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A RESEARCH PAPER ON "DESIGN AND DEVELOPMENT OF FLOOR CLEANING MACHINE"

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Abstract -*The purpose of this project is to clean the floors in colleges, hospitals, auditoriums, malls and workshops. The aim of this project work is to design and develop process for cleaning the floor having wet and dry surfaces. It is very useful for cleaning the wet as well as dry floors. In modern days interior decorations are becoming an important in our life cleaning of floor is very important for our health and this floor cleaning machine reduces the effort required for cleaning. Hence this project is very useful in our day to day life. It is very simple in construction and easy to operate, anybody can operate this machine easily. This floor cleaning machine consist of moisture cotton mop, swiping brushes, wipers and vaccum cleaner for reducing the cleaning time. The overall cost of this machine is also cheap. Such type of machines is widely used for this purpose but they are working under different principles and the cost is very high. In recent years, floor cleaning machines are getting more popular for cleaning large floor area in minimum time. However in India, which is a developing country requires large type of such machines to satisfy the cleaning needs.*

***Key word*:** *floor cleaning machine; vacuum cleaner; wiper.*

I. INTRODUCTION

Cleaning machine is very much useful in cleaning floors and outside ground in hospitals, houses, auditorium, bus stands and public place etc. In modern days interior as well as outside cleaning are becoming an important role in our life. Cleaning of waste is a very important one for our health and reduces the man power requirement. Many of floor cleaning machines are available but we developed machine is very simple in construction and easy to operate. Anybody can operate this machine easily. Hence it is very useful in hospitals, any large area space. The time taken for cleaning is very less and the cost is also very less. Maintenance cost is less. Much type of machines is widely used for this purpose. In our project we have made the machine to operate in a fully mechanical way with a little amount of electrical components. The Floor cleaner is of very simple construction and is very easy to operate; anyone can operate it without any prior training of any sorts with safety.

Cleaning is essential need of this generation. Basically in colleges and hospitals for floor cleaning regularly different techniques are used to clean the different types of surfaces. The reasons for floor cleaning are:

- Injuries due to slips on the floors are cause of accidental injuries or death. Bad practice in floor cleaning is a major cause of accidents.
- To beautify the floor.
- Debris and obstructions are to be removed.
- Allergens and dusts are to be removed.
- Surfaces wear to be avoided.
- To make the environment sanitary (kitchens).
- Traction should be maintained at optimum level, so that no slip will occur.

The dust or water present on the floor is scrub by the front two brushes. This dust and water is collected by the vacuum cleaner and the detergent water is sprayed on the floor the mope present in the middle section of the chassis perform rotary motion on the floor which cleans the dirt or dust. The remaining water on the floor is wiping by the wiper present in end of the cleaning machine.

II. HISTORY

Historical evidence suggests that carpet cleaning procedures emerged during the 19th century. The Industrial Revolution inspired new ideas of cleanliness in Europe and North America. Before the advent of the Industrial Revolution, people protected their carpets by covering them with druggets, or thick, heavy woolen goods that spread underneath tables and other exposed areas. Druggets protected against spills and other stains. Wealthy individuals used canvas cloth to cover

carpet while away on vacations and during social events held in their homes. The lack of ventilationcaused houses to fill with dust, dirt, and soot, which prompted people to search for ways to clean their homes. Societies placed significant value on their homes at that time, which sparked an innovative mindset tocleanhouses more efficiently. One of the most commontechniques for cleaning carpet involved beating rugs with brooms to remove sand, dust, and soot; however, this method did not remove stains. Effective stain removal methods did not emerge until the 1830s, when creative housewives recorded their secrets for the removal of ink, grease, and oil. One stain removal method involved scrubbing carpet with lemon juice and a hot loaf of bread. During the late 1860s and 1870s, carpet cleaning techniques took a leap for the better with the advent of the first manually-operated vacuum cleaner. The vacuum cleaner made it easier for people to manage their daily housecleaning. Ives W. McGuffey invented the "Whirlwind," or the first manually-operated vacuum cleaner in 1868. The "Whirlwind" was lightweight, compact, and difficult to operate. Other inventors designed their own manually-operated vacuum cleaners in the United States and Europe. By the 1880s, readers could find an array of professional cleaning advice in various publications. One carpet cleaning method involved mixing water and bull's gall before scrubbing it with a flannel cloth and then rinsing it with cold water. The vacuum cleaning industry went silent during the 1920s and 1930s, because carpet had become unfashionable during this time. However, most people acknowledged that rugs needed vacuuming before shampooing .Over the years, the carpet cleaning and flooring industry has improved its system and chemicals to clean more efficiently

III. PROBLEM IDENTIFICATION

During the manual cleaning operation some dust and dirt particle may remain on the floor and due to the action of air the dirt and dust particle transfer from one surface to another surface which create the problems during cleaning which tends to increase manual effort. Due to which desire cleaning of the surface not gain and because of that it takes more time.
During the rainy season the muddy water are dump on the corner of the wall with the help of manual cleaning it cannot possible to remove all the water from the surface of the floor which creates sleepy surface and which may increase the chances of accidents also the water which remains on the corridor enter into the rooms. Due to uneven surface of the corridor or floor during the wet cleaning of the surface desired cleaning not obtained and backflow of the water occurs which tends to increase manual effort and it is difficult to clean uneven surface of the floor and takes more time for cleaning of the surface.

IV. OBJECTIVE

1. To develop a machine that helps in easy and quick cleaning.
2. To provide the alternative method for road cleaning.
3. To reduce human efforts.
4. To save the time.
5. To reduce the cost.
6. To prevent injuries due to tripping or slipping. Injuries due to slips and trips on level floors are a major cause of accidental injury or death. Bad practice in floor cleaning is itself a major cause of accidents.
7. To beautify the floor.
8. To remove stains dirt.
9. To remove grit and sand which scratch and wear down the surface.
10. To remove allergens, in particular dust.
11. To make the environment sanitary.

V. RESEARCH METHODOLOGY

5.1 Problem Identification:

During literature survey we got that on many large places it hard to clean floor properly. Like in collages, companies, hospital etc. in this places the cleaning of floor takes much time and men power this cleaning is done on large scale because the area to be covered to clean is so large and this places doesn't clean properly by manual cleaning.

5.2 Literature Survey:

After studying the various research papers of floor cleaning machines we have concluded that there are certain limitations in floor cleaning machines which can be worked upon. For example cleaning machines are made with an aim to clean only dry surface of the floor. This means that they are only sufficient in the summer and winter season but not in rainy season this is the major issue for cleaning the floor surface but during the rainy season floor cleaning machines are required which can perform the tasks when the surface contain moisture or little amount of water on the surface of floor. So we are developing the machine which can work in both dry and wet conditions. This machine called as dry and wet

floor cleaning machine. This machine can remove the dust in summer season and also it can remove and clean the dirt, water from floor in rainy season.

5.3 Market Survey:

During the market survey we got that in the market there are several types of floor cleaning machines are available for large scale cleaning but the cost of these machines are very high.

5.4 Design:

In the design of the floor cleaning machine is very compact as compare to other cleaning machine are available in the market but has the attractive design and high durability.

5.5 Development:

The machine consist of several parts that is vaccum cleaner, DC motor, wiper, mope and brushes these parts are fitted on the welded chassis made up of mild steel square bar of one inch and these parts are connected electric system. For DC motor the supply is provided through SMPS which converts AC supply into 12v DC supply.

5.6 Testing:

After the completion of this project we tested and concluded that the cleaning performance of these machines is satisfactory.

VI. CONSTRUCTION

The manually operated floor cleaning machine consist of various elements such as, DC motors, vacuum cleaner, fresh water sprayer pump, wiper, mope, brushes, chassis and fresh water tank. For converting the AC supply into DC the Switched mode power supply (SMPS) is used. The fresh water tank is used to stores the water in it. While doing wet cleaning it provides water as per the requirement. The switch board is fixed onto the handle. It is used to start and stop the machine as per operator's wish different buttons are provided to operate the different component. Chassis is a Main part of machine which holds all other parts on it. It is made up of mild steel because it satisfies all the required conditions. Water is stored in a chamber that has a opening controlled by a motor. By putting this motor to ON position water or cleaning liquid starts flowing from the tank. It is connected to a shower type arrangement via connecting pipe. The sprinkler system has a number of holes arranged sequentially which can be modified manually. An arc is provided in order to adjust the position of mop when there is no need of mop. Wiper is provided behind the chassis to restrict the flow of water from chassis body for deep cleaning.
Followings are the Component of floor cleaning machine

6.1DC motor:

DC motor is an electrical machine that utilizes electric power resulting in mechanical power output. Normally the motor output is a rotational motion of the shaft. The input may be direct current supply or alternating supply. But in case of DC motor direct current is used. The mechanism of dc motor is like a bar wound with wire is placed in between 2 magnets having North and South Pole. When it is provided with electric supply the wire becomes energized resulting in rotational motion which leads to rotational output. The universal motor can operate on direct current but is a lightweight motor used for portable power tools and appliances. Larger DC motors are used in propulsion of electric vehicles, elevator and hoists, or in drives for steel rolling mills. The advent of power electronics has made replacement of DC motors with AC motors possible in many applications can operate on direct current but is a lightweight motor used for portable power tools and appliances. Larger DC motors are used in propulsion of electric vehicles, elevator and hoists, or in drives for steel rolling mills. The advent of power electronics has made replacement of DC motors with The universal motor can operate on direct current but is a lightweight motor used for portable power tools and appliances. Larger DC motors are used in propulsion of electric vehicles, elevator and hoists, or in drives for steel rolling mills. The advent of power electronics has made replacement of DC motors with AC motors possible in many applications possible in many applications.

Specification

DC motor I (12v, 3 Amp, 17.18 kg-cm, 200 rpm)

DC motor II (12v, 1Amp, 3.88 kg-cm, 300 rpm)

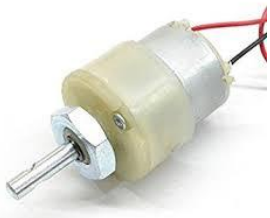

Figure:a) DC geared motor (200 rpm)

Figure: b) DC geared motor (300 rpm)

6.2 Vacuum Cleaner:

A vacuum cleaner, also known as a sweeper or hoover, is a device that uses an air pump (a centrifugal fan in all but some of the very oldest models), to create a partial vacuum to suck up dust and dirt, usually from floors, and from other surfaces such as upholstery and draperies. The dirt is collected by either a dust bag or a cyclone for later disposal. Vacuum cleaners, which are used in homes as well as in industry, exist in a variety of sizes and models—small battery-powered hand-held devices, wheeled canister models for home use, domestic central vacuum cleaners, huge stationary industrial appliances that can handle several hundred litres of dust before being emptied, and self-propelled vacuum trucks for recovery of large spills or removal of contaminated soil. Specialized shop vacuums can be used to suck up both dust and liquids.

specification

Dimensions – (415*415*440)mm
Weight – (6 kg)
Suction of motor – 2000 mm/wc (19600 pa)
Blower efficiency – 30 lit/sec
Noise – lessthan 88 dB
Power – 1200w
Voltage – 230v, 50Hz

Figure: Vacuum Cleaner

6.3 Brushes:

A scrubber is a type of wide brush with a long shaft used for cleaning hard floors or surfaces. Unlike a broom, which has soft bristles to sweep dirt away, a scrubber has hard bristles for brushing. It may therefore be used wet, with water or cleaning fluids. Around the brush head there may also be a removable floor cloth or mop, either soaked in water for cleaning or dry for wiping dry. However, these days other cleaning implements tend to be used for such purposes and for many other purposes. It is one of the most basic and versatile tools in use today, and the average household may contain several dozen varieties. They generally consist of a handle or block to which filaments are affixed either parallel- or perpendicular-wise, depending on the way the brush is to be gripped during use. The material of both the block and bristles or filaments is chosen to withstand hazards of its application, such as corrosive chemicals, heat or abrasion.

Figure:Brush

6.4 Wiper:

Wiper is made from plastic and sponge. The pipe is made up of zinc coated aluminium material. Wiper is provided at the last in the machine for cleaning the remaining dust or water. Provision is made to increase the swept area.

Figure: Wiper

6.5 Mope:

A mop (such as a floor mop) is a mass or bundle of coarse strings or yarn, etc., or a piece of cloth, sponge, or other absorbent material, attached to a pole or stick. It is used to soak up liquid, for cleaning floors and other surfaces, to mop up dust, or for other cleaning purposes.[1] The word is attested in English as early as 1496, but new refinements and variations of mop designs have been introduced, from time to time. For example, American inventor Jacob Howe received for a mop holder in 1893. A wet mop or moist mop is, in professional cleaning, used as in the second step in the cleaning of a surface. The wet mop is swept over the surface to dissolve and absorb fat, mud and dried-in liquid contaminations. Professional wet mops consist of a flat sheet of microfiber textile or a sheet with a surface. A dry mop or dust mop is designed to pick up dry, loose contamination such as dust, earth, and sand from the surface of the floor. It consists of yarn and/or microfiber and is used as a first step in cleaning a floor.is designed to pick up dry, loose contamination such as dust, earth, and sand from the surface of the floor. It consists of yarn and/or microfiber and is used as a first step in cleaning a floor.

Figure: Mope

6.6 Water spray pump:

The next work of the machine is to make the surface wet. To achieve this we have designed a sprinkling mechanism. Water is stored in a chamber that has a opening controlled by a motor. By putting this motor to ON position water or cleaning liquid starts flowing from the chamber. It is connected to a shower type arrangement via connecting pipe. the sprinkler system has a number of holes arranged sequentially which can be modified manually. This arrangement ensures equal wetness across the width. The challenge here is not to put too much liquid over the surface which may lead to wet floor after the cleaning is complete. To overcome this the motor is automated with the control system. This is programmed such a way to put required amount of liquid according to the relative stay of the machine.

Figure: Water spray pump

6.7 Switched mode power supply (SMPS):

Switched mode power supply (SMPS) converts A.C to D.C. A switched-mode power supply is an electronic power supply that incorporates a switching regulator to convert electrical power efficiently. Like other power supplies, an SMPS transfers power from a DC or AC source (often mains power) to DC loads, such as a personal computer, while converting voltage and current characteristics. Unlike a linear power supply, the pass transistor of a switching-mode supply continually switches between low-dissipation, full-on and full-off states, and spends very little time in the high dissipation transitions, which minimizes wasted energy. Ideally, a switched-mode power supply dissipates no power. Voltage regulation is achieved by varying the ratio of on-to-off time. This higher power conversion efficiency is an important advantage of a switched-mode power supply. Switched-mode power supplies may also be substantially

smaller and lighter than a linear supply due to the smaller transformer size and weight. The main advantage of the switching power supply is greater efficiency than linear regulators because the switching transistor dissipates little power when acting as a switch.

Specification

Input – 230v, 50Hz
Output – 12v, 50Hz

Figure: Switched mode power supply (SMPS)

6.8 Chassis:

It is the back bone of the system. All the systems and parts are attached to it. The solidity of the system is greatly affected by the chassis. It in square, rectangular or circular shape Chassis is consists of an internal vehicle frame that supports an artificial object in its construction and use, can also provide protection for some internal parts. An example of a chassis is the under part of a motor vehicle, consisting of the frame (on which the body is mounted). If the running gear such as wheels and transmission, and sometimes even the driver's seat, are included, then the assembly is described as a rolling chassis.

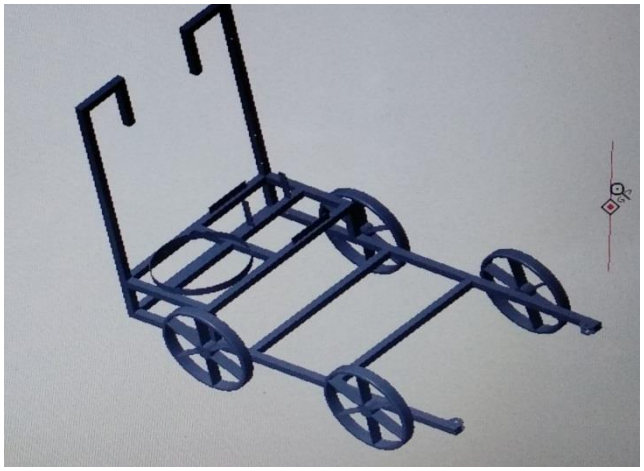

Figure: Model of Chassis

6.9 Caster wheel:

A caster is a wheeled device typically mounted to a larger object that enables relatively easy rolling movement of the object. Casters are essentially special housings that include a wheel, facilitating the installation of wheels on objects. Casters are found virtually everywhere, from office desk chairs to shipyards, from hospital beds to automotive factories. They range in size from the very small furniture casters to massive industrial casters, and individual load capacities span 100 pounds (45 kg) or less to 100,000 pounds (45 t). Wheel materials include cast iron, plastic, rubber, polyurethane, forged steel, stainless steel, aluminum, and more. This type of caster allows for movement in multiple directions. They can have one or two sets of raceways that allow the caster to swivel 360 degrees under a load.

Figure: Caster wheel

VII. WORKING

When 230V, 50Hz AC supply is provided to the electrical switch board of the machine. The main supply from electrical board is supplied to SMPS and vacuum cleaner, during working alternating current is supplied to the vacuum cleaner and SMPS. SMPS is a electrical device which converts the alternating current (AC) into direct current (DC) is used to operate the d.c motors which performs a key role in cleaning operation. There are three D.C motors one is used to rotate the mop for cleaning the middle surface that is covered by the chassis. The DC motor used for rotation of the mop having high torque than the motor used for the brushes. The other two DC motors having high RPM are used to clean the front section of the floor the DC motor rotates the brushes through the shaft which is connected to the shaft of the motor through nut and bolt. During summer season the uneven particles which collects on the surface of the floor are clean through the front two brushes and from the middle slots the dirt particles enters into vaccum cleaner from the suction pipe and the position of the mop can be adjusted with the help of arc provided on the left hand side of the chassis. During the dry cleaning the supply of water is disconnected.

Rainy Season:

During the rainy season the working of floor cleaning machine slightly changes in this condition the water and dust or dirt particles are brought into the middle section of the chassis through the rotating brushes. The rotational direction of the bushes are opposite to each other in order to collect the more amount of water in the middle section and this mixture of water and dirt is collected into the vacuum cleaner through inlet pipe which is located in between the two brushes. The third motor rotates the mop for efficient cleaning. At the bottom of the water tank water spray pump is provided which supply the fresh water for efficient cleaning the supply of fresh water is controlled through the control valve. In the water flowing tube number of holes are created for equal amount of water Different button in the electrical board is provided to control the electrical supply of each equipment of the floor cleaning machine.

VIII. MODELING

Introduction to PRO - E 3.0:PTC Creo Parametric is powerful software used to create complex designs with great preci sion.The design intent of a three-dimensional (3D) model or an assembly is definedby its specification and its use. You c an use the powerful tools of PTC Creo Parametric to capture the design intent of a complex model by incorporating intell igence into the design. Once you understand the feature-based, associative, and parametric nature of PTC Creo Parametri c, you can appreciate its power as a solid modeling tool. To make the designing process simple and quick, the designing process has been divided into different modules in this software package.

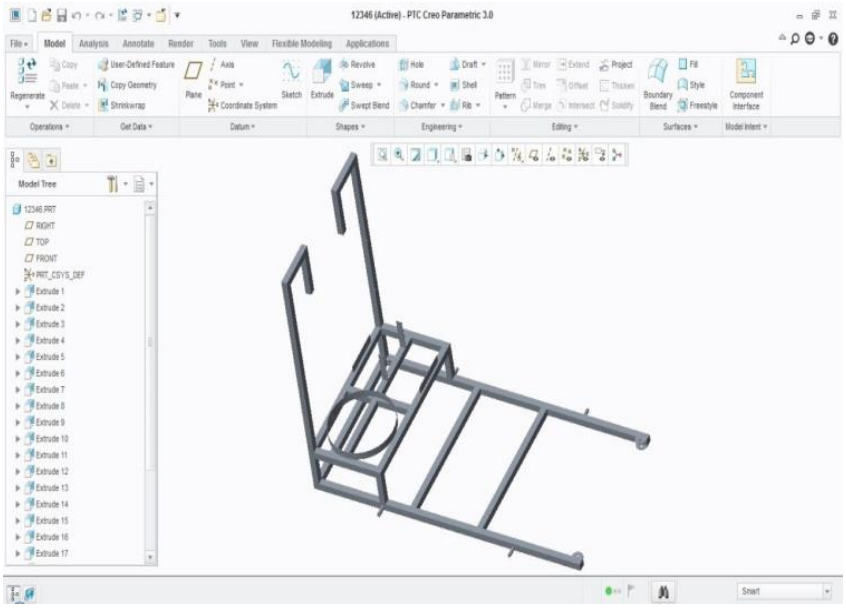

Figure: Modeling in PRO-E

IX. ADVANTAGES

1. Manual effort is reduced:
   This floor cleaning machine has the electric work system that reduces the manual effort in the cleaning of surface.
2. Operating time is less:
   As we are using the motorized brushes and mop in this machine this will reduce the operating time and cleaning work can be done faster.
3. Cleaning and polishing can be done at same time:
   By using brush we can clean the dirt and dust and as well as at the same time floor polishing is also done with the help of mop.

4. Power consumption is less:
   As we are using the low voltage electric dc motor the power consumption is less.
5. This machine requires low Maintenance cost.
6. In this machine Easy control of cleaning solution supply by controlling valve.
7. It can be used on various places other than rough surfaces.
8. By further modification the drive or movement can be made automatic.

X. DISADVANTAGES

1. Floor cleaning machine produces vibrations when used on rough floors or rough surfaces.
2. Floor cleaning machine is Suitable for only flat surfaces.
3. Floor cleaning machine is Semi-automated machine.
4. It is heavy to lift.
5. It is not capable to clean stair of any building.
6. Maintenance of mop is required.

XI. APPLICATIONS

1. Hospitals – floor cleaning machines are used in hospitals for both wet and dry cleaning. In order to obtain hygienic surface.
2. Computer centers – To maintain the desired cleaning surface finish.
3. Colleges – it is mainly used to clean the dust which is collected on the surface.
4. Railway station– On the platform of the railway station it can be used in any seasons.
5. Auditoriums & Malls
6. Cinema Halls

XII. CONCLUSION

In our project we introduced a floor cleaning robot capable of performing both vacuum and mopping. The main motive of the project is to cover the aspects of cleanliness in the society. The multiple applications provide a wide range of functions in which we can clean the pipe, scrubbing of surface for proper cleaning of the floor, remove dust and dirt from the road, provide a pick and place mechanism by which obstacles can be removed. This project is very helpful for the society and plays a vital role in cleanliness of the country. Few of those are the motor is not detachable and the high rpm leads to vibration of the whole system. If these features will be modified, this will work well. As a whole this is a successful product developed that can be used in current Indian house-hold. This design of automated floor cleaning system can be used to clean any kind of remote places. As the motors selected can consume much less power so it will be the power saving and cost saving too. Semi- automatic floor cleaning machine is designed and manufactured using D.C Motor and wiper mechanism. Manufactured machine is flexible and effortlessly operated. Manual Sweeping done by man might not be that effective as it will not be picking up everything in as it is not in sight but using the floor cleaner it can be done easily. A manually operated eco-friendly road cleaner is an alternative concept for avoiding such problems. The manually operated eco-friendly road cleaner can work very efficiently with respect to covering area, time and cost of road cleaning process compared with the existing machineries. Also it is economical. It was seen while testing of machine, that the cleaning is less effective where the road seems to be very rough and damaged.

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