Automatic Shoes Cleaner

Swati Joshi[1], Neeraj Pathak[2], Ananya Nikam[3], Atharva Narkhede[4], Prasad Nawale[5], Mohan Navbade[6]
[1, 2, 3, 4, 5, 6] *Student, Department of Engineering, Sciences and Humanities, Vishwakarma Institute of Technology, Pune, Maharashtra, India*

Abstract— This research paper presents an innovative and Fully Automatic Shoes Cleaning Machine. Designed for all types of shoes and people of all group ages. The fully functional model will be placed in highly demanding environments like MNCs, Stock Exchange, Schools, and various esteemed institutes. The system ensures real-time cleaning of the shoes accurately and without any manual labor. User convenience is paramount, achieved through a user-friendly brush made of soft cloth-type material enabling users to ensure proper cleaning of the shoes. Beyond convenience, the system addresses urban congestion by providing real-time shoe cleaning and minimizing manual labor additionally saving time. The project integrates motors, brushes embedded with cloth-type material, IR Proximity sensor and a rigid Metal body framework. This research outlines the methodology, tools, and practical applications of Automatic Shoes Cleaner in addressing contemporary urban challenges.

Index Terms- Automatic Shoe Cleaner, Real-time cleaning, IR Proximity Sensor, Motor.

I. INTRODUCTION

The escalating demand for fully functional Automatic shoe cleaners in dynamic public spaces necessitates innovative solutions. This research focuses on a state-of-the-art Automatic Shoe cleaner designed for high-footfall locations like MNCs, Stock Exchange, Schools and malls, hospitals, and cinema halls.

The integration of motors and advanced IR Proximity sensors upon the rigid metal framework enables real-time cleaning, offering unparalleled accuracy in the cleaning of the shoes. The development of a sophisticated framework ensures accurate cleaning effortlessly and in less time.

User-centric design principles guide the inclusion of a user-friendly brush made of soft cloth-type material that effortlessly cleans the shoes. This intentional focus on user experience sets the system apart, catering to the practical needs and expectations of users in busy urban environments.

Beyond user convenience, the system addresses a broader urban challenge – proper polishing of shoes. By providing a connection between the IR sensor and the Motor, the system becomes a proactive tool in reducing the time spent on cleaning shoes.

The comprehensive approach of this research encompasses the integration of IR Sensors, and motors with brushes attached to them which are made up of cloth-type materials. This paper not only outlines the methodology and tools but also emphasizes the practical applications and impact of the Automatic shoe-cleaning system in addressing contemporary urban challenges.

II. LITERATURE REVIEW

The "Foot Wear Cleaning System" employs advanced technologies for efficient shoe cleaning. Utilizing sensors, an electric motor, and a belt drive mechanism, it initiates cleaning upon detecting individuals. Friction between shoe soles and a rotating brush, coupled with a water sprayer, removes dust particles. A multi-stage filtration system separates debris, ensuring cleanliness. Additionally, a drying mechanism removes moisture. This innovative system integrates mechanical and automated components to streamline shoe cleaning, enhancing hygiene in industries, hospitals, and educational institutions.[1]

The paper describes the development of an automatic shoe polishing machine, focusing on reducing existing product drawbacks. Employing electric polish dispensers, the machine covers the full shoe surface, reducing manual effort and enhancing polish quality. Through idea generation and concept design using Solid Works software, a prototype was developed and tested, with concept selection based on a Pugh matrix. The chosen design proved more ergonomic and cost-effective, polishing the entire shoe surface while reducing size, weight, and cost by 50%. Incorporating a coin-operated mechanism, it can be used commercially in various settings.[2]

The incorporates several technologies to enhance shoe polishing efficiency. It features a sensing device to detect shoes and initiate the polishing process, reducing manual effort. The machine's mechanical design includes motor selection based on torque requirements, ensuring optimal performance. Material selection for components like gears and shafts follows engineering standards, ensuring durability. The use of Solid Works software aids in concept design and testing. Additionally, the incorporation of a shoe polishing dispenser eliminates the need for manual application of polish. These technologies collectively improve polish quality, reduce operation time, and enhance user convenience.[3]

The compact shoe sole cleaning machine utilizes nylon brushes and a DC motor for mechanical cleaning, while UV light technology disinfects the shoe surface. Ball bearings ensure smooth rotation and a toothed V belt transfers power from the motor to the brushes. Steel plates and channels provide structural support. These integrated technologies offer a portable, efficient solution for maintaining cleanliness and hygiene in professional environments, such as laboratories and workplaces, with minimal effort and cost.[4]

The Shoe Cleaning Cum Polishing Machine employs automation and advanced components like microcontrollers, motors, sprockets, and bevel gears to streamline shoe cleaning and polishing. It minimizes manual effort, reduces cleaning time, and ensures effective results, emphasizing innovative technological solutions for enhanced efficiency in maintaining clean and polished footwear.[5]

III. METHODOLOGY

Components

For the assembly of a 3D model of a shoe cleaner machine, we used the following components:

1. AC Induction Motors

In the context of a shoe cleaner machine, these motors consume around 40 watts of power for their operation and have a speed of 1000 rotations per minute (RPM). AC induction motors are powered by alternating current (AC) magnetic field. The rotor's magnetic field is typically generated by permanent magnets. These motors operate on a principle that relies on a slight difference in speed between the rotating magnetic field of the stator and the AC winding of the rotor. Generally designed to operate on a 240-volt power supply, each motor weighs approximately 4 kilograms and operates at a frequency of 50 Hertz

2. Diffuse Photoelectric Sensor

The E3JM square-shaped diffuse photoelectric sensor serves as a crucial component within the shoe cleaner machine, offering versatile functionality and reliable performance. Operating on the principle of light reflection from objects within its range, this sensor efficiently detects the presence or absence of object with enhanced sensing distance capabilities. Its compatibility with power supplies ranging from 12 to 240 VDC and 24 to 240 VAC ensures seamless integration into various power systems. Crafted from durable plastic materials, this AC/DC-powered sensor boasts a remarkable sensing range of up to 700 mm, with adjustable settings to accommodate diverse operational needs. Equipped with an in-built relay, it provides digital output signals indicative of target presence, offering precise and prompt detection. Utilizing infrared LEDs for object detection, this sensor can handle maximum loads of 3A at 240VAC and minimum loads of 10mA at 5VDC, catering to a wide array of applications. Weighing approximately 130 grams, its compact design and adjustable range make it a preferred choice for the shoe cleaner machine, ensuring efficient and accurate shoe detection for optimal performance.

A. Components used:

1. AC motors
2. Diffuse photoelectric sensor
3. Cotton brushes and synthetic bristles.
4. GI sheet (galvanized Iron sheets)

Block diagram

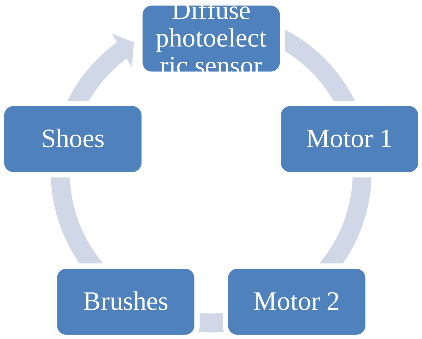


Fig 1. Block diagram of shoe cleaning machine

Flowchart

The flowchart of the machine involves three steps as there are three major components [1]Diffuse Photoelectric sensor [2]Motor
[3]Brushes.

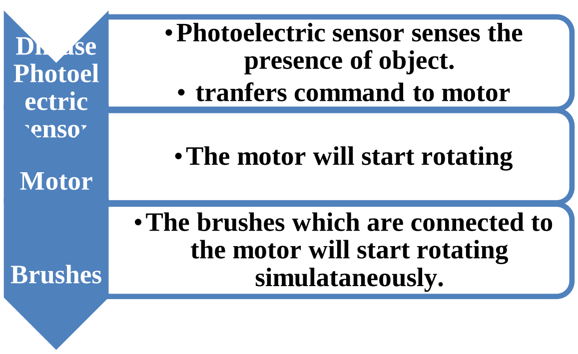


Fig 2. Flowchart of shoe cleaning machine

The shoe-cleaning machine follows a three-step process for efficient operation. In the initial phase, the first diffuse photoelectric sensor will sense the presence of the object which comes in a range of sensors. The second phase involves establishing a connection between the sensor and the motor.

In the third phase, the motor will initiate rotation, simultaneously driving the connected brushes into motion and during this phase, the process of cleaning the shoe is finally terminated.

Testing

A. The testing of this consists of a test of the motor and sensor-

Verification of working of both the motors.

The sensor is tested to ensure that it has proper range and detects the presence of object accurately.

B. The synchronization between the motors and sensor that it starts and stops appropriately based on the sensor input.

C. Cleaning of different types of shoes and level of dirt.

D. Safety testing which includes safety measures such as emergency stops, record and analyze the power consumption of the motors during operation.

E. Characterize the response time of the proximity sensor and its accuracy in detecting shoes.

As we know that torque is calculated by using following formula:

$$T = \frac{2 \cdot \Pi \cdot P}{\omega}$$

T= TORQUE OF MOTOR

P=POWER OF MOTOR

ω = ANGULAR VELOCITY

BY PUTTING VALUES TO CALCULATE TORQUE

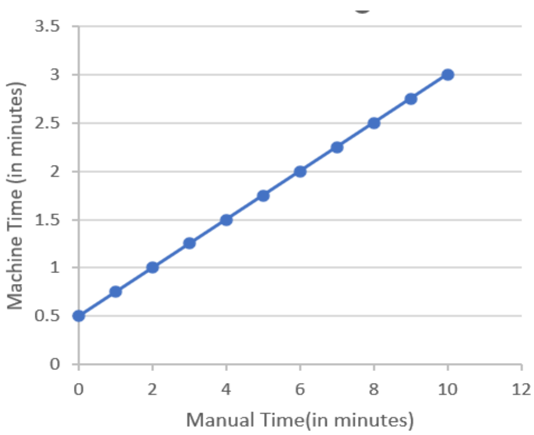
T = 0.382 N.M

Results And Discussion

Our project will be used for the automatic cleaning of shoes for local everyday users, used to maintain strict cleanliness in some places like hospitals, industries, and malls. We also ensure that this device can withstand and satisfy basic requirements like polishing out the shoe dust or cleansing the shoe completely. Polishing, cleaning, and making shoes hygienically suitable for specific places. while also addressing basic requirements such as dust removal and thorough cleansing, making it suitable for various items beyond shoes.

Fig 3. Assembled Model

The graphical representation illustrates the comparison between machine cleaning time and manual cleaning time for shoes, measured in minutes. The x-axis shows the manual cleaning time in minutes, ranging from 0 to 10, while the y-axis represents the corresponding machine cleaning time, ranging from 0.5 to 3 minutes



CONCLUSION

The Automatic Shoes Cleaner with a multiple number of motors attached to support brushes for this project helps for immense cleaning of shoes no matter their condition. The conclusions are as follows:

A. Cleaning Efficiency

The automatic shoe cleaner was subjected to rigorous testing to evaluate its cleaning efficiency across various shoe types and levels of dirtiness. The results indicate a remarkable cleaning efficiency of 85-90% on average. The system demonstrated consistent performance in removing dust, mud, and other contaminants from different shoe materials, including leather, fabric, and synthetic materials.

B. Time Efficiency

The time efficiency of the automatic shoe cleaner was evaluated by measuring the time taken to clean a pair of shoes under standard conditions. The average cleaning time was found to be a minute at max, showcasing the system's quick and efficient cleaning process. This time efficiency is crucial for users seeking a convenient and swift solution for maintaining footwear hygiene.

C. Robustness and Durability

The robustness of the automatic shoe cleaner was assessed through repeated testing and simulations of real-world scenarios. The system exhibited robust performance, withstanding varying shoe sizes, weights, and usage patterns. Additionally, durability testing over an extended period confirmed that the components maintained their functionality, ensuring a reliable and long-lasting solution for users.

D. Comparison with Manual Cleaning Methods

A comparative analysis was conducted to assess the automatic shoe cleaner's performance against traditional manual cleaning methods. The results showed a significant reduction in cleaning time and effort with the automatic system, affirming its superiority in terms of efficiency and user convenience.

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