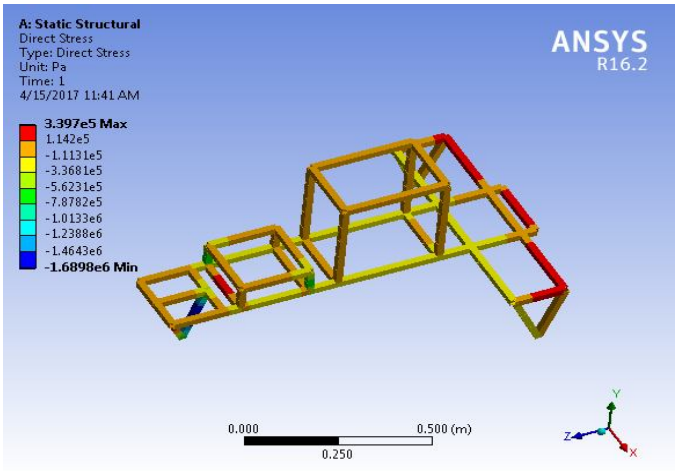


Figure 15-Image of direct stress

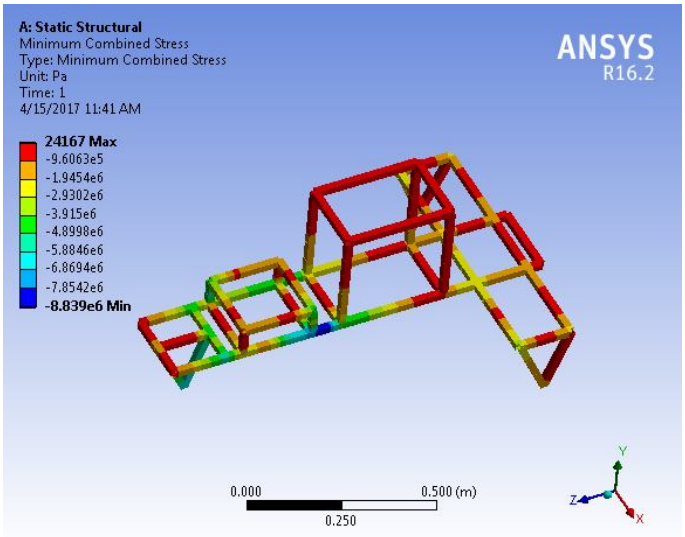


Figure 16-Image of minimum combined stress

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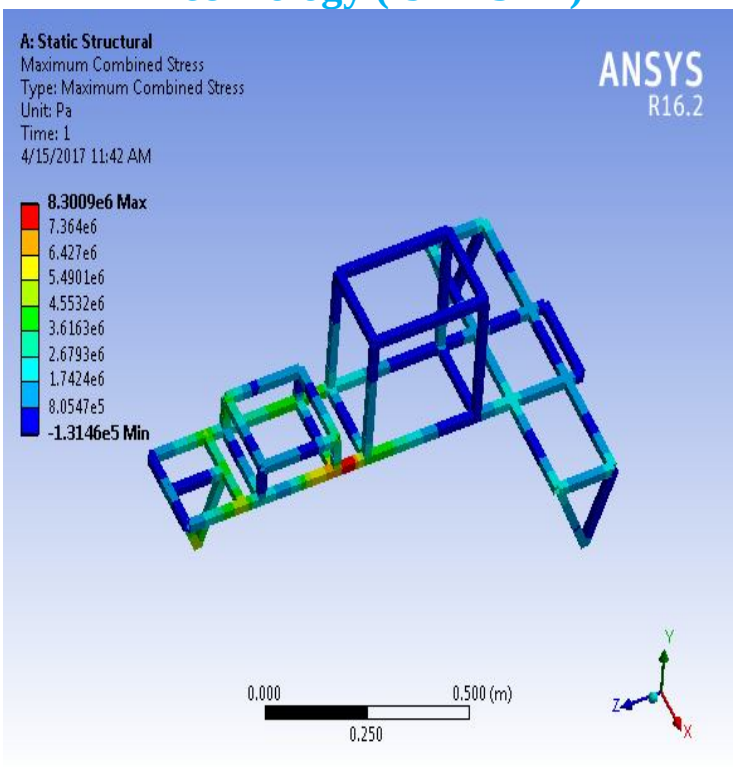


Figure 17-Image of maximum combined stress

VI. MANUFACTURING

A. *Bill of Material*

Table 2-Bill of materials

Sr. No	Name of the Part	Material	Qty.	Cost
1	Pump	-	1	2800/-
2	Wheels	-	3	750/-
3	Bucket	-	1	200/-
4	Square pipe	Mild steel	20meter	900/-
5	Circular disc	Mild steel	1	20/-
6	Flexible pipe	Plastic	2meter	200/-
7	Clutch mechanism	Standard	1	500/-
8	Nut & bolts	Mild steel	20	200/-
9	Sprocket and chain	Standard	1	400/-

Cost of project = (A) Material cost + (B) Machining Cost + (C) Labour Cost

B. *Material Cost*

1) *Material Cost is Calculated as under:* It includes the material in the form of the Material supplied by the "Steel authority of India Limited" as the round bar, angles, square rods, plates along with the strip material form. We have to search for the suitable available material as per the requirement of designed safe values.
2) *Finished Product Cost:* Following components which we have directly purchased from the Market. being easily available and cheaply availably available as compared to their manufacturing cost.

Here we have selected the material as per the following,

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Table 3: Material cost

Sr. No	Name of the Part	Material	Qty.	Cost
1	Pump	-	1	2800/-
2	Wheels	-	3	750/-
3	Bucket	-	1	200/-
4	Square pipe	Mild steel	20meter	900/-
5	Circular disc	Mild steel	1	20/-
6	Flexible pipe	Plastic	2meter	200/-
7	Clutch mechanism	Standard	1	500/-
8	Nut & bolts	Mild steel	20	200/-
9	Sprocket and chain	Standard	1	400/-
	Total			5970/-

B. Machining Cost

Here we have to work on the different machines for having different Operations. So the machine is being hired for that much period of time. Considering the depreciation and the electric light bill along with the rent of the shop or the initial investment.

Table 4: Machining cost

Sr. No	Machine	Time hours	Rate in Rs.	Rupees
1	Welding machine	10	90	900/-
2	Drilling machine	5	90	450/-
3	Grinding machine	3	70	210/-
4	Cutting machine	4	100	400/-
	TOTAL	22		1960/-

C. Labour cost

The labour cost consists of the amount incurred on the wages paid to the operator :The cost is calculated based on the calculation of the hourly wages paid to the operator. Here the operator is considered as the skilled operator.

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Table 5: Labour Cost

Sr. No	Operation	Hours	Rate/hours	Amount paid
1	Welding	10	50	500/-
2	Drilling	5	50	250/-
3	Cutting	3	50	150/-
4	Painting	4	50	200/-
	Total	22		1100/-

Hence the Total manufacturing cost = A+B+C
=5970+1960+1100
=9030/-
TOTAL COST OF PROJECT = 9030/-



Figure 18- Image of actual model

VII. CALCULATIONS

Table 6: Data collection for flow rate

Data collection for flow rate calculations

Time consumed	60 Seconds
Replicate	Volume of water collected(*lts*)
1	1.1
2	1.2
3	0.9
4	0.95

Average volume flow rate = 1.1+1.2+0.9+0.95= 1.0375 *lts*

A. Minimum Effort Required for Moving the Vehicle

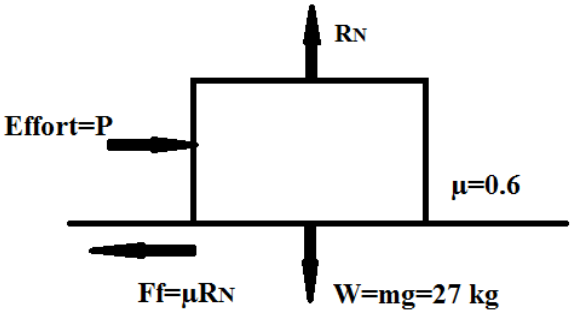


Figure 19- Free body diagram for effort calculation

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Weight of body = 27 kg = mg = 27*9.81 = 264.87 N
Coefficient of friction = 0.6
Normal reaction = 264.87 N
Frictional force = Ff = μRN = 0.6*264.87 = 158.92 N
Minimum effort required for moving the vehicle = 158.92 N = 16.2 kg

B.Distances (Horizontal & Vertical) and Height of Crop

Table 7: Applicable crops

Sr. no.	Name of crop	Distance between plants (horizontal/vertical)	Height of crop
1	Sorghum	15 inch/3-4 inch	5.5-7 feet
2	Pearl millet	15 inch/3-4 inch	5.5-7 feet
3	Sugarcane	15 inch/3-4 inch	5.5-7 feet
4	Soybean	15 inch/2 inch	5.5-7 feet
5	Corn	15 inch/3 inch	5.-7 feet
6	Groundnut	15 inch/3 inch	1.5 feet
7	Cotton	24-36 inch/24-36 inch	2-5 feet
8	Pigeon Pea	15 inch/6 inch	3-4 feet

VIII. APPLICATION

A. For the insecticides application to control insect pests on crops and in stores, houses, kitchen, poultry farms, barns, etc.
B. For the fungicides and bactericides application to control the plant diseases.
C. For the herbicides application, to kill the weeds.
D. For the harmony sprays application to increase the fruit set or to prevent the premature dropping of fruits.
E. For the application of plant nutrients as foliar spray.
F. For applying the powdery formulation of poisonous chemicals on the crops and for any other purposes.
G. Pesticides Sprinkling.

IX. CONCLUSION

A. The suggested model has removed the problem of back pain, since there is no need to carry the tank (pesticides tank) on the back.
B. As suggested model has more number of nozzles which will cover maximum area of spraying in minimum time & at maximum rate.
C. Proper adjustment facility in the model with respect to crop helps to avoid excessive use of pesticides which result into less pollution.
D. Muscular problems are removed an there is no need to operate the lever.

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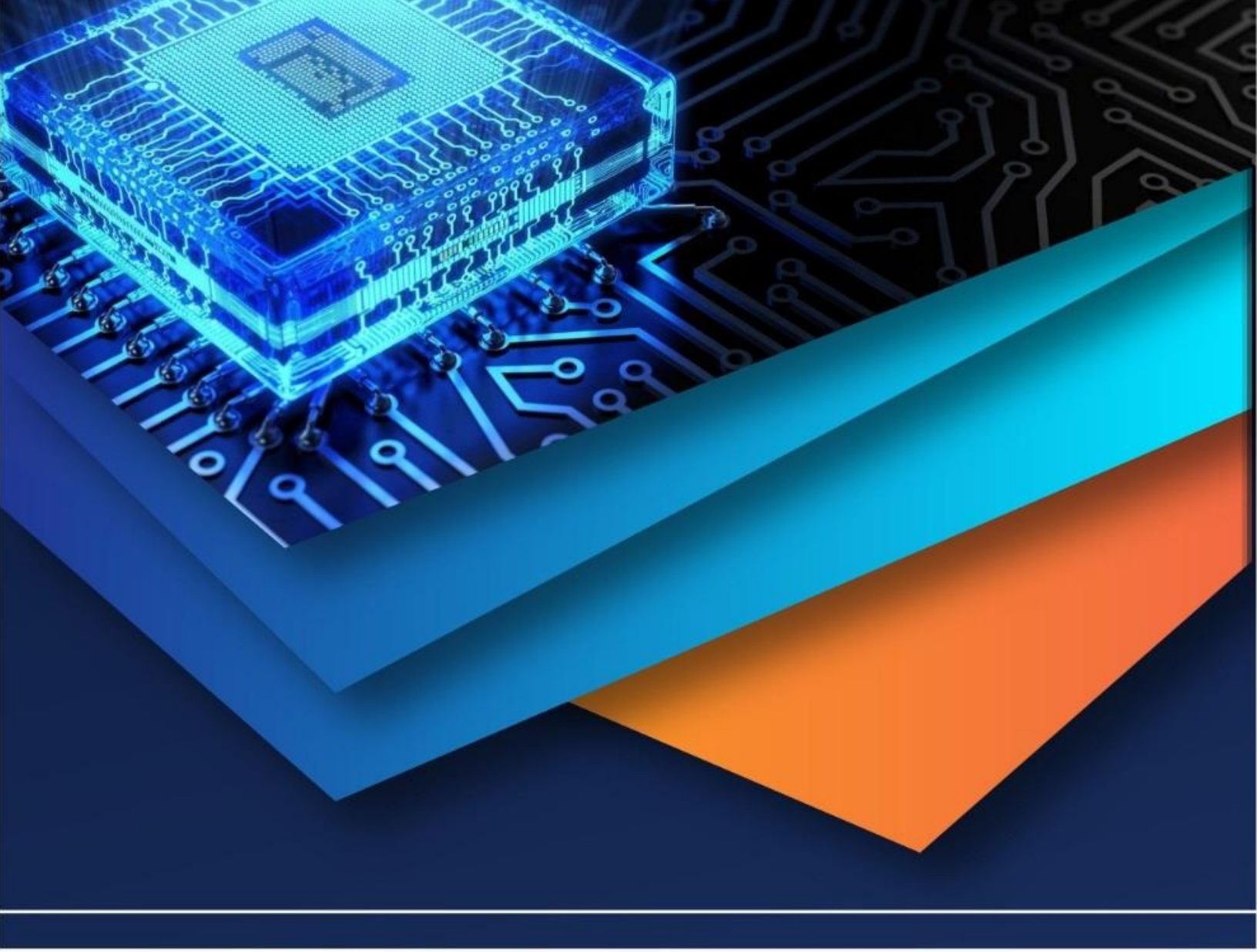
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