

Design and Development of Roadside Waste Collector



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Abstract: Cleaning has become a basic need of all the human beings. Throughout the world many researchers are conducting experiments in order to eradicate and solve the solid waste removal process. There should be improvising with innovative ideas and techniques which may ensure good health. If an equipment is developed it should be eco-friendly with its usage. All the designer people should be aware of its affects and advantages in preparing a equipment. It's a great task in order to improve the quality and standards of a equipment for its better usage. It should be designed by keeping the ergonomic aspects. Here in this paper it describes the solid waste removal principle and its working which has been prepared by the scrap materials for the domestic purpose only with low cost expenditure. A prototype model is also prepared which uses DC drive powered rotary brush with pneumatic controlled dust shifting which helps user to remove the waste and to maintain clean and hygienic environment and thus avoids health inequalities and safety concerns with regards to workers as well as common people.

Keywords: DC Motor, Rotary Brush, Pneumatic Cylinder.

I. INTRODUCTION

India is one of the largest countries among the developing nations with large amount of waste products generated day to day life activities. Major amount of wastes generated are thrown along the roadside and only human resources are used to the collect all those wastes. The present method is used to collect the waste materials such as plastic materials, bottles, dust particles by vacuum cleaner. This method is much costlier, more time consuming in nature and affects the human workers in the way of ergonomics. Workers may be affected by Gastro-intestinal infections, respiratory and skin diseases. Thus, in our project the vacuum method is replaced by brushes [Industrial roller brush]. This system helps to remove materials such as solid waste [wood, vegetable wastes etc.], plastic items etc., This product reduces the human effort, time and power consumption and more economical.

II. METHODOLOGY

The methodology of this research work has been depicted in Fig.1.

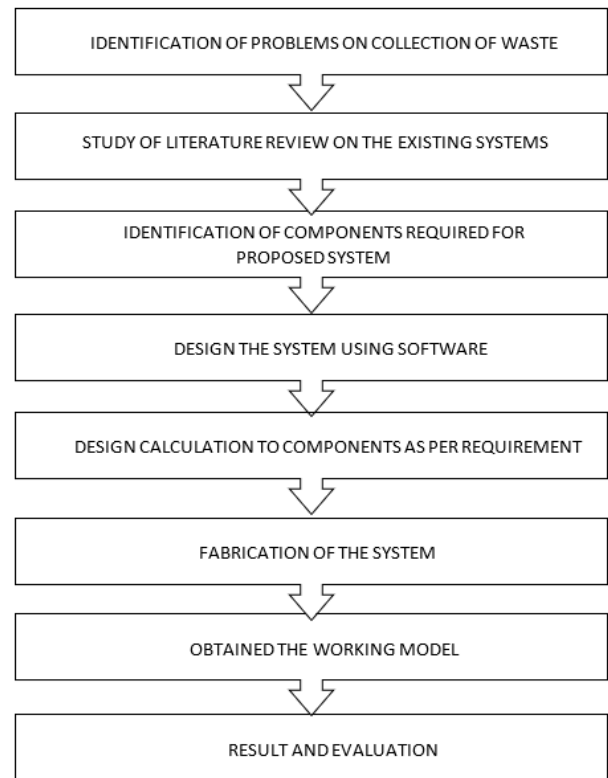




Fig 1 Methodology

III. MATERIALS AND SPECIFICATIONS

Table 1 Materials and its Specifications

COMPONENTS	MATERIALS	PICTURES	SPECIFICATIONS
Pneumatic cylinder	Cast Iron		Stroke=300mm Dia=32mm
DC Motor	Cast Iron		Power=12V, 7A Speed=90rpm

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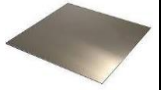








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Battery	Lead Acid Battery		12V, 7.5A
Sheet Metal	Stainless Steel		T=0.56mm
Frame	Mild Steel		Square Rod 4cm*4cm
Shaft	Mild Steel		Dia=1.2cm
Metal Strip	Mild Steel		Required size
Bearing	Stainless Steel		ID=12mm OD=37mm
Cleaning Brush	Plastic		6 Brush Covering Dia=28cm
Hose	Rubber		As Required
Connector	Plastic		As Required
Direction Control Valve	Plastic		1
Wheel	Rubber with Steel Hub		4 Wheels Dia=38cm
Mini Compressor	Cast Iron		230V, 50Hz, AC Supply

IV. DESIGN CALCULATIONS

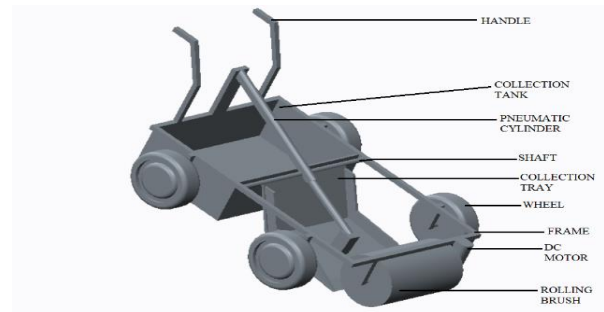


Fig. 2 Proposed Design

Fig 2 represents the proposed design of the project. With the help of this design further calculations and designs are made.

1. Volume of the collection tank = $L \times B \times H$

$$L=50\text{cm}, B=30\text{cm}, H=20\text{cm}$$

$$\text{Therefore volume} = 50 \times 30 \times 20 = 0.03\text{m}^3$$

2. Torque of DC motor used, $P = (2 \times \pi \times N \times T) / 60$

$$T = (P \times 60) / (2 \times \pi \times N)$$

$$P = 70\text{W}, N = 90\text{rpm}$$

$$T = (70 \times 60) / (2 \times 3.14 \times 90)$$

$$T = 7.4\text{Nm}$$

3. Load lifting capacity of cylinder

$$\text{Force} = \text{Pressure} \times \text{Area of cylinder}$$

$$P = 2\text{bar}, d = 0.016\text{m}$$

$$F = (2 \times 10^5) \times (3.14 / 4 \times 0.016^2)$$

$$F = 40.95\text{N}$$

$$\text{Load} = 4.17\text{Kg}$$

Volume of the collection tank that is provided is 0.03m^3 . The torque that can be generated by the DC motor used is 7.4Nm. The pneumatic cylinder is fixed to transfer the waste from collection tray to the collection tank. The maximum load that can be lifted by the pneumatic cylinder is approximately 4Kg.

V. DESIGN ANALYSIS

Design Process can be carried out by different software such as AUTOCAD, SolidWorks, ProE, Creo, etc., The design process was done entirely by using the CREO 2.0 Software. This software was selected as it is more user friendly and most common software for solid modelling.

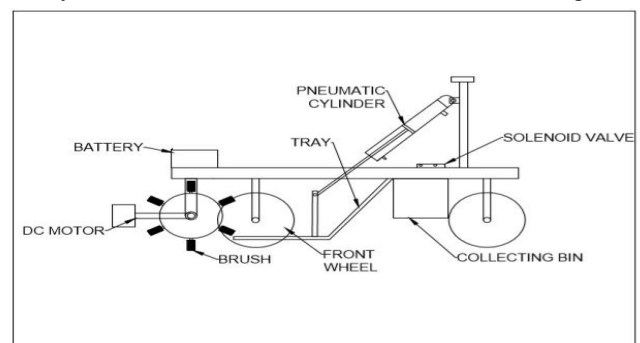


Fig. 3 2 D Design of the System

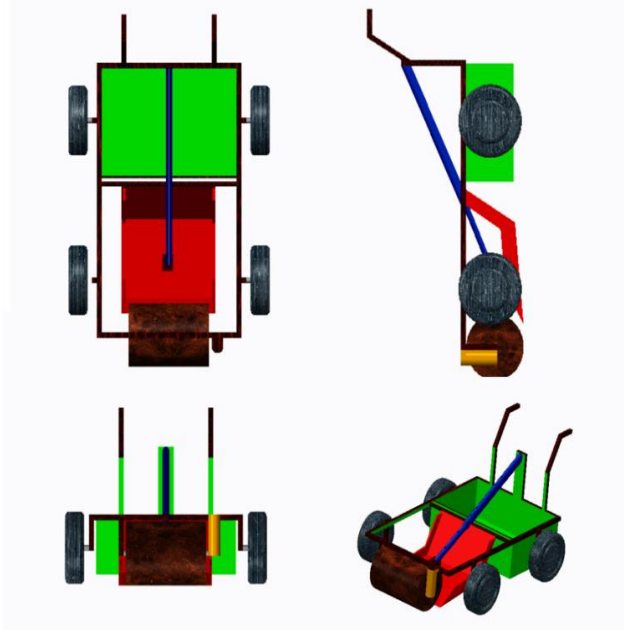


Fig. 4 Views of the System

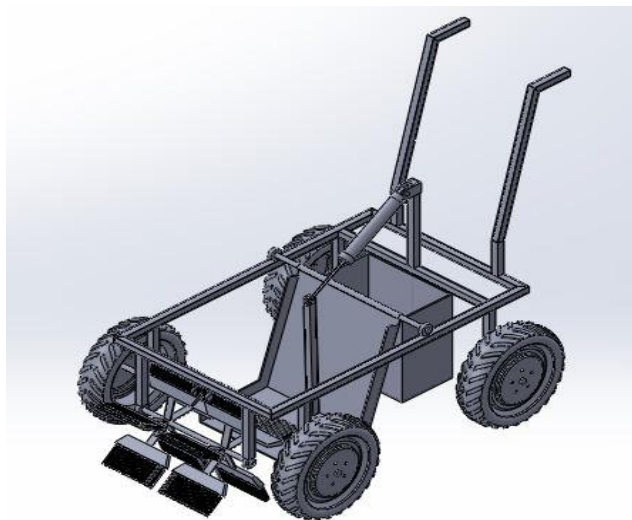


Fig. 5 3D Design of the System

VI. PROPOSED SYSTEM

The front side of the product consist of the rotating brush coupled to DC motor. Six small brushes are combined to form the rotating brush. The brush is made up of nylon. The main advantage of this brush is that it is flexible and high performing. There is a shaft combining all the small brushes. The middle portion consist of collection tray. Collection tray is a inclined tray in which one end touches the ground and the other end is fixed to a shaft. The collection tray is lifted by using the pneumatic cylinder. The reciprocating motion of the pneumatic cylinder is converted into rotary by using the shaft in which the one side of the collection tray is connected. The shaft relates to bearing on both the ends. The back side consist of main waste collection tank which is made up of sheet metal in the shape of a box opened on the top side.



Fig. 6 Fabricated Model



Fig. 7 Fabricated model

VII. WORKING

The vehicle is placed on the place where the cleaning operation to be done, initially collecting tray is placed in the home position near rotating brush. Once the initial settings are pre checked DC motor gets turned on and tends its shaft to rotate about the fixed axis. This rotation is transferred to the connected rotary brush and makes the waste spread on the surface to force into the collecting tray. Once the collecting tray is filled solenoid valve attached to the pneumatic cylinder gets activated which allows the compressed air to enter the pneumatic cylinder and makes it to extend, this makes collecting tray with dust to shift its position about its fixed hinged point. This causes the dust filled inside tray to shift into the collecting tank from there it is removed. This process is repeated for performing cleaning operation.

VIII. CONCLUSION

The main motive of the project is to cover ensure cleanliness in the society. It focuses on cleanliness of roads, pathways etc., The multiple applications provide a wide range of functions in which we can clean the waste along roadside, remove metal particles from the road, remove different types of wastes. By application of this technology, we have assembled such a vehicle which has multiple features being cost effective at the same time. The low budget projects are very useful for the society and being low cost and energy efficient that plays a vital role in cleanliness.

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