

Design & Fabrication of Mechanically Operated Multi-Purpose Eco-Friendly Floor Cleaning Machine

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Abstract

The objective of this project is to develop and create a mechanically driven, multifunctional eco-friendly floor cleaning device. The device aims to minimize environmental impact while offering a reliable and effective cleaning solution for different kinds of flooring. To achieve the best cleaning results, the machine combines mechanical and electrical components. It has a strong motor that powers the revolving brush and water spray system that make up the cleaning process. While the water spray system wets the surface and aids in dislodging and removing dirt particles, the brush helps to agitate and loosen dirt and grime. The device is intended to be portable, lightweight, and simple to use, making it perfect for both domestic and professional use. To guarantee user safety, it also has a number of safety measures. Overall, the multi-purpose eco-friendly floor cleaning machine provides a cost-effective, sustainable alternative for cleaning floors while also helping to create a cleaner, healthier atmosphere.

Keywords: Eco-friendly, Multifunctional, Cost-effective, Synchronized, Sustainable.

Introduction

The cleanliness of the surfaces on which we walk and stand is especially crucial for maintaining a healthy lifestyle. Particularly floors are prone to collecting dirt, dust, and other pollutants that can be harmful to inhabitants' health. Therefore, maintaining a hygienic living or working environment requires routine floor cleaning. The use of harsh chemicals in conventional floor cleaning techniques not only harms the flooring but also pollutes the environment.

This project focuses on the design and construction of a mechanically controlled multi-purpose eco-friendly floor cleaning equipment in order to address these problems. The machine uses mechanical and electrical components to provide excellent cleaning while reducing its

negative effects on the environment.[8] In order to agitate and loosen dirt and grime, moisten the surface, and remove dirt particles, the machine has a strong motor that powers a spinning brush and a water spray system. The machine's design makes it portable, lightweight, and simple to use, making it perfect for usage in both domestic and professional settings.

The initiative intends to offer a sustainable and affordable floor cleaning solution, helping to create a cleaner, healthier environment while using less toxic chemicals. The project also emphasizes the significance of eco-friendliness in design and production, highlighting the necessity of eco-aware solutions to handle contemporary problems.



History

According to historical records, carpet cleaning techniques first appeared in the 19th century. New concepts of cleanliness were influenced by the Industrial Revolution in Europe and North America. Druggets, which are thick, heavy woollen items laid below tables and other exposed locations, were used to preserve carpets before the Industrial Revolution. Druggets resistant to stains and other mishaps. During social gatherings and when on vacation, wealthy people covered their carpet with canvas cloth⁵. Houses filled up with dust, grime, and soot due to a lack of ventilation, which led people to look for ways to clean them.

At that time, societies put a high value on their homes, which inspired a creative mind-set to clean homes more effectively. In order to get rid of sand, dust, and soot, one of the most popular carpet cleaning methods entailed thrashing carpets with brooms; unfortunately, this approach could not get rid of stains.[7] It took until the 1830s for efficient stain removal techniques to be developed, at which point inventive women shared their tips for removing ink, grease, and oil⁶.

Scrubbing carpet with lemon juice and a heated loaf of bread was one stain treatment technique. The introduction of the first manually operated Hoover cleaner in the late 1860s and 1870s significantly improved carpet cleaning methods. People found it simpler to handle their everyday housecleaning thanks to the Hoover. An 18687 Ives Hoover cleaner. The "Whirlwind" was small, light, and challenging to control. In the US and Europe, several innovators created their own manually operated Hoover cleaners.

Literature Study

Liu et al ^[1] carried out a technical analysis of residential floor cleaning robots based on US granted patents. They observed that the macroscopic analysis of patents and patent bibliometric or patent maps, is useful tools to make an overview for designated technical topics and they observed that the Samsung is the top one patentee in cleaning robot after macroscopic of view.

Imaekhai Lawrence et al ^[2] evaluation has shown how the use of multiple assessment techniques can provide a comprehensive appraisal of the design, usability and musculoskeletal loading upon the operator. They suggested that the trials with a larger number of subjects would certainly strengthen the conclusions.

Abhishek Chakra borty et al ^[3] reported that the most significant cause of road dust to the total suspended particulate burden is vehicle traveling on paved and unpaved' surfaces. Consequently, data directly relating dust to road accidents are rare, but in a study if dust is the cause of 10% of these accidents' casualties, then the cost could amount to as much as 0.02% of GDP in some developing countries and total about \$800 million annually. In recent years, conventional floor cleaning machines are most widely used in airports, railway stations, malls, hospitals and in many commercial places, as cleaning is one of the important parameters for the sanitation and government regulations. For maintaining such places, cleaning the floor is the major task which is necessary. There are conventional floor cleaning machines available to perform floor cleaning operations in above said places. Generally, a conventional floor cleaning machines requires electrical energy for its operation. In India, especially in summer there is power crisis, in majority of places. Hence

cleaning the floor using the conventional floor cleaning machines is difficult without electricity.

Shubham Khade et al ^[4] has designed floor cleaning machines 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 floor cleaning machine is proposed. This can perform 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. The machine will work on electricity. This work can be very useful to improve the life style of mankind.

Md K S Ghaffar et al ^[5] 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 vacuum 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.

Objective

The goal is to produce and design a floor cleaning device that is capable of cleaning different surfaces such as floors and flat areas. The machine must be manually operated and capable of performing multiple tasks in a single effort while also being cost-effective.

Working Principle

A crucial part of the everyday regular activity is cleaning. Directly and indirectly, good cleaning and sanitising promote and safeguard human health. To keep our surroundings tidy, we utilise the floor cleaner. so that we may roam the streets feeling revitalised. Robots, diesel engines, electric motors, and other technologies are frequently employed to clean the ground and roads in the age of contemporary technology.[9] But these procedures are difficult to carry out, produce a lot of pollution, and require a lot of upkeep. Therefore, user-friendly road and floor cleaning equipment must be developed in order to conserve energy and protect the environment.

A set of wheels that are connected by a shaft hold the dust cleaning machine system in place. The shaft connects the wheels to each other. With the use of manual force that can manage it, the wheels are shifted to the proper position. Three adjustment holes are provided for the handle so that it may be adjusted to the

desired height. At either side, a chain drive connects the wheels and gear. The wheel and gear determine how the chain is moved.[10] The brush sweeps up any debris on the road and deposits it in the waste-collection box while travelling in the opposite direction of the wheels. To dispose of the garbage where you want it to go, remove the waste collection box.

Mechanism involved

A chain drive has several benefits since it outperforms .The utilisation of a bevel gear and chain drive mechanism allows the transformation of linear motion into rotational motion. The chain drive system is a positive drive and provides optimal efficiency. Moreover, compared to a gear drive system, it is simpler to redesign and modify. Additionally, the chain drive operates better under stress loading circumstances than gears and distributes operating loads across a greater number of tooth than gear motors do.[11] In addition, chain drives are less expensive to install and maintain than identical gear drives, and they take up less room for a given weight and velocity condition than pulleys and belts. This chain-driven floor cleaning device accomplishes simultaneous dry and wet cleaning as requested while also reducing the amount of sweeping and wiping required. It is an eco-friendly device that delivers efficiency and sustainability while running on clean energy.[13]

Ergonomic Design & Development

The practise of creating or organising workplaces, items, and systems to fit the users of them is known as ergonomics. The majority of people have heard of ergonomics and believe it has to do with

sitting or the design of automobile controls and instruments, and they are correct. But it is much more than that. Anything that includes humans, such as workplaces, sports and leisure activities, and health and safety, must be designed with ergonomics in mind. A field of research known as "human factors" or "ergonomics" tries to better people's interactions with surroundings, systems, and goods by first understanding about human capabilities and limits.[12]

The goal of ergonomics is to reduce the risk of harm or injury through improving work spaces and settings. Therefore, as technology advances, it becomes increasingly important to make sure that the tools we use for work, leisure, and pleasure are created with our bodies' needs in mind.

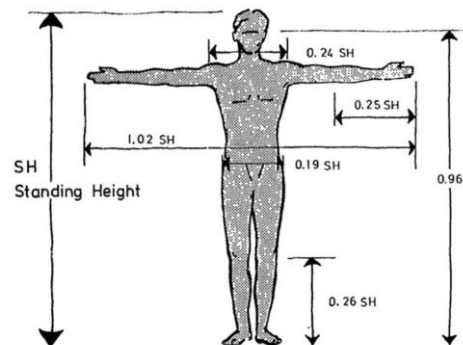


Fig: 1 Ergonomic measurement of a Human body

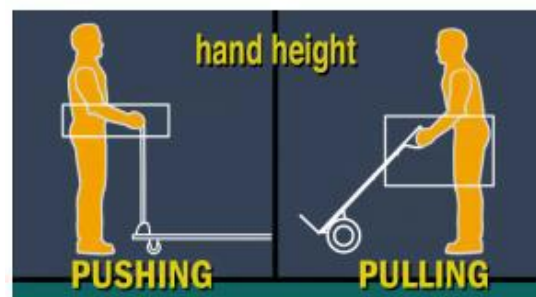


Fig.2 Ergonomically designed trolley

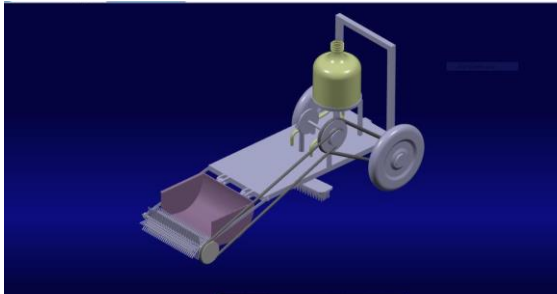


Fig:3 Ergonomically Designed trolley

Factors to be considered to Design the trolley

Minimum requirements for trolley that it should have:

- ❖ A Height-adjustable spring or scissor base to ensure employees can position the load at a suitable height for lifting or sliding heavier items at the bottom
- ❖ Handles that project away from the body of the trolley so employees can use the handles without their legs or feet hitting the trolley while walking
- ❖ A height limit for stacking, so the employee pushing can see over the load
- ❖ A clearly visible label showing the load rating in kilograms and number of items
- ❖ Castors and wheels suited to the floor surface.
- ❖ Low-resistance bearings
- ❖ Regular inspection and maintenance – remove damaged trolleys from service until repaired or replaced

Forces Required to Push and Pull

- ❖ Floor gradient
- ❖ Castor and wheel design and materials

- ❖ Floor surface
- ❖ Trolleys with mechanization to reduce the need for employees to use force when pushing and pulling

Material Selection

Carbon Steel IS 4923 YST 310

The IS 4923 YST 310 Rectangular Hollow Sections Standard Pipe is a fire resistant and is non-corrosive by nature and has high tolerance as well as good conductivity and high tensile strength having wide range of application such as Oil & Gas Pipelines has been used in the low-pressure conveyance of various mediums such as gas, air or steam. It is also used in the transportation of water, oil, as well as other fluids. Industries such as buildings construction, machinery, irrigation & distribution prefer using the IS 4923 YST 310 Square Hollow Section because of its resistance to high heat, extreme cold & high temperature gases.

Result

An automated machine can be replaced by a manually operated one, especially in times of power outages. This initiative seeks to encourage hygiene in residential areas without the use of energy. To do this, we created an easy-to-use chain drive system that anyone can use. The equipment requires extremely little maintenance, and any issues can be found and rectified right away. This green floor cleaning system can be used to clean a variety of public locations, including malls, train stations, hospitals, auditoriums, community centres, municipal buildings, schools, colleges,



ports, airports, steel and cement mills, food and beverage industries, engineering and electronics firms, and others.

This project demonstrates how the use of basic engineering concepts may result in the development of an eco-friendly system that is both affordable and has a number of features. Due to its low cost and good energy efficiency, this low-budget initiative has a considerable positive social impact and contributes significantly to the cause of cleanliness. We can conserve energy and provide the machine the performance we want by putting fundamental mechanical engineering principles into practise. In addition to being secure and effective, our cleaning equipment is more affordable than employing cleaners. The machine is also simple to use, making it available to everyone and lowering the overall cost of cleaning.

Future Scope

In the future, the scrubber's design should be changed. On the campus of our college, the scrubber has been successfully tested on the floors. The present design has, however, been shown to have a few flaws, therefore adjustments will be required if the scrubber is to function properly. Despite this, the idea is really helpful, and there is a lot of room for mechanical advancement. Up till the best outcomes are obtained, the optimisation procedure will be carried out. Overall, the initiative was successful in meeting its objectives and has the potential to completely change how floors are cleaned. Because the scrubber may travel in the direction of

the dust, floors are cleaned more effectively. This is a well-made item that may be utilised in contemporary Indian homes.

Due to a few concerns with the machine's rectangular cleaning design, it may be necessary to install more operating mechanisms in the future. By increasing RPM, lowering vibration, and making the design more transportable, further research can improve the system and solve its space and water storage problems. The equipment will operate effectively after these changes. Monitoring and lowering the equipment's total weight are two potential future uses.

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