INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI

ME 322

TERM PROJECT

SEM VI

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1. INTRODUCTION

Cleaning has become a basic need for all human beings, and it is an unavoidable daily routine process. The conventional road cleaning machine is most widely used in railway stations, airports, hospitals, Bus stands, etc. also this machine needs electrical energy for its operation. It is not user friendly as well as eco-friendly. In summertime there is a power crisis and most of the road cleaning machines are not used effectively due to this problem particularly. In our project we are using easily available materials at low cost. It is the better alternative for conventional machines.

1.1 Why do we need it?

Road sweeping has been a normal operation for most municipalities for hundreds of years. At present cities spend between 30 to 50 percent of their solid waste budgets on street cleansing. Thousands of workers are hired for road cleaning in India. The labor force is usually required to work for 8 hours and is given half an hour's recess. The overall cost of a normal road cleaning machine ranges from 15000 to 2 lakhs.

The road cleaning machines currently used are costlier and more harmful to the environment.
So, there is a huge requirement of development of easy, effective, economical, and eco-friendly ways to clean roads.

1.2 Market Survey

There exist many products in the market which can solve this problem. Those products can be classified based on Power consumption.

- ➢ Fuel or battery-powered road cleaning machines are used worldwide and have been proved to be very efficient in the cleaning process.
- ➢ Battery less road cleaner or eco-friendly road cleaner which cannot be commercially used though can be used for small scale cleaning.
- ➢ A lot of high-scale road cleaning methods are developed throughout the world, yet India majorly depends on manual labor in most of the parts.
- ➢ Small scale eco-friendly road cleaners are being developed as mini projects.
- ➢ Though these small-scale cleaners can be used commercially, their efficiency is too low compared to powered cleaners.
- ➢ So, a more efficient eco-friendly road cleaner is the current need in the field.

Mini project made by a student. Only one roller is used to collect the leaves and it is placed in front of the wheels. A chain drive is used for power transmission.

Another mini project made by a student. Only one roller is used to collect the leaves and it is placed behind the wheels. Two spur gears are used to reverse the direction of the roller rotation.

1.2.1 Different Levels of Commercial Road Cleaners: -

- **Roots Flipper+ Manual Sweeper:** hand pushed sweeping machine for manual sweeping. Battery powered. Cost: Rs. 22,000.

- **Roots Sweep RB100 Battery Operated Ride on Sweeper:** medium sized ride-on sweeper designed for cleaning narrow passages & even congested areas with agility. Cost: Rs. 8,10,000.

- **Roots RSB 6000 Truck Mounted Road Sweeper:** High-Performance truck mounted city sweeper, with a capacity of 6 cubic meters. Two side brushes along with the central main broom and powerful vacuum make road sweeping easy. The auxiliary engine powers the broom and vacuum functions. Cost: 86,50,000.

- **Macro M60 Self Propelled City Sweeper:** Roots Multiclean Ltd offers Macro M60 which guarantees total control over fine particles, maximum productivity, and Optimum maintenance costs. Since this sweeper is designed to sweep both urban and industrial areas, the performance guarantees efficient operation. Cost: 42,50,000.

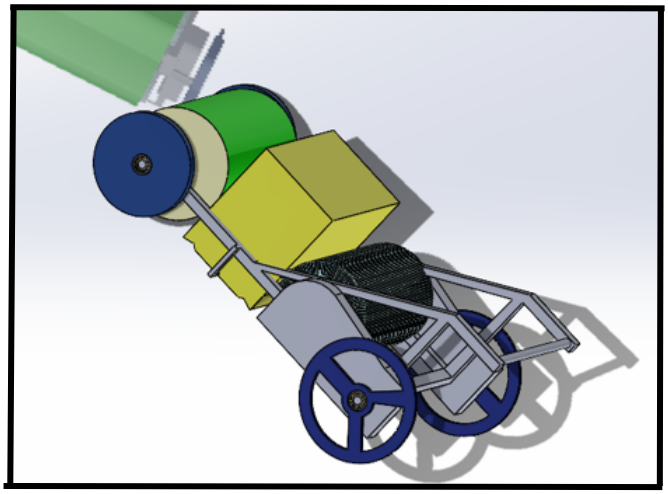
2. LITERATURE REVIEW

2.1 DESIGN OF ECO-FRIENDLY ROAD AND FLOOR CLEANER, 2022 [1] - A Mini project is made by the students for small-scale road cleaning. It uses a metal frame that can be pushed by a person. Two wheels are attached at the front and two small wheels at the back. Chain drive is connected from the front wheel to a gear. Another gear is used to reverse the rotation's direction and connected to a brush roller. A collecting box is kept collecting the swept waste.

2.2 STREET CLEANSING - MOHUA.GOV.IN [2] - A vast government chapter about road and street cleaning. It comprises of topics like sources of wastes, manual cleaning, amount of work and allowances given to the workers, classification of streets, equipment used for street sweeping, specifications about carts used to dispose waste and containers, cleaning of surface drains, mechanical sweeping, and institutional arrangement for manual sweepers.

3. DESIGN DESCRIPTION

3.1 PROPOSED DESIGN-



This machine is run by human effort. The system is fixed with a pair of wheels which relate to the help of shaft. The shaft makes the wheels connected to one and other. The wheels are moved to a desired position with the help of manual force which can handle is provided to move. The handle can be adjusted for the required height and provided three adjusting holes for it. A Chain drive is connected to the wheels and gear at both sides. The chain is moved according to the wheel and gear. The brush is moving in the opposite direction of the wheels and the brush brooms the waste present on the road also it dumps the waste into the waste collecting box. The waste collecting box is removed to dump the waste into desired places.

- Mass of the System = 14865.10 grams
- Surface area = 49774.09 square centimeters
- Center of mass: (centimeters)

X = -19.13 Y = 31.98 Z = 70.70

COMPONENTS	SPECIFICATION
Sprocket material	Mild Steel
Axle, Frame, Container material	Mild Steel
Sweeper Material	Polypropylene / plastic

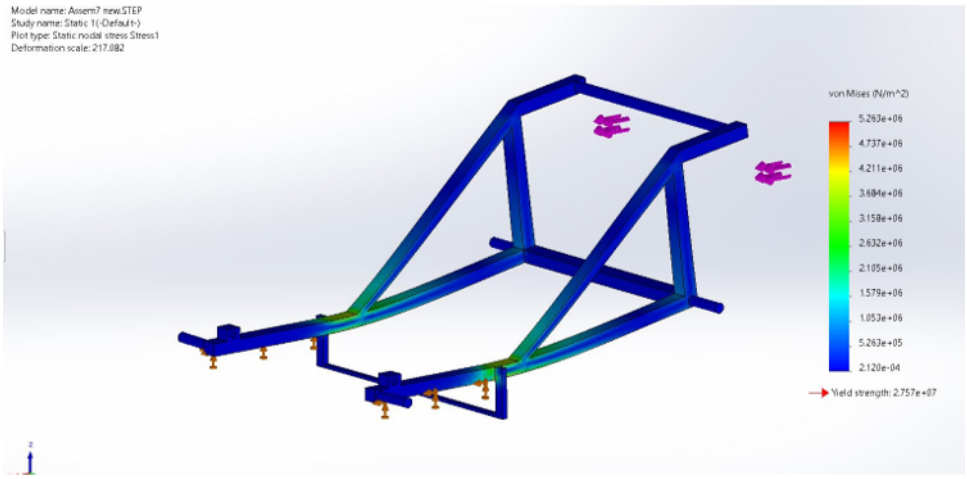
3.2 Design Calculations:

- Belt drive Pulley ratio
    - Radius of larger pulley = 50 mm
    - Radius of smaller pulley = 30 mm
    - Ratio = 50/30 = 1.66
- Spur gear ratio
    - 20 teeth in pinion
    - 60 teeth in gear
    - Ratio = 60/20 = 3
- Brush rpm:
    - Brush rpm= 3*1.66*wheel rpm
    - Diameter of Wheel = 66 cm
    - Radius of Wheel = 33 cm
    - Circumference = 2*pi*33 = 207.34 cm
    - Assume 60 revolutions, rpm of wheel = 60 rpm
    - Total distance = 60*207.34 = 12440.4 cm

Brush roller rpm = 3*1.66*60 = 300

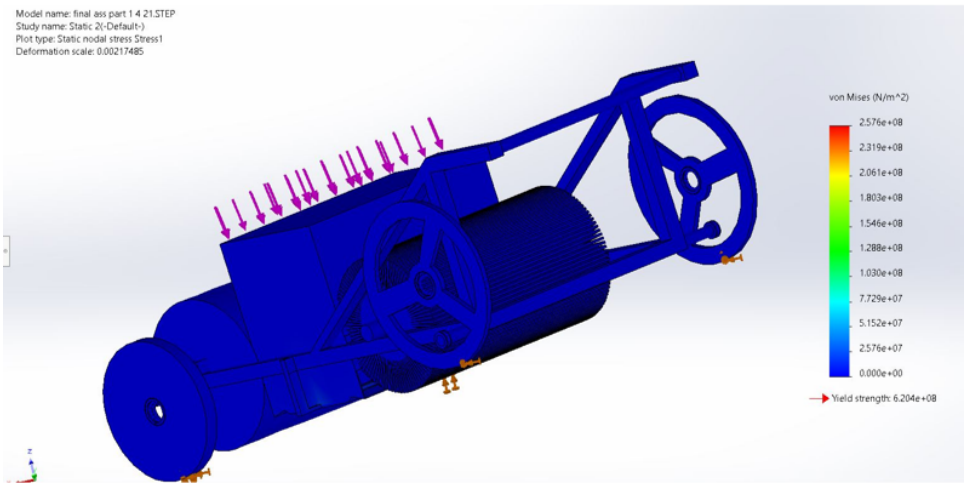
3.3 Stress Analysis

3.3.1 Horizontal Force Analysis:



- In this analysis, we are acting a Horizontal force of 30 N (which is taken as the force exerted by the Consumer).
- By Taking the material as Mild steel (Yield Strength = 2.757e+7), We have done the stress analysis for the structure of Chassis.

3.3.2 Vertical Force Analysis:



- In this analysis, we are acting a range of Vertical force of from 10 N to 70 N (which is taken as the force exerted by the Consumer) on the system.
- Based on the stress analysis, the container can withstand a maximum Vertical Load of 60N. Thus, the Road Cleaner can carry a Maximum waste of 6 Kg

4. RESULT & DISCUSSIONS

4.1 CAD MODEL-

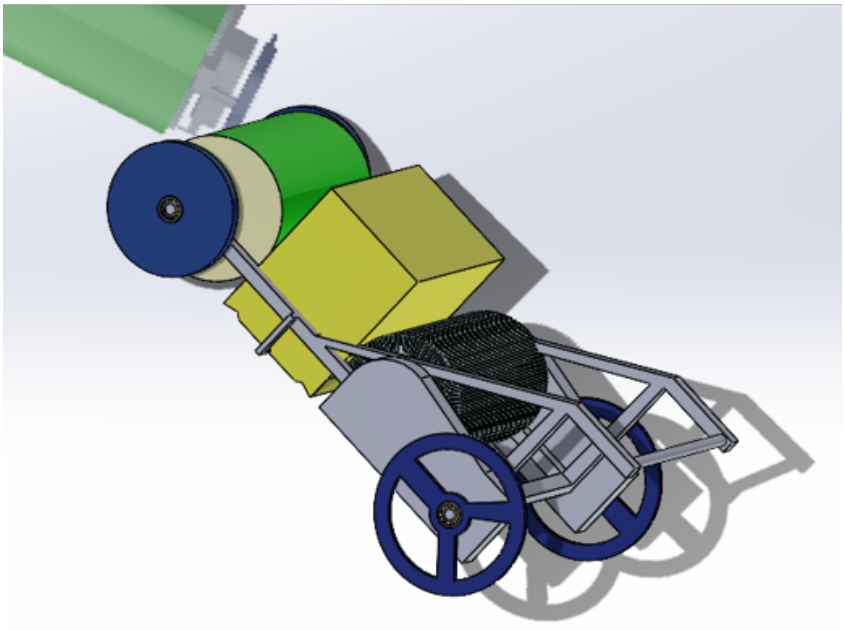


Fig. - Isometric view of the final model

Eco friendly road cleaning machine is an advanced type of machine used for the roads or street. The machine is run by human effort. The system is fixed with a pair of wheels connected with shaft help. The shaft makes the wheel connected to one other. The wheels are moved to a desired position with the help of manual force which can handle moving. A chain drive is connected to the wheels and gear at one side. The chain is moved according to the wheel and gear. The brush moves in the opposite direction of the wheels move and the brush brooms the waste present on the road also it dumps the waste into the waste collecting box. The waste collecting box is removed to dump the waste into desired place.

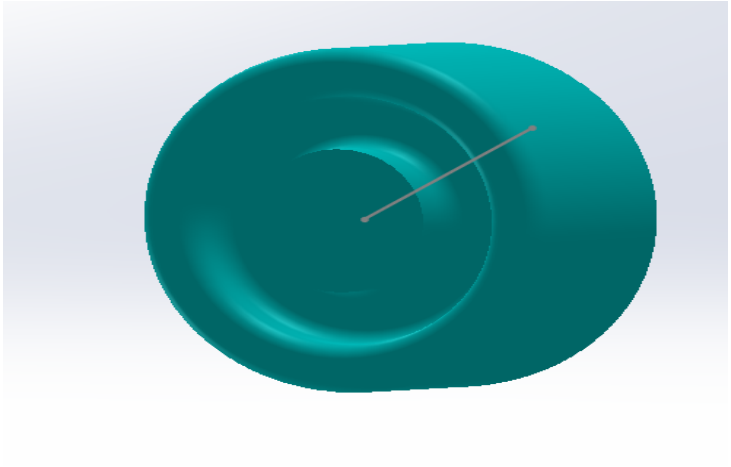
CAD model of individual parts: -

1. **Cycle wheel:**

A cycle wheel is used for movement of our machine. We use two wheels, each wheel having a diameter of 500 mm (about 1.64 ft).

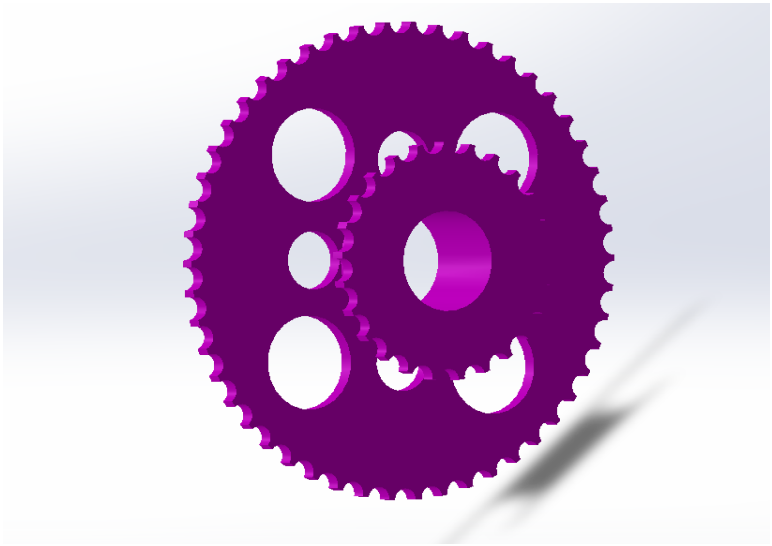
2. **Supporting wheel:**

supporting wheel Diameter of wheel 100mm (about 3.94 in). It is used for movement of machine.



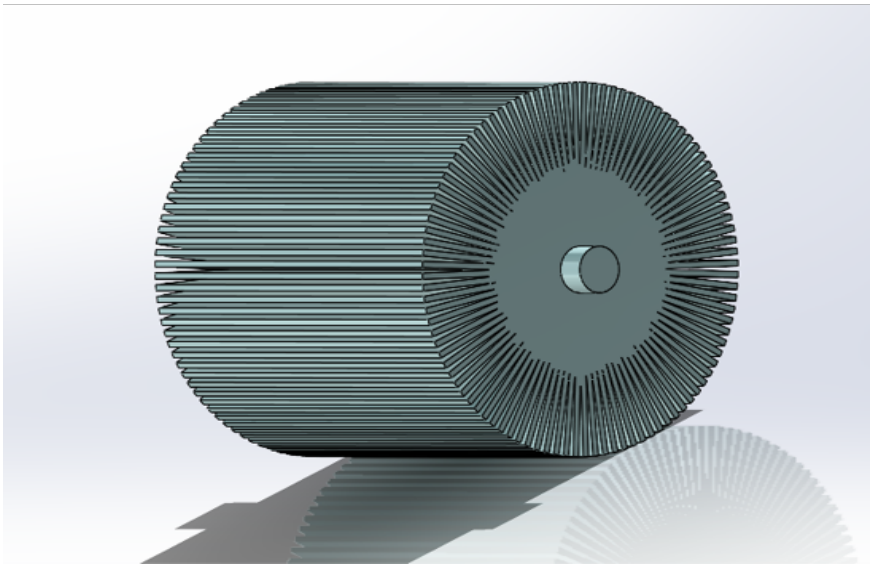
3. Sprocket:

It is used for transmitting power from wheel to secondary sprocket to brush. It has an outer diameter is 150mm (about 5.91 in) & 44 teeth.



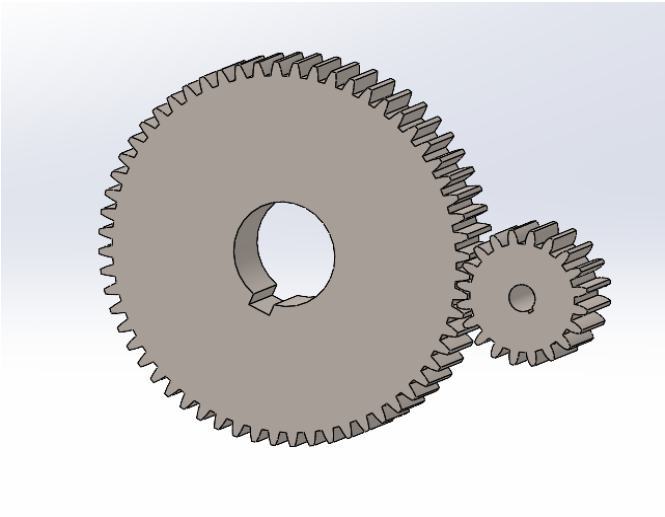
4. Roller brush:

Roller brush having a length of length of 900mm (about 2.95 ft) long and outer diameter of 250mm (about 9.84 in).



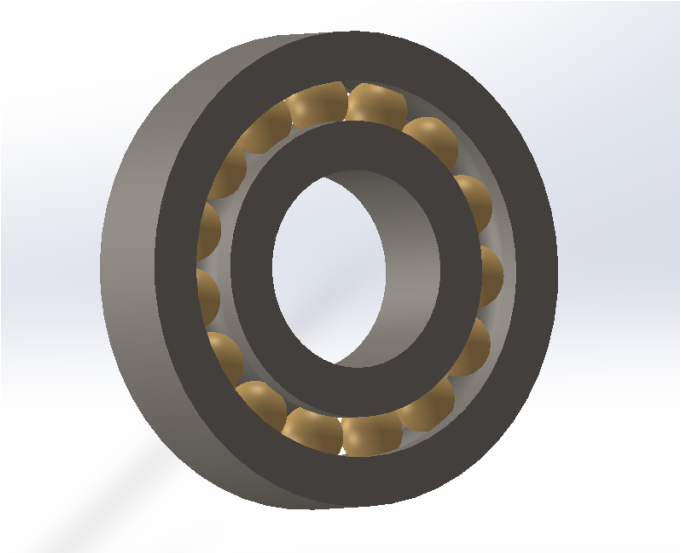
5. Spur gear:

Use two gear driver and driven the small gear has a diameter of 36mm (about 1.42 in) and larger gear has a diameter of 120mm (about 4.72 in) and 64teeth.



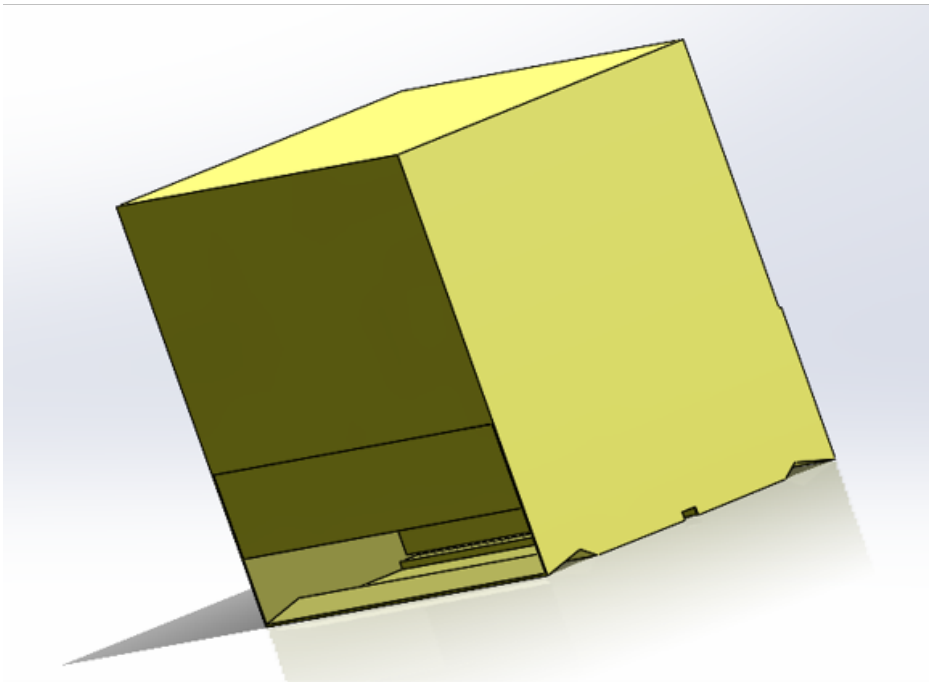
6. Pedestal bearing:

It is used to support a rotating shaft with the help of compatible bearings and various accessories. Its inner diameter is 25mm (about 0.98 in).



7. Collecting Box:

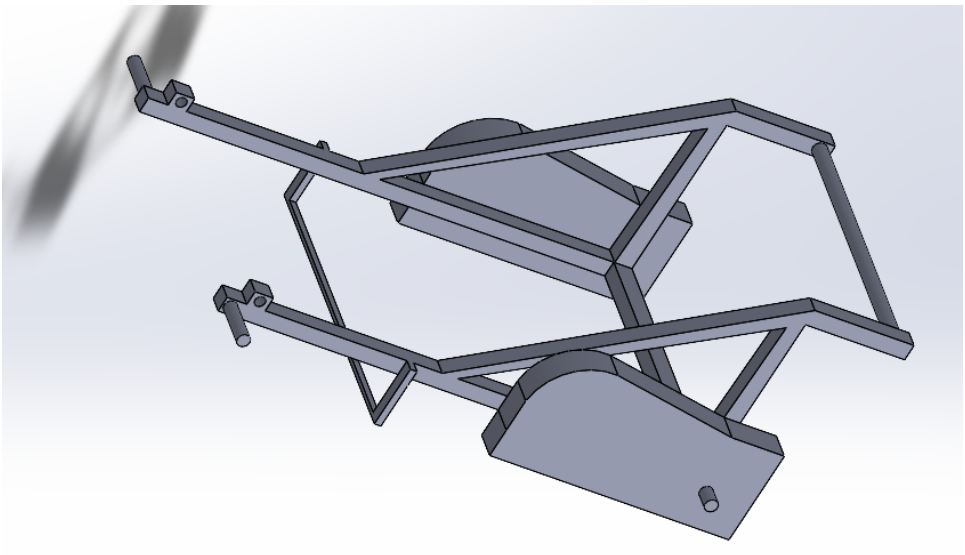
The function of the collecting box is to collect the waste up to some quantity after that remove box and dump the waste.



8. Frame:

Frame is the body part on which all the other components are assemble-

- Cycle wheel
- Small wheel
- Pedestal bearing
- Spur gear
- Industrial brush
- Bin



4.2 WORKING PRINCIPLE OF ROAD CLEANING MACHINE-

Eco friendly road cleaning machine is an advanced type of machine used for the roads or streets. The details of the working of the Eco-friendly Road cleaning machine are explained below.

Eco friendly road cleaning machine we are making without using any power supply, fuels and engines but is run by human efforts. The system is fixed with a pair of wheels which relate to the help of shaft. The shaft makes the wheels connected to one and other. The wheels are moved to a desired position with the help of manual force which can handle is provided to move. The handle can be adjusted for the required height and provided three adjusting holes for it. A Chain drive is connected to the wheels and gear at both sides. The chain is moved according to the wheel and gear. The brush is moving in the opposite direction of the wheels and the brush brooms the waste present on the road also it dumps the waste into the waste collecting box. The waste collecting box is removed to dump the waste into desired places.

5. COST ANALYSIS

Component	Rate (Rs.)	Qty.	Price (Rs.)
Chain+ 2 sprockets	360	2	720
Belt Drive	380	1	380
Gears	200-400	2	800
Rim	540	2	1080
Tyre	200	2	400
Rollers	1000	2	2000
Paint	365	1	365
Metal sheet	495	5	2475
Hollow Metal pipe	250	10	2500
Miscellaneous			1500
Total Price			11740

The prices shown above are obtained from several e-commerce websites like Flipkart, Amazon, IndiaMART, etc.

6. CONCLUSIONS AND FUTURE WORK

6.1 Conclusion

Effectiveness - waste collection effectiveness increased from 75% to 94%
Storage – A storage box with larger collecting area is used and it is open from two sides to collect litter from both rollers.
Cost – less components will be used to reduce cost as well as the weight of the machine.

6.2 Future Work

The following work can be done on our design in the future to make it more robust and better suited for production and usage.

- Extension – We can add this model to cars and other vehicles for automatic road cleaning.
- Self-Driven - A motor can be introduced to make itself driven.
- Vacuum – A vacuum pump can also be attached to suck the garbage from below. This will increase efficiency and reduce working time.

7. ACKNOWLEDGEMENT

We would like to thank Dr. Poonam Kumari, our course instructor for giving us this great opportunity to present our project idea. Because of her efforts only we worked on this and completed the final project design in the stipulated time without fail.

8. REFERENCES

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