SEMI-AUTOMATIC FLOOR CLEANING MACHINE

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ABSTRACT

Automated floor cleaning machines are commonly used in developing countries since many years because of high cost of labor, time, efforts and affordability. The concept is not popular in developing or emerging economic countries. Reasons for non-popularity are cost of machine and operational charges in terms of power tariff. This article is based upon on our innovative project to design, development and manufacturing of semi-automatic floor cleaning machine which will work on solar energy, battery or electricity. A semi-automatic floor cleaning machine is developed by keeping basic consideration for less energy consumption, machine as well as operational cost reduction, reduce the human effort, environment friendly and easy to handle. Base of the project was to use renewable energy which is abundant in most of the countries, will have less environmental impact and easy to construct for commercial scale in future.

Key words: Design, Innovation, Manufacturing, Modeling, Solar energy.

Cite this Article: Vardhaman Ladage, Shardool Jawanjal, Dnyanesh Kamat, Rutuja Majgaonkar and Bhagyashri Kadam, Semi-Automatic Floor Cleaning Machine. *International Journal of Design and Manufacturing Technology* 8(1), 2017, pp. 01–07.

<https://iaeme.com/Home/issue/IJDMT?Volume=8&Issue=1>

1. INTRODUCTION

Fully automatic machines available in the market are of high ranges. So, keeping the focus on cost factor, they are not affordable to all. The organization committee of hostels, hospitals, hotels can't afford these costs. Hence, there is need to develop floor cleaning machine which is cost effective using renewable sources.

In crowded places such as railway stations floors are not regularly cleaned due to hectic work of sweepers and non-availability of machines because of this, hygienic environment is not maintained. In India, especially in summer there is power crisis, in majority of places. Hence floor cleaning using floor cleaning machine is difficult without electricity. To overcome this problem, an alternative is made by using solar energy. Considering assembly, weight, handling design machine is flexible. Provision is made for water spraying. Main mottoes of research are:

- To reduce the human effort and cost.
- To make the environment sanitary.

2. MATERIAL&METHODOLOGY

Table 1 Material

Sr. No.	Part Name	Material	Specification
1 2 3 4 5	Chassis Crank Rod Wiper Handle	Steel Angle IS:808-1989 Mild Steel B.S.10720.1983	Angle 35×35×4 25ISF3
6	Roller	AISI52100 (Chrome Steel)	Hardness- 60-64 Rc

After taking number of trials of different mechanism, four bar chain mechanism is selected to operate the wiper by pivoting it properly. Later 3-D modeling and simulation was carried out using CATIA software. The CATIA tool is used to determine the swept area of wiper. To get maximum swept area pivot is adjusted. Using DMU Kinematics tool from CATIA, suitable length of links and wiper are selected.

Figure 1 Mechanism on CATIA software

To clean the floor, fiber cloth is attached to the wiper, addition to that there is provision of water jet through nozzle. Considering the ergonomics, position of handle is fixed, for ease of operation two switches are provided. The weight of machine is about 13kg and Mild steel is chosen for most of the components since it having required properties. It is also beneficial from cost and availability criteria.

Figure 2 CATIA Model

This machine is simply operated by pushing or pulling the handle with less effort as heavy load rollers are provided at the base. Designed machine operates on battery which can be charged either on solar or by electric supply. It is mainly designed to clean the Educational institutes, malls, hostels, colleges, hotels so that hectic work of sweepers can be reduced to great extent.

3. BODY PARTS

Motor

The motor is wiper motor used in cars. It requires 12V battery to operate. Basically it gives two speeds high and low which are suitable for floor cleaning.

Crank & Connecting Link

Crank is of 80 mm length. It is driven by motor. Connecting link is of 350 mm length whose ends are connected to crank and wiper.

Wiper

The length of wiper is 600 mm and pivoted at 100 mm length from one end. Provision is made to increase the swept area.

Microfiber Cloth

Microfiber cloth is used. Water soaking capacity is comparatively greater than any other alternatives.

Battery

12V battery is used for driving the wiper motor. It is rechargeable battery and can be operated for 3-3.5 hrs at “high speed”. It can be charged in 1hr by regular A.C. supply

Solar panel

10W solar panel is used which charges the battery in 4 hrs.

SMPS

Switched mode power supply (SMPS) converts A.C to D.C. It converts 230V A.C to 12V 5A D.C. It is purposely held in machine which has two advantages.

1. It can charge the battery by taking A.C. supply.
2. Output of SMPS is connected to motor as it gives 12 V output.

Figure 3 Machine Components**Table 2** Specifications of shown parts

Sr. No.	Component name	Specification	Qty.
1	Microfiber cloth	450 x 140 mm	1
2	Chassis	600 x 300 x 20 mm	1
3	Water tank	1.5 lit.	1
4	Push On switch	-	1
5	Toggle switch	Two way switch	1
6	Battery	12 V	1
7	SMPS	230V to 12V ,5A	1
8	Motor	12V, High speed 60 Rpm, Low speed 40 Rpm	1
9	Rolling wheel	Φ30 mm	4
Other parts			
10	Handle	-	1
11	Crank	80x 25x 3 mm	1
12	Connecting link	350 x 25 x 3 mm	1
13	Wiper link	600x 25x 3 mm	1
14	Solar panel	10W	1
15	Water Nozzle	-	1

4. WORKING

4.1. Principle

In this machine, as shown in Fig: (1), Crank is used for the motion of wiper through connecting links. Crank is connected to motor through which all motions are followed. Other end of crank is connected to connecting link which is connected to wiper, to give proper motion to wiper it is pivoted to chassis. Thus the rotary motion of crank is converted into oscillatory motion of wiper. 4.2 Working

Figure 4 Mechanism

Crank is driven by motor, and one end is connected to connecting link by nut bolt. Taking time into account two speed variants (high and low) are provided in the machine. It is controlled by the toggle switch situated at the handle. Cleaning element (cloth) is fixed to the wiper by means of which soaking and cleaning is carried out.

The water jet is provided at front side of machine such that water is sprayed on the floor as per requirement, by pressing the push on switch. Water tank which is connected to water jet is of 1.5 liter. Water, floor cleaning agents can be used in tank to spray on the floor for cleaning purpose.

5. CALCULATION

For Wiper,

$$\text{Angle Swept} = 85^\circ$$

$$\text{High speed Rpm} = 60\text{rpm}$$

$$\text{Low Speed Rpm} = 40\text{ rpm}$$

Calculation for swept area

$$\text{Swept Area} = \left[\frac{C}{360} \times \pi \times R_1^2 \right] - \left[\frac{C}{360} \times \pi \times (R_1^2 - R_2^2) \right]$$

Where,

$$C = \text{Swept angle} = 85^\circ$$

$$R_1 = \text{Length of Wiper from Pivot} = 500\text{ mm}$$

$$R_2 = \text{Length of wiping cloth} = 450\text{ mm}$$

$$\begin{aligned} \text{Swept Area} &= \left[\frac{85}{360} \times \pi \times 0.5^2 \right] - \left[\frac{85}{360} \times \pi \times (0.5^2 - 0.45^2) \right] \\ &= 0.18\text{ m}^2 \end{aligned}$$

For Motor,

Using tong tester,

For low speed

$$\text{Current drawn} = 0.07\text{A}$$

For high Speed

Current drawn = 0.25A

For low speed of motor

Maximum Power= $V \times I$

= 12×0.07

= 0.84 W

For High speed of motor

Maximum Power = $V \times I$

= 12×0.25

= 3W

- Time required to charge the battery of 12V by regular A.C supply is 1hr.
- Battery backup is of 3hr at high speed and 5 hr. at low speed.

6. BILL OF MATERIAL

Table 3 Bill of material

Sr No.	Component Name	Cost In Rs.
1	Chasis	100
2	Crank	50
3	Connecting Rod	150
4	Wiper Link	100
5	Handle	100
6	Motor	1200
7	Toggle Switch,Press Button, Water Nozzle,Roller	250
8	Solar Panel / SMPS (IF A.C USED)	700/400
9	Moping Cloth	300
10	Battery	1000

7. MANUFACTURED MODEL

Figure 5 Manufactured Machine

8. ADVANTAGES

- Cost effective & portable.
- User friendly, requires less human efforts.
- Less maintenance.
- Flexible i.e. it can be operated on solar, battery or direct A.C supply.

9. CONCLUSION

Semi- automatic floor cleaning machine is designed and manufactured using D.C Motor and wiper mechanism. Manufactured machine is flexible and effortlessly operated.

Effective use of solar energy conserves electricity. The need of this project is satisfied and with the help of machine, cleaning of the floor can be done easily.

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