

Application of Segway machine for floor cleaning with adjustable wiper

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Abstract—The adjustable wiper is attached to the Segway machine which can clean the any type and at any size of floor 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 energy which will have less environmental impact and easy to construct for commercial scale in future. Floor cleaning machine should provide a safe and healthy environment for residents and visitors, and cleaning of common spaces plays a vital role. Cleaning should be an environmental enhancement, not a source of unintended pollution. By definition, cleaning is the removal of unwanted matter, contaminants, or pollutants from the environment, or the prevention of soiling; thus, it is or should be green. Cleaning is about removing pollution, not adding to it.

IndexTerms—Segway machine, adjustable wiper, Adjustable handle

I. INTRODUCTION

All Fully automatic machines are 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 electrical battery. 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.

II. HISTORY OF FLOOR CLEANING MACHINE

Previously the floor cleaning is done by manually by using wiper or cloth. But this process was time consumable and required more efforts and these were costly. The first useful electric-powered floor cleaning machines date back to the early 1900s. Coincidentally, this was about the same time vacuum cleaners were introduced, the first floor cleaning machines were known as "divided-weight" machines. With these machines, the bulk of the weight of the machine was on its rear wheels, which will remain on the floor during cleaning of floor. These early machines used brushes made of Tampico and Bassine. Divided-weight machines lacked sufficient speed, weight, and pressure over the brush to produce a high-gloss shine, and they were hard to maneuver. The major benefits for the user were that the machines were faster and less strenuous to use than floor cleaning by hand. Floor cleaning technology continued to advance, further extending the length of time required between refinishing. By the 1970s, rotation speeds of 750 to 1,000 rpm were common.

III. EASE OF USE

The Segway machine is self-balancing two-wheeler vehicle that is driven by rechargeable batteries. This has the most creative, innovative design giving it the best features.

This is having a nice way of including fun and exciting moments in people. Apart from the fun, safety, and comfort are key requirements. The design of Segway machine for floor cleaning is innovative in nature.

It has a two-wheel design unlike the common automatic floor cleaning machine have more wheels and these are more bulky. Because of this Segway machine is more compact and easier to control. Segway machines are light in weight. The material from which it is made is light in weight making it more efficient in handling.

This machine can be used both indoors and outdoors. It operated using a battery. Hence, it does not need any fossil fuels to be powered. Therefore, it is ecofriendly. Battery is pocket friendly and it is affordable. There are no emissions that pollute the environment.

IV. PROBLEM IDENTIFICATION

The manually floor cleaning is time consumable and required more efforts and cost of operation is also more. The automatic operated floor cleaning machines are work more faster and hence it is less time consumable. But most of the automatic machines are more bulky and cost of the machine is relatively more than conventional method.



Fig 1.6.1 Manually floor cleaning.

1.6.2 floor cleaning by using machine:

The floor cleaning machines are work more faster and hence it is less time consumable. But most of the floor cleaning machines are more bulky and cost of the machine is relatively more than conventional method. The operation of the floor cleaning by using machine is becomes more complicated due to wiring and additional attachment with machine.



Fig. 1.6.2 floor cleaning by using machine

V. DESIGN OF FLOOR CLEANING MACHINE

3.1 CALCULATING TORQUE

Consider weight of rider = 80 kg

Chassis weight including batteries = 30 kg

Therefore, Total weight=110 kg (approx.)

Coefficient of friction between road and tire = 0.3

Torque required = Coefficient of friction*Friction Force * Radius of Wheel

$$T = 0.3 * 110(\text{kg}) * 10(\text{cm})$$

$$T = 3.30\text{kgf-m (Approx.)}$$

As two motor are used. Therefore torque required by each motor = 1.65kgf-m (Approx.)

3.2 CALCULATING STRESS

Stress: It is the intensity of internal resistance offered by a body/material against deformation.

Stress= Resisting force per unit area (or) load/area

- The weight acting on the Segway = weight of the Segway + weight of the user.

- Weight of the Segway = 30kg
- Max Weight of the user = 80kg
- Total weight acting on the Segway = 30+80 = 110kg
- Load acting on the Segway = $110 \times 9.81 = 1079.1 \text{ N}$
- Area of the Segway chassis = $300 \times 450 \text{ mm} = 135000 \text{ mm}^2$
- Stress acting on the frame or chassis of the Segway = $1079.1 / 250000 = 7.993 \times 10^{-3} \text{ MN}$

The stress acting on the frame of the Segway is very less than the allowable stress of the mild steel. So, the design is safe.

Yield stress: The yield stress or yield strength of the material, beyond which the material is said to start yielding.

- The maximum weight acting on the chassis of the Segway = 200kg
- The area of the frame = $300 \times 450 = 135000 \text{ mm}^2$
- Yield stress = yielding load/area
- Load acting = $\text{mass} \times 9.81 = 200 \times 9.81 = 1962 \text{ N} = 1962 / 135000 = 0.0145 \text{ MN}$
- The yield stress developed due to the max load is far less than the yield stress of the mild steel. Hence the design is safe.

Factor of safety = the ratio of ultimate load to allowable load is known as factor of safety

- Factor of safety = Ultimate load/Allowable load
- The ultimate load acting on the Segway chassis = $200 \times 9.81 = 1962 \text{ N}$
- The allowable load acting on the Segway chassis = $110 \times 9.81 = 1079.1 \text{ N}$
- Factor of safety = $1962 / 1079.1 = 1.8182$
- Design factor of safety = 2
- The factor of safety for our Segway is less than the designed factor of safety. Hence the Segway design is safe.

4.2 PRINCIPLE COMPONENTS OF FLOOR CLEANING MACHINE

The components of machine

4.2.1. FRAME OR CHASSIS:

The Segway we have fabricated has a rectangular shaped chassis. This chassis is made from mild steel pipe. The pipes used are medium gauge one inch hollow square pipe. This pipes are welded together to form the chassis of the Segway. This are joined in such a way it form a 300X450 mm square shaped member. At the center of the frame another square pipe is added to increase the strength and weight carrying capacity of the frame. On top of the frame mild steel sheet is added to provide the platform for standing on the frame.

4.2.2. DRIVING MECHANISM:

The drive train is the heart of the automobile. In our Segway the drive train includes two DC motor and rechargeable battery which are charged to drive the motor. The type of drive in a Segway is two wheel drive. In which both the wheels are driving wheels.

The powers from the motors are transferred to the wheels independently or separately. The motors shaft is welded to the wheel shaft for the transfer of motion between the wheels and the motor. The final parts of the drive train are the wheels and tires, which transfer the power generated by the motor to the ground.

4.2.3. MOTORS:

The motors used in our Segway are dc motors with a voltage of 12v, 60 rpm and with a power of 90watt.

4.2.4. BATTERY:

The battery which we used for our Segway is a 12v and 7 amp lead acid batteries and these batteries are rechargeable. The batteries are connected in parallel and are connected to the control unit from which the power is transferred to the motors. The total charging time will be some 2-3 hours.

4.2.5. CONTROL UNIT:

The control unit of a Segway is the brain of the Segway. It plays a very important role behind every operation of the Segway. The signals which ever are given to the Segway are transmitted through the control unit to the motors. For the Segway to run the control unit is needed. The operation of the control unit will be in accordance with the switches, when the switches are pressed the signals are transferred from the control unit to the motors.

4.2.6. ASSEMBLY OF MACHINE

- Two motors are placed in the opposite side of the chassis and they are attached to the frame by c-clamps.
- Motor shaft is fitted in coincidence with the wheel shaft.
- Segway wheels are attached on the motor shaft.
- Handled bar is fitting in the front side of chassis.
- Later the two shafts are joined together by the process of welding.
- Wheels are assembled to the frame or chassis by using ball bearings and c- clamp.

- vii. The handle bar is attached to the Segway on top of the chassis at the front side of Segway, on which toggle switch fixed.

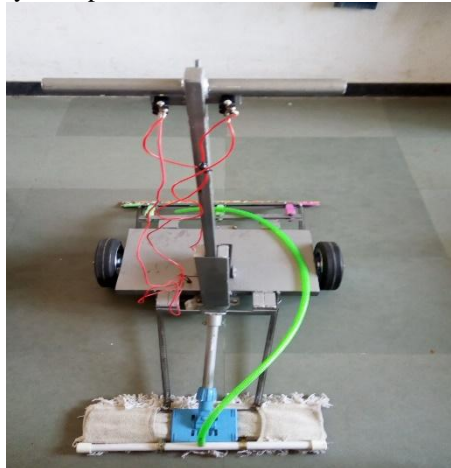


Fig 4.2 Complete assembly of the floor cleaning machine

VI.RESULT AND DISCUSSION

Table 5.1 Total cost of machine

Components	Quantity	Cost (Rs)
Motor	2	4000
Wheels	2	600
Frame materials		1200
Battery	1	1000
Stud & Nut	37	600
Wiper	1	350
Switch	2	70
Motor (sprayer)	1	300
Extras part		230
Fabrication		400
Total		8750

5.2 RESULT AND DISCUSSION:

Above table shows the total cost for Design and fabrication of floor cleaning machine by using Segway. The total cost of this floor cleaning machine is around 9000/ which will less than existing floor cleaning machine. The design which we have come with cost the Segway around 9,000 as compared to original Segway which costs around 3 lakhs plus tax, thus the product is cost effective. The product thus developed is fully operational and gives desired motion. It is being tested in college campus which results in successful outcome.

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