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''Design and Fabrication of Manually Operated Floor Cleaning Machine''

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Abstract: - With the advancement of technology, automated floor cleaning machines are getting more attention of researchers to make life of mankind comfortable. The concept is developing in economic countries but the reasons for non-popularity is the design complexity, cost of machines, and operational charges in terms of power tariff. In this paper, a manual floor cleaning machine is proposed. In early day a floor is clean by using a broom which is operated by human hand, in this a continuous movement of human hand is required which create fatigue and time consuming . The aim of this work is to develop and modernized process for cleaning the floor with wet and dry. This machine is capable of performing cleaning of floor in dry as well as wet condition, and it also have storage box to store a dust. This floor cleaning machine is designed by keeping the basic considerations for machine and efforts reduction, environment friendly and easy handling. The machine will work on electricity and there is no need of training to operate it. This work can be very useful to improve the life style of mankind.

1. Introduction

Cleaning is the essential need of the current generation. Basically in household the floor has to be cleaned regularly. This machine deals with designing and fabrication of floor cleaning machine. The main aim is that it combines operation of all three different device's operation i.e. vacuum cleaner, dryer & mop. For floor cleaning, many types of machines are available in the market are of high ranges and high weights. So, keeping the focus on weight as well as cost, they are not affordable to everyone. As many type of machines is widely used for this purpose. Hence, there is need to design and develop a floor cleaning machine which is multi use and cost effective. Considering weight criteria, machine assembly, handling the machine is very flexible. It is very simple in construction and easy to operate. Anybody can operate this machine easily. The size of the machine is also portable, so we can transfer from one place to other place very easily. This machine is applicable for various floor cleaning activities. Hence there is a need of bringing revolution in the area of science and technologies, which could help easily in repetitive tasks which we perform daily. It also giving consideration to the intensity of labor required and improving qualities to its optimum level.

A manually operated floor cleaning is developed with major list of objectives:-

1. To achieve simultaneous dry and wet cleaning in a single run.

2. Lower Maintenance Cost and Time.

3. Required less cleaning time.

4. Clean more space in less time.

2. Literature Review

Himani Patel in her research, she works on wireless multipurpose floor cleaning machine. She focused on the problems of long wires so to overcome this problem she use battery system which can be rechargeable when electricity is available and work as required.**[1]**

Arjun V Murali et al. in their research, they work on floor cleaning machine. Their aim to develop and modernized process for cleaning the floor with wet and dry. At first dust is collected from vacuum cleaner. After that Water is sprayed from water tank and floor cleaning is done by rotating press which is coupled to the DC motor. Fan is used to dry the water which is fitted to the Back side of the vehicle.**[2]**

Mr. S. Rameshkumar et al. in their research, they work on Design and fabrication of multipurpose floor cleaning machine. In their work, modeling and analysis of the floor cleaning machine was done using suitable commercially available software. From the finite element analysis, they observe that the stress level in the manually operated floor cleaning machine is within the safe limit.**[3]**

Samarth G. Gaikwad et al. in their research, they work on Design and development of multi-functional floor scrubber and cleaner. They focused on to design and develop a multifunctional floor scrubber and cleaner which will substantially reduce the cleaning time and cost of the machine. At the same time, the floor cleaning machine should be capable of cleaning rough as well as smooth floors and inaccessible corners effectively. Through efficient project management, aspects like minimization of manufacturing and operational cost, aesthetic and ergonomic considerations were taken into account. Eventually this machine will lead to hefty decrease in time, money and effort.**[4]**

Shubham Khade In his research, he works on Multi-use floor cleaning machine. He developed machine which is capable of performing cleaning of floor and corners effectively, semi-automatic water spray, cleaning of byre, dry as well as wet cleaning tasks. This floor cleaning machine is designed by keeping the basic considerations for machine and operational cost reduction, efforts reduction, environment friendly and easy handling.**[5]**

Shubham Antapurkar in his research, he works on Arduino based dry and wet automatic floor cleaner. His aim is to construct a floor cleaner which will be fully automatic providing dry and wet cleaning as well as UV sterilization. The current market is occupied by cleaners with only one or two functionality. For its cost reduction and simplicity, he is using Arduino. The cleaner will be a step for providing comfortable life by resolving problems in traditional floor cleaning methods.**[6]**

Anup Mendhe et al. in their research, they work on Multi-purpose floor cleaning machine. They focused on to develop and modernized process for cleaning the floor. The floor washer is a new mechanism for solving the problems of floor cleaning, pipe cleaning, dust or garbage removing that makes a life difficult. The study comprehend of floor cleaner which having components like dc motor operated wheels, blower, scrubbers, pipe cleaning brush, mechanical gripper, solar panel. A 12V rechargeable battery is used as a power supply.**[7]**

Aadil Arshad et al. in their research, they work on Design and development of floor cleaning machine. They designed and developed process for cleaning the floor having wet and dry surfaces. So they are developed the machine which work in both dry and wet conditions. This machine can remove the dust in summer season and also it can remove and clean the dirt, water from floor in rainy season.**[8]**

Ms. R. Abarna et al. in their research, they work on Design and fabrication of automatic floor cleaning machine. Their system enables cleaning of the floor by the help of highly stabilized and rapidly functionalized electronic and mechanical control system. Current project work targets to use automatic floor cleaner for large floor in house-hold purposes and office floors. The cleaning purpose is specifically carried out by continuous relative motion between a scrubber and the floor surface.**[9]**

3. Components Description

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. It requires 12V battery to operate, in this two D.C. motor are require

Tank: It stores the water in it. While doing wet cleaning it provides water as per the requirement.

Frame: It 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 conditions required and also it is easily available in the market.

SMPS: Switched mode power supply (SMPS) converts A.C to D.C .It converts 230V A.C to 12V 5A D.C. Output of SMPS is connected to motor as it gives 12 V output. 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

Vacuum Cleaner: A vacuum cleaner is a device that uses as air pump 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.

Rotating brush: These brushes have a rotating motion. It is made up of nylons. The nylons are fixed around the shaft. Nylon Roller Brushes consists of a structural shaft connected to the plastic tube. The filaments, locked to the support are trimmed to form a cylindrical work surface. The versatility of this structure allows maximizing working performance. Roller brushes are also referred to as cylinder brushes and are staple set (punch filled), or wound from brush strip for cylinder & coil brushes.

Water spray pump: The next work of the machine is to make the surface wet. To achieve this we have designed a sprinkling system. By using water pump water flows to the surface with the help of pipe and we made very small holes at the end of the pipe, which gives us a sprinkling effect. Water is stored in a chamber that has a opening controlled by switch. By putting switch to ON position water or cleaning liquid starts flowing from the chamber.

Mop: 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.

Hot air blower: It is an electromechanical device that blows ambient or hot air to speed the evaporation of water to dry the floor. It works by passing air across a heated element to elevate the temperature of the air.

4. Design calculation

- **Torque requirement and selection of motor:-**

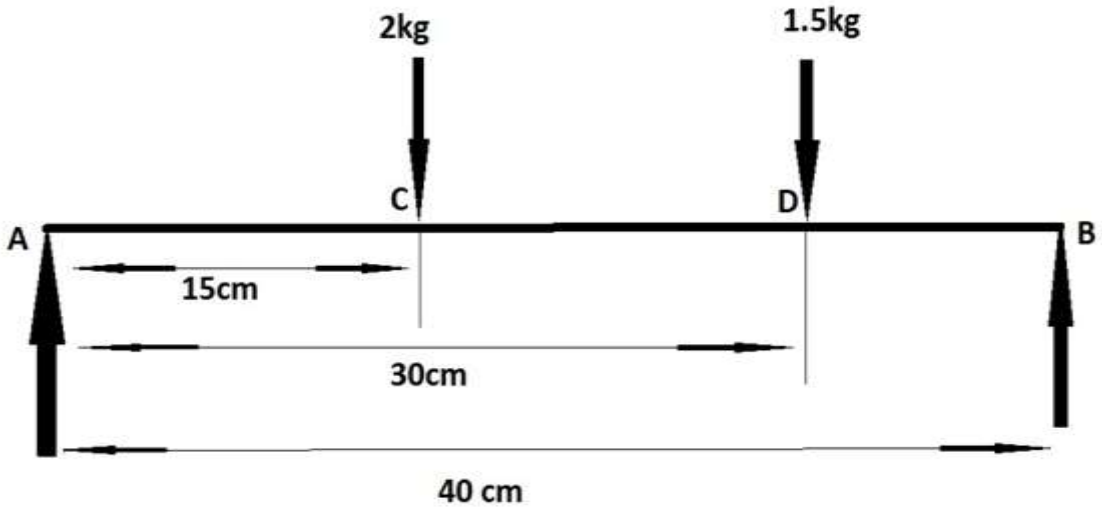
1. Load on mop=5kg (considering max for better work)
2. Diameter of bracket=34cm=0.17m
3. Coefficient of friction between mop and floor=0.8 (by taking a reference from literature reviews)

*Force=0.8×5×9.81=39N

*Torque requirement=F×R=39×0.17=6.63Nm

Hence 10Nm torque at 60Rpm can be used.

- **Design of frame:-**



(beam structure of a frame)

C=2×9.81=19.62N

D=1.5×9.81=14.71N

RA+RB=19.62+14.71

RA+RB=34.33N

Taking moment at RA we get

19.62×0.15+14.71×0.3=RB×0.40

RB=18.39N

Therefore RA=15.94N

Bending moment at various point

MA=0

MC=RA×0.15=15.94×0.15=2.39Nm

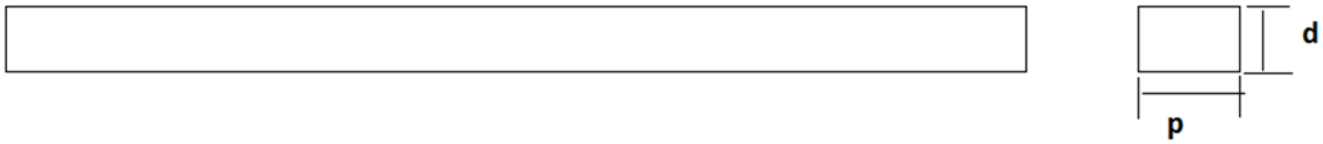
MD=RA×0.30-C×0.15=19.94×0.30-19.62×0.15=3.039Nm

ME=0

Max bending moment is at point D of 3.039Nm

By formula,

(Bending moment)/(MI)=(Bending strength of mild steel)/Y----------{1}



Where, MI=pd3/12 (moment of inertia of rectangular section)

Bending strength of mild steel=370 n/mm2

Y=distance between neutral axis to the edge =d/2

By put all the value in equation {1} we get,

d=1.56mm.hence, here we have taken 3mm standard strip which is easily available in market.

5. Components Specification

S.N	Component Name	Specification	Quantity
1.	Frame	M.S. 60*40 cm	1
2.	motor	12V,60 RPM	1
3.	SMPS	230 V to 12V,1A	1
4.	Rolling wheel	-------	2
5.	Mop wheel	35 cm Dia.	1
6.	Water tank	1.5 Lit	1
7.	Push ON switch	--------	1
8.	Vacuum cleaner	230 V,50 Hz, 1000W	1
9.	Hot air blower	1000W	2
11.	Circular brush	12 cm Dia.	2
13.	Dc motor	12 v,150 rpm	1
14.	water pump	9 v	1

6. Methodology

Floor cleaning is achieved by different technique which might be of different kinds. Different types of floor need different type of treatment. The floor should be totally dry after the cleaning process. Otherwise it may result in hazard. On some floors sawdust is used to absorb all kind of liquids. This ensures that there will no need of preventing them from spill of the sawdust has to be swept and replaced every day. Household cleaning is a repetitive task carried out by number of people every day. Therefore cleaning machine is very much useful in cleaning floor in houses. Many of floor cleaning machines are available but this floor cleaner is very simple in a construction and very easy to operate, anyone can operate it, without any prior training of any sorts with safety. The time taken for cleaning is very less and cost is also very less. Our floor cleaner will save huge cost of labor in future. This machine mainly consists of dc motor, vacuum cleaner, water pump, circular & roller brush, mop, SMPS, and hot air blower. The whole assembly is mounted on a frame made up of mild steel as it is cheap and easily available. In the front side, circular brush is mounted at both the ends and roller brush is at the center. Using L-clamp motor is mounted on circular brush in left side, which transmit power with the help of timing gear. Vacuum

cleaner located after roller brush then after water is supplying to mop. At the end of the frame hot air blower is mounted to supply hot or ambient air to wet floor. Supply is given to the system is ac supply which is converted into dc supply with the help of SMPS. When machine moves in forward direction circular brush divert all dirt towards center and with the help of roller brush vacuum cleaner sucks all dirt inside and makes floor dust free. Here, vacuum cleaner is use to suck a dirt and store in a storage box. After that a water sprayer is attach which have small hole to spray water to make a surface wet, it takes water from a water tank. Floor is cleaning by rotating press mop which is coupled to the DC motor. Hot air blower is used to dry the water which is fitted to the Back side of the vehicle.

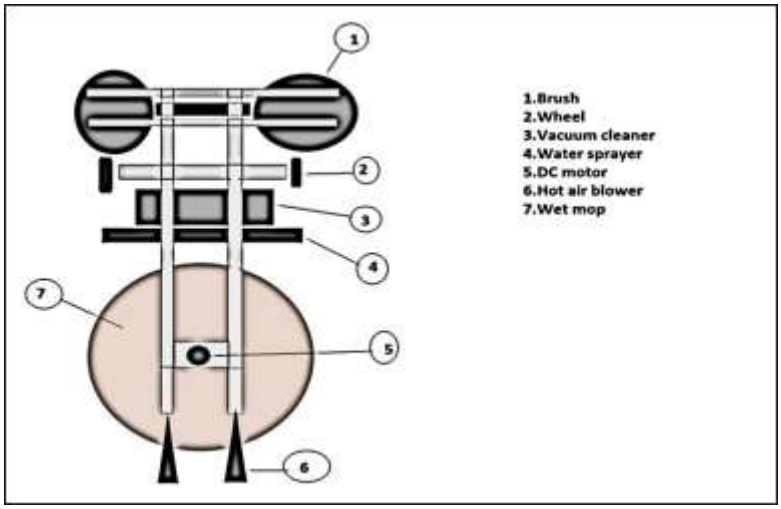


Fig: Block Diagram

7. Manufactured Model

8. Advantages

1. Number of cleaning tasks can be done with less cost.
2. User friendly, requires minimum time and human effort.
3. Less maintenance.
4. One machine can do dry cleaning and wet cleaning both.

9. Conclusion

Reviewing various literatures on floor cleaning machines it is 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 not use for wet surface of the floor. This is the major issue for cleaning the floor surface but in case of wet surface, floor cleaning machines contain moisture or little amount of water on the surface of floor. This machine can work in both dry and wet conditions. And at last this machine can dry the wet surface with the help of hot blower. Therefore this machine is also called as dry and wet floor cleaning machine. The ultimate need of this machine is satisfied and with the help of this machine can clean the floor easily. The application of this machine is high when compared to other existing floor cleaning machines. Overall the concept is very much helpful and there is scope of a lot of development in mechanical parts.

10. Future scope

The machine may be modified in future by adding battery and automatic operating system because current design has few problems. Few of those are the space occupied by vacuum cleaner is maximum therefore there is no space is remaining for battery, water storage problem, 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. Monitoring, self-charging, lighter body weight, are the future scope of this machine.

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