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DESIGN AND FABRICATION OF SMART AUTOMATIC SHOE POLISHING MACHINE

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Abstract: *Our project aims to design and fabricate a smart automatic polishing machine. Wearing shoes is a part of the dress code as all of the employees in any organization. In the present busy world scenario wearing clean shoes regularly is time-consuming. This machine helps in reducing the difficulty of existing products available in the market. As this project is a novel and useful one, our product finds better application in any organization. The design of the smart automatic shoe polishing machine satisfies the requirements of the present market scenario. The major innovation of this project is that the machine is equipped with a sensor that performs the required operation with a high degree of accuracy. The machine with the sole cleaner, which cleans the bottom of the shoes simultaneously. The selected mechanism is very simple, that provides the utmost safer and flexible operations for longer life. The highlights of this project include portability and flexibility features. The integrated blue-tooth facility in the shoe polishing machine assists the employees in polishing their shoes more smartly. This project outperforms all of the conventional methods for polishing the shoes.*

Keyword: *Design, Fabrication, Shoe polishing, Smart, Blue-tooth*

1. INTRODUCTION

In this corporate world, dressing plays regard very important role to look professional. In this regard, good shoe polishing with shine gives more importance. By polishing the shoe manually may damage the surface of the leather. By this Life of the shoe will get reduces. More than this it will take much time and human effort to polish. On the other hand, the current automatic shoe polisher which is available in the market will not do recommended polish and also it will take more time to polish.

A shoe is an item of footwear intended to protect and comfort the human foot while doing various activities. The shoe is generally made from leather which requires extreme care and regular polishing to maintain its shiny appearance. This requires a waxy paste or cream known as the shoe polishing wax which is first applied to the shoe evenly using a cloth or a brush. Buffing is then carried out by vigorously rubbing it to obtain a shiny surface. This also extends the life of the shoe. The application of this wax is a manual and time-consuming process. This machine is intended to grip the shoe at the right place, apply a layer of polishing wax all around the shoe, and perform buffing action to obtain a shiny effect and to assure minimum damage to the shoe.

There are so many this types of machine exists but a developed method of making makes the users use at the same time a wants of the users never ends. Still, further modification can be done in this type. The automatic shoe polishing machine is used to polish your shoe within a short interval of time which reduces human strength and effort. All the professionals want that their shoes should give an attractive look and much better long-lasting but forget to follow the steps that needed, therefore reminding all these difficulties we have developed this machine which gives your shoes the desired look every day with a very good shine. The main problems that arose in the manual machine types need more attention for the

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automation. As professionals mainly concentrate on smarter and easier ways to lead life. Considering all these factors into account, it has been identified for the development of innovation. In the coming sections the motivation, objectives, and the fabrication of our innovation have been discussed clearly.

2. MOTIVATION AND OBJECTIVES

2.1 Motivation

The famous saying by our elders "Cleanliness is next to Godliness". Besides, most of the production firms, medical, and educational societies possessing the utmost reserved workrooms such as instrumentation and control, computer-labs, seminar-halls, and common workplaces. Moreover, in the present day scenario production and inventory shops for pharma, and petrochemical, etc., aim to be cleaner and have to be free from dust and dirt which would be carried through the shoe of the employees to the work area, causing untidy environment and also sometimes hazardous to the working environment.

Some of the commercially available machines are available in the present-day market. These machines are completely not enough in satisfying the customized needs like 360^{O} cleaning in all the portions of shoes. Moreover, Furthermore, to satisfy the aesthetic sense for the common people, appearance is quite essential. Considering all these factors into reflection, we have been motivated to develop the novel and innovative shoe polish machine satisfying the professional sense of the design.

2.2. Objectives

Considering the above features concerning the shoe-polishing machine an attempt has been made to develop an innovative machine that could perform the required operations in an improved manner with low-cost. The key objectives of the present work include

- To reduce human efforts.
- To improve the qualitative polish features
- To reduce the required time of shoe
- To integrate sole polishing also as an additional feature
- To provide a cost-effective solution with ergonomics consideration, reduce time consumption & produce quality shine product to the customer

3. LITERATURE REVIEW

The design to innovate a shoe-sole cleaning machine is identified as a need for development, through integrating polishing-facility. All the working professionals need to wear cleaned shoes before they enter their facilities to safeguard themselves and also keep the facilities clean. Considering these features the sole-cleaning facility integrated shoe polishing facility has developed by the past researchers.

Some of the connected literature to the shoe polishing machine has listed.

In the industry perspective the design and development of an automatic shoe polishing machine, which could reduce the difficulties in existing products available in the market and at the same time increase the use of the product in the office [1]. In later years the development of a shoe-sole cleaning integrated with shoe-polishing machine, because of

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multiple parameters requirement as per customer needs such as compactness and economical features available [2]. The pulse width modulation (PWM) based automatic closed-loop speed control of dc motor. The authors examined about controlling the speed of the dc motor at varying load conditions through the PWM method, using Atmega- 8L microcontroller as a feedback system. It was concluded that constant speed can be maintained at varying load conditions by PWM [3]. In has been reported that a novel Open-loop phase control method is developed by coding a program using ARDUINO software in which the ARDUINO controller takes input from the user and generates firing pulses for the TRIAC which controls the speed of the Induction motor [4]. The total process is executed with the help of an ARDUINO controller kit where ARDUINO and Tera-Term software are used for Micro Controller and serial monitor. This results in variable speed control of Induction motor [5]. The shoe polishing machine by using only a single or specific coin based on a sensor equipment method for polishing the shoe within a short interval of time [6]. In recent years a semi-automatic sole cleaning machine at a low cost. This work has designed and fabricated a sole-cleaner for the shoe-cleaning process in the easiest way [7]. The duty-cycle variation of the signals results in the change of speed in the motor. Data acquisition (DAQ) obtains ripple current from the motor which is used as a feedback element. A proportional–integral–derivative (PID) control is a universally accepted control algorithm that is widely used in industries. PID controller is LabVIEW is used to control the speed of the required dc motor [8]. At present, the research listed to the shoe-polishing machine's operation through coin-based operation for specific sensor/device methods only presented. The present work targets to design and fabricate the complete automatic shoe-cum-sole polishing machine using the integrated mechanism. Environmental sustainability and energy efficiency factors are key factors for the better utilization of the resources [9]. In this work, we have utilized the Arduino processer, which supports an integrated mechanism to assist the user in the remote mode with the help of Bluetooth connectivity. To achieve higher productivity and quality products at a low cost, the industry should go towards semi-automation or automation. Operations that are repeating in nature should be automated. In steel doors, manufacturing industries' packaging of doors is one of the operations that is mostly done manually [10]. Fuzzy TOPSIS (Technique for Order Preference by Similarities to Ideal Solution) is one of the best methods to get an ideal solution among similar options. Also it can be used to automate the process and overcome ambiguity, uncertainty in the selection process [11]. This project focuses on the automation of the shoe polishing and shining process without any human involvement in the process [12]. The main purpose of the sensor integrated is to sense and measure the features of the coin kept, like the dimension, weight, magnetic properties, etc. These arranged sensors only operate only when physical contact with the human.

4. METHODS AND METHODOLOGY

The is an objective of the project to provide an apparatus for shining shoes which overcomes the problems encountered in the conventional art and which can obtain the desired shoe shining effect similar to when shined by manual work or can obtain an excellent shoe shining effect.

The user deposits coin into the coin slot outside of the machine. When the coin cross the infrared sensor IR transmitter transmits the towards coin and then signals are reflected towards to the IR receiver, the IR sensor transfer the singles to the Arduino board then the signals from the Arduino board are transferred to the power supply board, then signals from

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power supply board are transfers to the 2 mode relay .the relay processing the signals and the signals are transferred to the 12 volts transformer .the transformer transform the power to the ac motor .when the motor receives the signals from the transformer the motor starts working. The block diagram of the shoe-polishing machine mechanism is represented in Figure 1. The power from the motor is transformed to sole cleaning brush shaft by the belt drive, the sole cleaning brush shaft and shoe polishing brush shaft are connected by the chain drive.

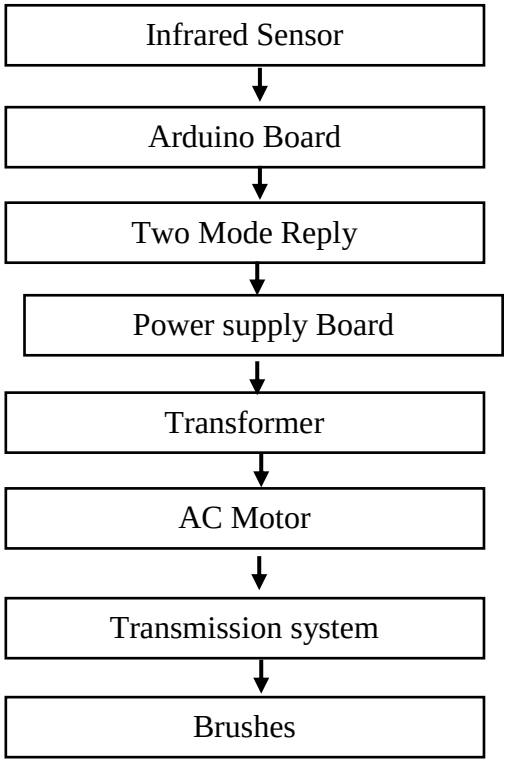

Fig. 1. Block Diagram of Shoe Polishing Machine Mechanism

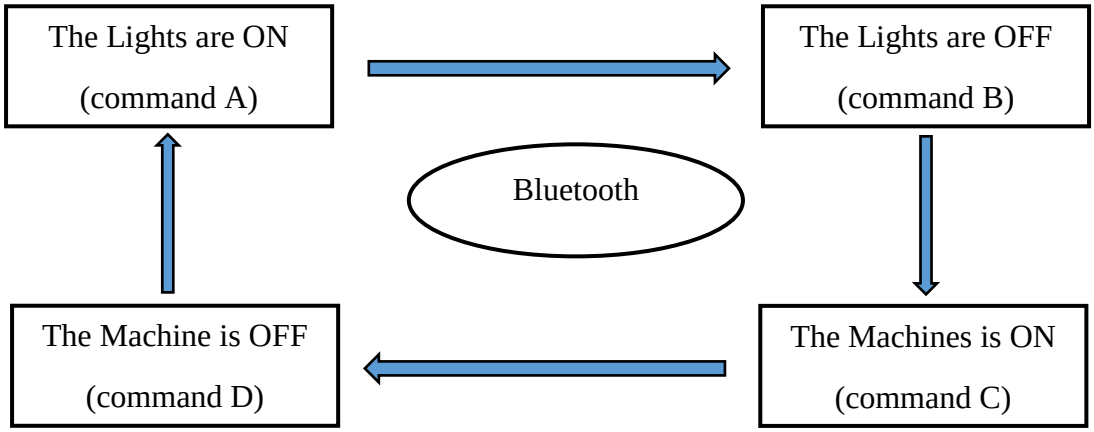

Fig. 2. Block Diagram of Bluetooth Operation

The operations of the Bluetooth controls are controlled when the power supply is given

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to the machine the Bluetooth is on automatically if we want to use the Bluetooth on our smartphone we need the android application Bluetooth terminal. The block diagram of the Bluetooth operation for the present machine is represented in Figure 2. We connect the Bluetooth by entering the password. We programmed the Bluetooth to operate based on the given command.

Commands of Bluetooth to operate the shoe polishing machine

Command A=the lights are ON

Command B= the lights are OFF

Command C= the machine is ON, and

Command D= the machine is OFF.

The fabrication of the machine is done based on the proposed design. The shoe polishing machine consists of the following constituents.

4.1. Coin collecting box

A locked container or receptacle for holding coins deposited in a pay telephone, pinball machine, turnstile, or another coin-operated machine. A locked receptacle to store the coins inserted in a coin-operated device (as in a payphone). A coin collector can be called a numismatic or numismatist. The word numismatic means the study or collection of currency. This covers tokens, paper money, coins, and medals. It also means a person who studies or collects currencies. The coin collecting box is represented in Figure 3.

Fig. 3. Coin Collection Box

4.2. Infrared sensor

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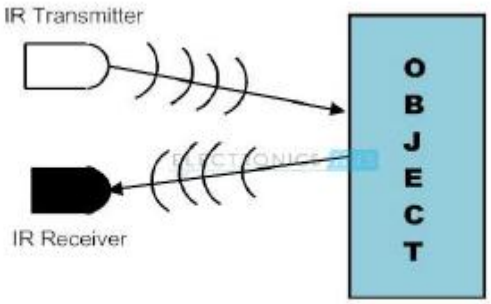

Fig. 4. Block Diagram of Infrared Sensor

IR Sensor module has the great adaptive capability of the ambient light, having a pair of an infrared transmitter and the receiver tube, the infrared emitting tube to emit a certain frequency encounters an obstacle detection direction (reflecting surface), infrared reflected the receiver tube receiving, after a comparator circuit processing, the green LED lights up, while the signal output will output digital signal (a low-level signal), through the potentiometer knob to adjust the detection distance, the effective distance range 2 ~ 10cm working voltage of 3.3V-5V. The block diagram of the infrared sensor is listed in Figure 4. The detection range of the sensor can be adjusted by the potentiometer, with little interference, easy to assemble, easy to use features, can be widely used robot obstacle avoidance, obstacle avoidance car assembly line count, and black-and-white line tracking and many other occasions.

4.3. Arduino board

The Arduino Uno R3 is an open-source microcontroller board based on the ATmega328 chip. This Board has 14 digital input/output pins, 6 analog input pins, Onboard 16 MHz ceramic resonator, Port for USB connection, Onboard DC power jack, An ICSP header, and a microcontroller reset button. The Arduino board utilized in the present work is depicted in Figure 5. It contains everything needed to support the microcontroller. Using the board is also very easy, simply connect it to a computer with a USB cable or power it with a DC adapter or battery to get started. External (non-USB) power can come either from an AC-to-DC adapter (wall-wart) or battery. The adapter can be connected by plugging a 2.1mm center-positive plug into the board's power jack. Also leads from a battery can be inserted in the Gnd and Vin pin headers of the Power connector. The board can operate on an external supply of 6 to 20 volts. If supplied with less than 7V, however, the 5V pin may supply less than five volts and the board may be unstable. If using more than 12V, the voltage regulator may overheat and damage the board. The recommended range is 5v to 12v for Arduino Uno.

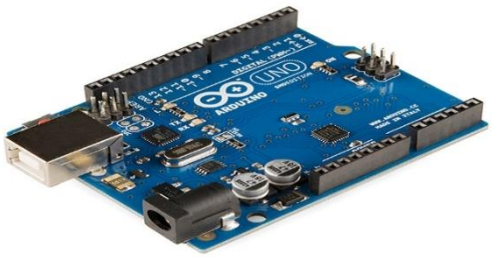

Fig. 5. Arduino Board

4.4. Power supply board

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The regulated power supply accepts unregulated inputs from 7.5V to 15V AC or DC and gives the regulated output of 5V and 12V suitable for microcontroller projects which need precise voltage to work. The input can come from the power transformer or wall mount DC adapter.

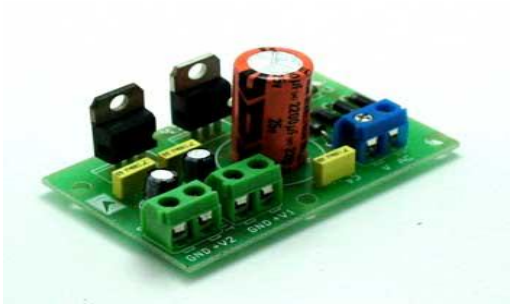

Fig. 6. Power Supply Board

Since the board has Diode Bridge input polarity does not matter. All outputs are brought to the screw terminal. The power supply board utilized for this work is represented in Figure 6. There is also an unregulated output voltage to drive high current loads like relays and motors.

4.5. Transformer

12-0-12 1A Centre Tapped Stepdown Transformer is a general-purpose chassis mounting mains transformer. The transformer has 230V primary winding and center-tapped secondary winding.

Fig. 7. 12 V Transformer

The transformer has flying colored insulated connecting leads. The transformer utilized for this work is depicted in Figure 7. The Transformer act as a step-down transformer reducing AC - 230V to AC - 12V.

4.6. Bluetooth

The HC-05 is a very cool module that can add two-way (full-duplex) wireless functionality to your projects. You can use this module to communicate between two microcontrollers like Arduino or communicate with any device with Bluetooth functionality like a Phone or Laptop. Many android applications are already available which makes this process a lot easier. The module communicates with the help of USART at 9600 baud rate hence it is easy to interface with any microcontroller that supports USART. The integrated Bluetooth control is represented in Figure 8. We can also configure the default values of the module by using the command mode. So if you looking for a Wireless module that could transfer data from your computer or mobile phone to a microcontroller or vice versa then this module might be the right choice for you. However, do not expect this module to transfer multimedia like photos or songs; you might have to look into the CSR8645 module for that.

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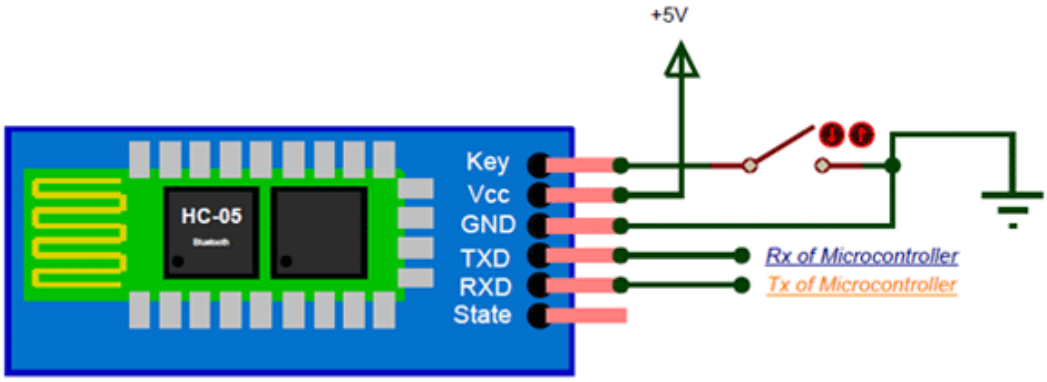

Fig. 8. Integrated Bluetooth Control

4.7. Working Principle:

The introduction of this machine helps in efficient working by combining the cleaning and polishing in one place. It reduces the human effort. This machine is portable and economical it not only completes the need but also adds a new lifestyle for the faculty who regularly uses the shoe. The user deposits coin into the coin slot outside of the machine. When the coin cross the infrared sensor IR transmitter transmits the towards coin and then signals are reflected towards to the IR receiver, the IR sensor transfer the singles to the Arduino board then the signals from the Arduino board are transferred to the power supply board, then signals from power supply board are transfers to the 2 mode relay .the relay processing the signals and the signals are transferred to the 12 volts transformer. The complete design of the coin-operated shoe polishing machine is depicted in Figure 9. The transformer transforms the power to the ac motor. When the motor receives the signals from the transformer the motor starts working. The power from the motor is transformed to sole cleaning brush shaft by the belt drive, the sole cleaning brush shaft and shoe polishing brush shaft are connected by the chain drive. if you looking for a Wireless module that could transfer data from your computer or mobile phone to a microcontroller or vice versa then this module might be the right choice for you. However, do not expect this module to transfer multimedia like photos or songs; you might have to look into the CSR8645 module for that. As soon as the module is powered you should be able to discover the Bluetooth device as “HC-05” then connect with it using the default password 0000 and start communicating with it. The technical specifications of the developed machine are listed in Table 1. The name password and other default parameters can be changed by entering into the android application.

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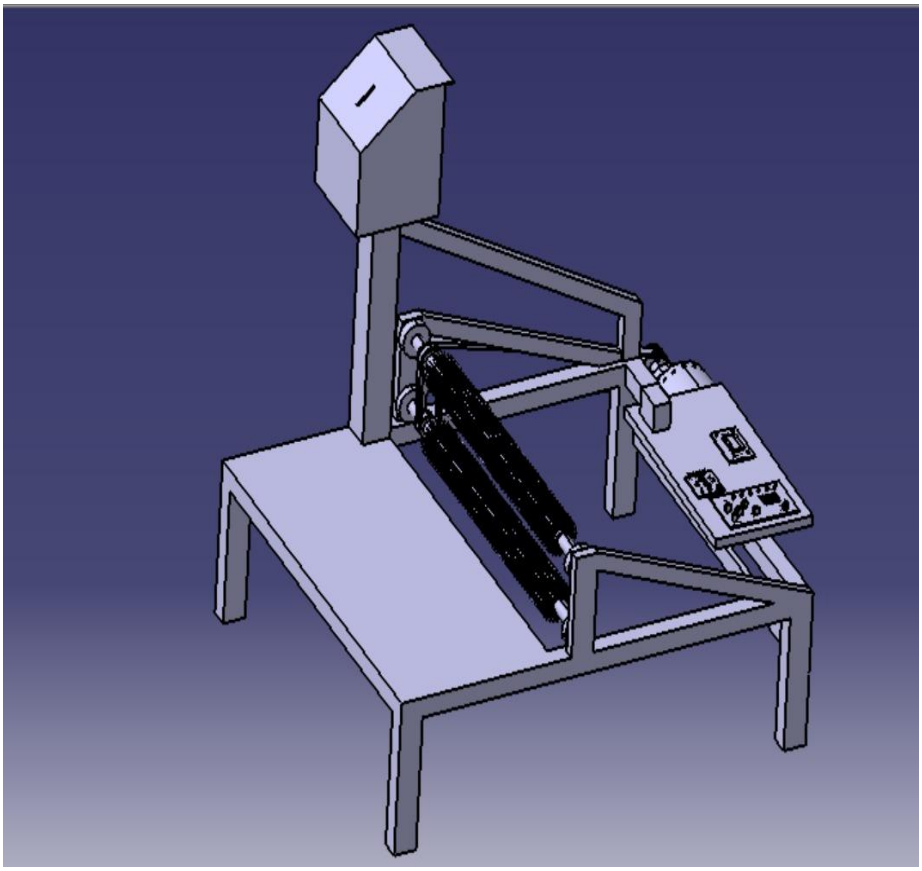

Fig. 9. Design of Coin-operated Smart Shoe-polishing Machine

Table 1. Technical Specifications of the Coin-operated Shoe Polishing Machine

S. NO	TITLE	SPECIFICATIONS
1	Infrared Sensor	3V, 30 cm potentiometer
2	Arduino Board	ATmega 328p microcontroller
3	Relay	Two-mode relay
4	Power Supply Board	12 volts
5	Transformer	12v,220 amp
6	Bluetooth	HH05
7	Ac Motor	12 v, 0.5 Hp motor
8	Brushes	Wire brushes
9	Frame	Cast iron frame

4.8. Model Validation

The validation of the developed model is required. This can be accomplished by some of the designs may be validated by comparing with similar equipment performing similar purpose. Demonstration and/or inspection may be used to validate requirements and other functionality of the product. Verification is a theoretical exercise designed to make sure that no requirements are missed in the design, whereas validation is a practical exercise that ensures that the product, as-built, will function to meet the requirements.

4.9. Selection of shoe polishing machine

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Consider a shaft rotating at a speed of 3600 rpm having the power of 12.5 kW. We have to calculate the diameter of the shaft. Since it has a negligible effect on the shaft. (shoe cleaning brush/ polishing brush.)
Solution: The given N=3600 RPM and P=12.5 kW
Step 1: The permissible shear stress Assume SAE 1030 from design data book as per ASME Sys=296, taking Fs =3

$$\tau = \frac{Sys}{F_s} = \frac{0.5 * Sys}{3} = \frac{0.5 * 296}{3}$$

τ = 49.33 MPa
Step 2: Torsional moment

$$P = \frac{2 * \pi * N * T}{60}$$

$$T = \frac{60 * P}{2 * \pi * 2400}$$

$$T = \frac{60 * 12.50 * 10^6}{2 * \pi * 2400}$$

$T = 49.73 \times 10^3$ N-mm

Step 3; diameter of shaft
We know that, $r = \frac{d}{2}$

$$\frac{T}{J} = \frac{\tau}{r}$$

$$T = \tau * \frac{\pi}{16} * d^3$$

$$d = \sqrt[3]{\frac{16 * 49.73 * 10^3}{\pi * 49.33}}$$

$$d = 17.2525 \text{ mm}$$

Since, the considered diameter = 30 mm, which is greater than the calculated diameter =17.2525 mm is less than 30 mm. Therefore, the design is safe.

5. CONCLUSION

In the present work, we have arrived at the following conclusions. This work can be more improved by making certain revisions. The major objective of the design and fabrication of coin-operated automatic smart shoe polishing machine arrived at the following conclusions:

- The high-speed rotation of the brushes assists in cleaning the shoe-sole efficiently and the rotary brushes attached to the shaft assists in shoe-polishing, when the wax polish applied to the shoe by the user.
- As the machine is coin-operated, it would be better utilized commercially. So the maintenance of the machine can be effectively managed.
- It also does the buffing operation to give a shiny appearance to the shoes.

- Bluetooth control integrated. It is easily upgradeable.
- No line of sight hence can connect through any obstacles.
- Shining your shoes with shoe polish is a simple and effective way of extending their life and preserving their natural appearance.

At the academic incense the project has been completed a better design but for the commercial application it is not complete. The suggested design is limited to standard shoe sizes. The developed machine is enough capable of polishing a pair of shoes in 120 seconds. At an outset the developed coin based automatic smart shoe polishing machine can be connected to a wide range of devices like tablets, smart-phones, and computers. The Bluetooth controller integration enabled security and smart look to the developed machine.

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