

## Design and Fabrication of Semi-Automatic Sole Cleaner

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### ABSTRACT

In recent years' people especially students most probably clean their shoes manually using brush, which somehow takes a long time to get clean. It is even hard for them to clean it by their own especially for primary students because it requires a lot of energy, which is out of their physical ability. Therefore, with the new shoe cleaner machine, this will be definitely benefited on the user's desire. With the small machine, which is can be perfectly fitted with the size of the shoes and it can be useful enough as the important role is to clean the shoes. The shoes can be cleaned in much less time with no effort. An attempt has been made to design and fabricate a sole-cleaning machine to make the shoe cleaning process simpler. This work focuses on automation of the shoe cleaning process without any human involvement in the process. As all the employees, faculty, Students etc., are required to wear clean shoes before entering their work place, School, College laboratories etc., The shoe sole cleaner is designed, considering all the parameters with respect to customer need in terms of portability and economically available to them. Thus, not only providing clean environment but also the style quotient to the person with polishing effect.

**Keywords:** Sole Cleaner, Shoe polishing, Automatic Cleaning

### 1. INTRODUCTION

In the past, people mostly do their heavy task by their own that involve hard physical which somehow out of their capabilities. In some other reasons, it makes even the simplest things that can be done in a while take a long time and somehow been delayed. As we know, there are many kind of automated machine that have been developed nowadays not just in the industry yet also for home care needs in every residence. The automated machine becomes more crucial as in most house have at least one automated machine such as a washing machine.

At first, washing machine is designed to make life easier and at the same time to reduce, the time needed. As the time goes by, the demand of needs become higher and there is so much improvement on the machine itself. Hence, the new machine for shoes has significant advantages for user and future generations. The major objectives of the work are i) To Reduce human effort. ii) To improve the effectiveness of cleaning the shoe. iii) To reduce the time of operation. iv) To improve cleanliness of the shoe.

### 2. COMPONENTS UTILIZED

#### 2.1 Motor

The motor that we have used is 230V 50Hz 2.5Amps 1/4HP motor has shown below. An AC motor is an electric motor driven by an alternating current (AC). The AC motor commonly consists of two basic parts, an outside stator having coils supplied with alternating current to

produce a rotating magnetic field, and an inside rotor attached to the output shaft producing a second rotating magnetic field. It powers the entire shoe-cleaning machine. It has very versatile use. These are more commonly used in electric fans, small pumps and small household appliances.

*Table 1. Specifications of motor*

S.no	Specification	Range	Unit
1	Voltage	230	Volt
2	Frequency	50	Hz
3	Current	2.5	Amps
4	Power	180/0.25	Watts/HP
5	Speed	1440	rpm

## **2.2 Mild Steel**

Mild steel, also called plain-carbon steel is a type of steel alloy, which is the most common high volume steel in production. Mild steel contains a small amount of carbon and provides material properties that are acceptable for many applications. In order for steel to be considered low carbon, there are certain characteristics it must meet. For example, the steel has to have less than 0.3% carbon in its total make-up to be considered low carbon. Mild steel is considered the most common form of steel as the cost is comparatively small, so is generally used when large amounts of steel are needed.

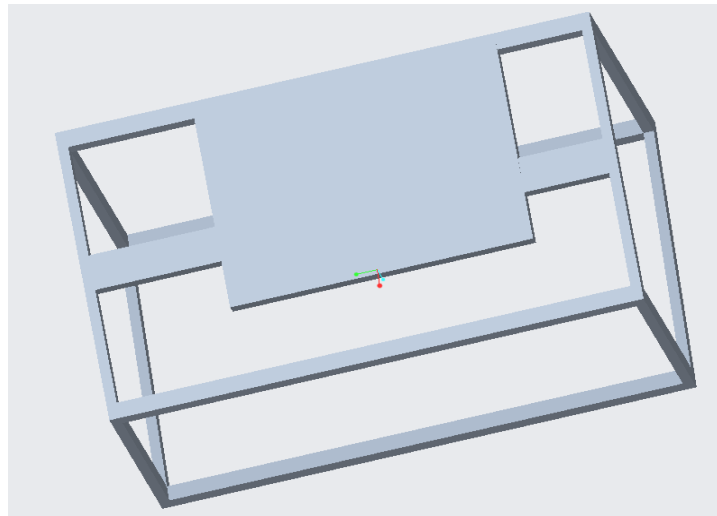
Low carbon steel properties include; it is easily workable and easier to form straight from the forming process, whether that process is hot forming or cool forming. Unlike other grades of carbon steel, which tend to be brittle, mild steel is very hard, yet malleable, making it the perfect choice for construction materials, car manufacturing, motorcycle frames, construction of pipelines and many other every day products like cookware.

Although Mild Steel can be known to rust due to its poor corrosion resistance, it is usually painted and/or protected to prevent any rusting. Mild Steel can be easy to shape and machine because it is very flexible and can be hardened by a heat treatment process called carburizing.

This makes it a suitable material for producing a variety of products in the consumer industry. When it comes to welding, low carbon steel is one of the most easily welded metals. The reason for this is due to the low carbon content. Mild steel contains - carbon 0.16 to 0.18 % (maximum 0.25% is allowable), Manganese 0.70 to 0.90 %, Silicon maximum 0.40% , Sulfur maximum 0.04% , Phosphorous maximum 0.04% .

## **2.3 Frame**

The mild steel frame that we used act as the base for the whole setup. Since mild steel provide good strength with less weight the whole arrangement can be built over it. The frame is made with square cross section, which gives more stability to the machine.



**Fig1. 3D Model of the frame**

## **2.4 Plate**

Two mild steel plates are used in the present work; one is welded to the bottom of the frame to rigidly support the motor and the other is welded in the top part of the frame. The plate, which is at top of the frame, is used to place the foot over it. We used the mild steel plate so that it can withstand more load with less thickness because of its high strength.

The dimensions of the plate is given below

- 1) Plate 1- (13cm x 38cm)
- 2) Plate 2- (16cm x 16cm)

## **2.5 Shaft**

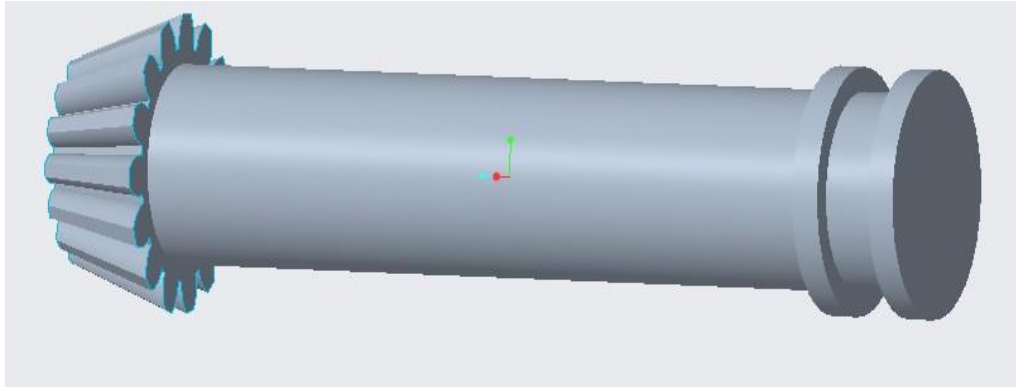
A Shaft is a rotating machine element usually circular in cross-section, which is used to transmit power from one part to another. We used three shafts, which is made of mild steel so that it can be easily machined. Since weight of the mild steel shaft is less, load for the motor is reduced and the power consumed by the motor will be reduced. We use three shafts in our machine. The shaft one consists of two bevel gears, two bearing and one pulley. The pulley is fixed at the right extreme end and one bearing is fixed at the left extreme end. The other bearing is fixed at the few centimeters left to the pulley. The bevel gears are placed next to the bearing from each ends.

## **2.6 Belt and Pulley**

V-Belts are made in trapezoidal Section. The power is transmitted by the wedging action between the belt and the V-groove in the pulley or sheave. This wedging action results in higher force of friction. The Groove angle of a sheave is made somewhat less than that of the belt section angle. V-Belts are used with electric motors to drive blowers, compressors, appliances (like mixer, grinder, etc.). In this type, the power transmission is high due to wedging action in the grooved pulley and it is more compact and shock absorbing.

## **2.7 Bevel Gear**

Bevel Gears are used to transmit power between two intersecting shafts at any desired angle, although 90° shaft angle is most common. Bevel Gears are not interchangeable because they are designed and manufactured in pairs. We use straight bevel gear in which the teeth on the bevel gears are parallel to the lines generating the pitch cones. In our machine, it is used to transmit power from main shaft to the two-side shaft



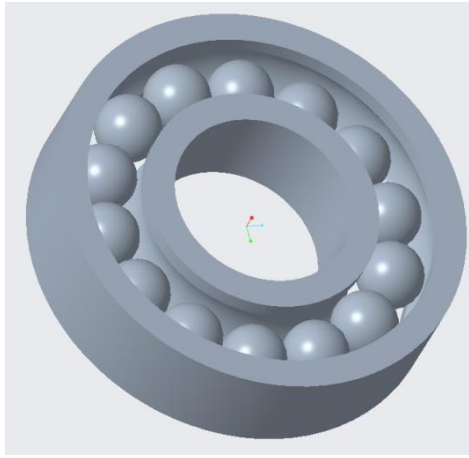
*Fig 2. 3D Model of the bevel gear with the shaft*

## **2.8 Brushes**

Brushes used for cleaning come in various sizes, ranging from that of a toothbrush, to the standard household version accompanied by a dustpan, to 36" deck brushes. Brushes perform a multitude of cleaning tasks. For example, brushes lightly dust the tiniest figurine, they help scrub stains out of clothing and shoes, they remove grime from tires, and they remove the dirt and debris found on floors with the help of a dustpan. Specific brushes are used for diverse activities from cleaning vegetables, as a toilet brush, washing glass, cleaning tiles, and as a mild abrasive for sanding. We use cylindrical type of brush for cleaning shoe.

## **2.9 Bearings**

Bearings are mechanical assemblies that consist of rolling elements and usually inner and outer races which are used for rotating or linear shaft applications, and there are several different types of bearings, including ball and roller bearings, linear bearings, as well as mounted versions that may use either rolling element bearings or plain bearings. Ball bearings have spherical rolling elements and are used for lower load applications, while roller bearings use cylindrical rolling elements for heavier load carrying requirements. Linear bearings are used for linear movements along shafts and may also have rotational capabilities. Mounted bearings are assemblies in which the bearings are pre-assembled in mountings that, in turn, are bolted to frames, stanchions, etc., and are used for supporting the ends of shafts, conveyor rollers, etc. In addition to ball and roller bearings in their radial, linear, and mounted forms, bearings include those for civil engineering applications, which are called slide bearings; those used in small instruments and the like, known as jewel bearings; and very specialized bearings known collectively as frictionless bearings which includes air and magnetic varieties. Sleeve bearings, journal bearings, and other fluid-film bearings are addressed in the Bushings family.



**Fig 3. 3D Model of the bearing**

### **3. WORKING OF THE SOLE CLEANER**

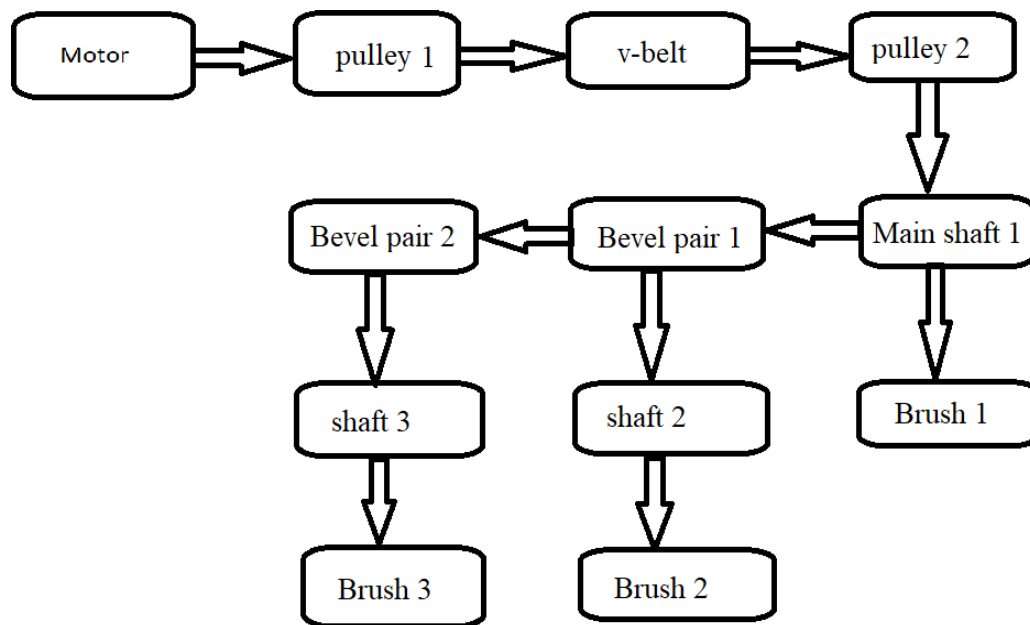
The A.C Power supply is provided to the Single-phase Induction motor. The Single-phase Induction motor commonly consists of two Main parts in it. They are Stator and rotor. An outside Stator having coils supplied with alternating current to produce a rotating magnetic field, an inside rotor attached to the output shaft producing secondary rotating magnetic field. The rotor of the motor is connected to the shaft. In which the shaft is connected to the Pulley 1.

This Pulley 1 is connected to pulley 2 via V-belt, which is used to transmit power efficiently due to its wedging action. The Wedging action provides high frictional force, which transmits power from pulley 1 to pulley 2. This Pulley 2 is connected to the shaft 1. The Shaft 1 consists of two bevel Gears and two Bearings in it. The bevel Gear is used to transmit power between two intersecting shafts. It is transmitted at an angle of 90 degree.

The Power from Shaft-1 is transmitted to shaft-2&3 using Pair of bevel gears. So that the all the shafts starts rotating. The Bearings are Placed at the corners of the shaft to transmit power in a Smooth and noiseless way. The Plate-1 is placed between the shafts in which the foot of the person is placed over the Plate-1. An Another Plate is used to fix the motor over it for a support. All these Shafts, plates and Gears are placed on a frame.

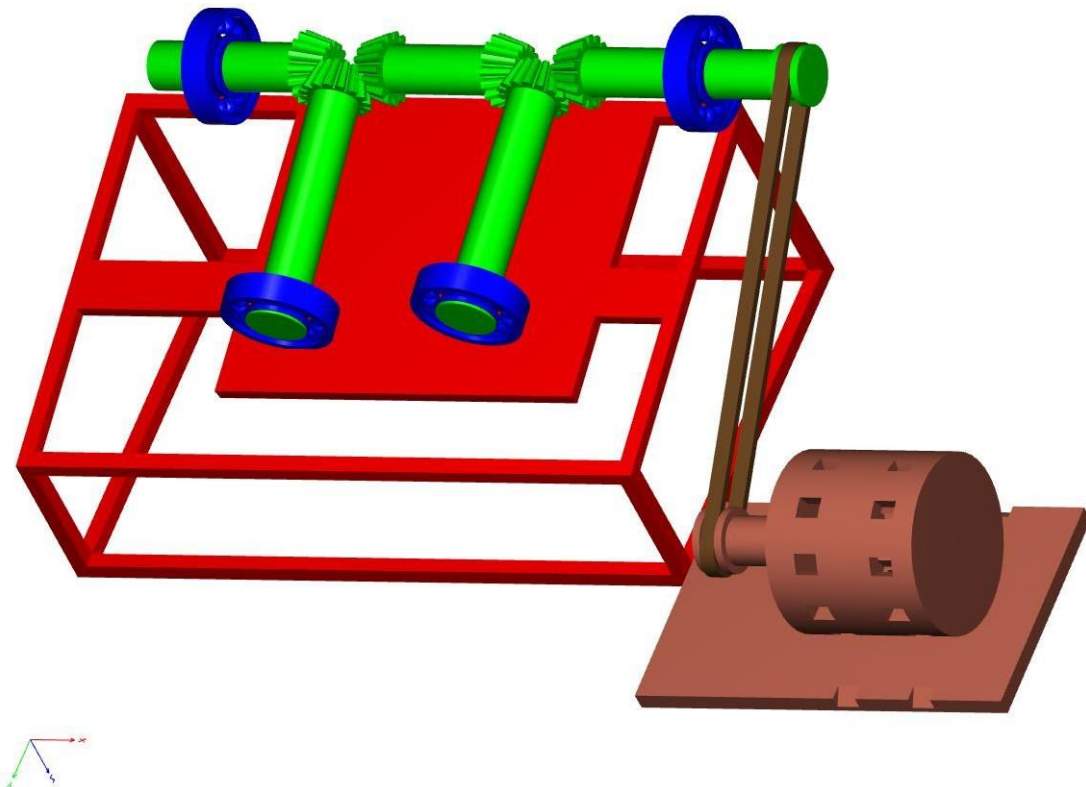
This Frame is made up of Mild steel in which Arc Welding is used to join the metals. Arc welding is used because it can join metals by electric spark, which produces high temperature so that mild steel is melted and two mild steel rod is fused with each other. This is how the frame is made. The Entire assembly is placed over the frame. The Cylindrical brush is rolled over the shaft in which it also rotates along with the Shafts. Now the Shoe is placed over the plate-1 in which the bristles that is protruded outside the brush wipes out the dust particles from the shoe. This is how the Shoe cleaning machine works!

### 3.1 Power Flow



*Fig 4. Power flow chart*

### 4. DESIGN & DIMENSIONS OF THE SOLE CLEANER



*Fig 5. 3D Model of the shoe cleaning machine*



**Table 2. Components dimension**

S. No.	Parameters	Dimensions
1.	Shaft-1	Length-31cm Diameter-3cm
2.	Shaft-2&3	Length-15cm Diameter-3cm
3.	Plate-1 (Footpad)	16cm x 16cm
4.	Plate-2 (Motor Plate)	13cm x 38cm
5.	Frame Rod Cross-section	1.25cm x 1.25cm
6.	Pulley	Diameter-5cm
7.	Belt	Width-1.5cm Length-76cm Thickness-1cm
8.	Bearings	Thickness-1.5cm
9.	Bevel Gear	Angle-90 <sup>0</sup> No.of Tooth-22 (for a Pair)

## 5. WORKING MODEL

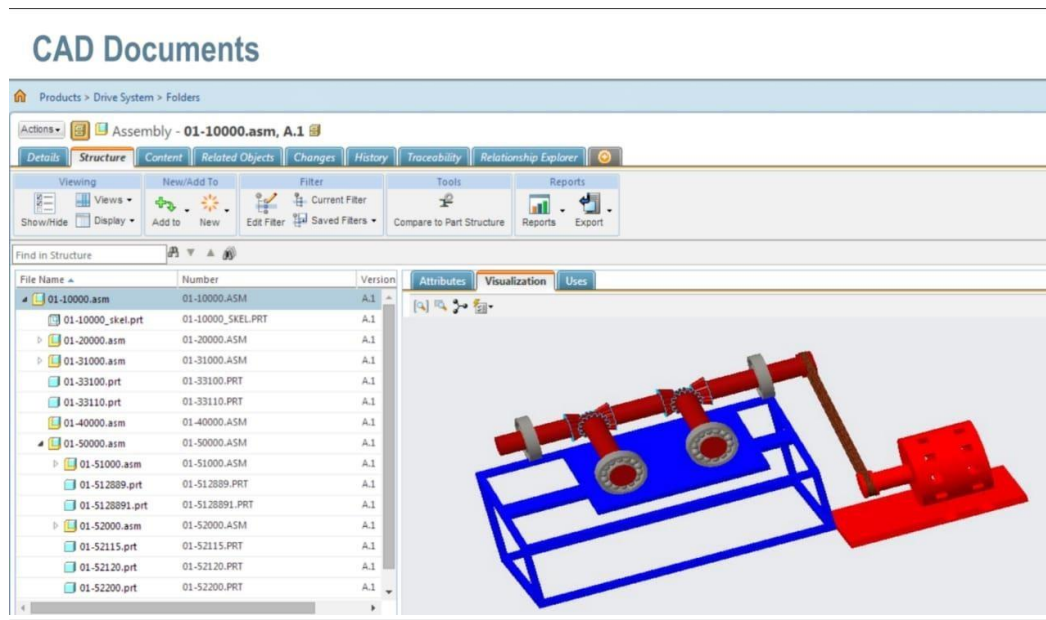


**Fig 6. Working model of shoe cleaning machine**

## 6. PRODUCT LAUNCHED IN PLM

Windchill is the industry-leading PLM software from PTC. Windchill's open architecture enables easy integration with other enterprise systems, helping you quickly see value from your PLM software. With comprehensive out-of-the-box functionality and highly-configurable role and task-based apps, you can expand access to valuable product data to stakeholders who don't

typically use PLM while avoiding over-customization and complexity. For manufacturers embarking on digital transformation, Windchill provides a solid foundation for the smart, connected enterprise. By enabling a digital thread of information, manufacturers can build a digital twin, invest in IoT technology, leverage augmented reality for better collaboration, or explore generative design and additive manufacturing.



*Fig 7. Product launched in windchill software*

## 7. CONCLUSION

The high speed rotation of the brush helps in cleaning of the shoe effectively and the rotating brush attached to the same shaft helps in polishing the shoe, where the liquid polish is manually applied to the shoe by the user. Hence the shoe cleaners are extremely useful in places where the dust due to the footwear is a major problem. The sole cleaning machine is a complete set up produced for cleaning the shoe in order to maintain dust free environment to the user. Thus we can conclude from the above that the usage of sole cleaning machine is a must for all the industries (chemical, food processing etc.) and institutions where cleanliness and dust free environment is a primary requirement.

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## Conflict of Interest

None of the authors have any conflicts of interest to declare.

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