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Automatic Floor Cleaning Machine for Domestic Application

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ABSTRACT: Cleaning is a necessity in modern era. The main objective of the robot is to reduce human interaction in floor cleaning, Automatic floor cleaner is a system that enables cleaning of the floor by the help of highly stabilized and rapidly functionalized electronic and mechanical control system. This machine is electro mechanical machine with ultrasonic sensor. The proposed system has two main section: vacuum section and mopping section. microcontroller is the heart of the system. In that we use Arduino programing, the machine can perform dust sweeping and mopping simultaneously. Also, the machine is controlled with the help of online platform. This machine is designed to reduce cost and considering specially abled people. Current project target to use automatic floor cleaner for large floor in house-hold purposes and offices floor.

I.INTRODUCTION

In today's world where time is money cleaning has been viewed as time-consuming task. However, cleanliness and hence health cannot be compromised. Automatic floor cleaner is a smart floor cleaning machine best suited for household & office purposes. Also, the machine performs dry cleaning parallel saving time and power consumed. Thus machines have taken the manual works. For career oriented and job going women it becomes hectic to handle home and office together. Traditionally floor is cleaned with the assistance of mop or wet mop using the hand as a possible tool. they need to clean hard on the surface. The cleaning includes cleaning of varied surfaces basically cement floors, highly polished wooden or marble floors. Among these floors the rough surface floor like cement floor, mostly present in semi urban areas are covered with such a lot of dust which needs longer for cleaning.

For saving the time the necessity was of House Cleaning Machine, which is an automatic system that works and cleans on its own without human control/intervention. Autonomous machine or machine for floor cleaning application reduces much time in lifestyle. It performs sweeping and mopping tasks at a time, it also does obstacle detection and automatic path finding Service machines are getting popular recently these machines operate semi- or fully-automatic.

II.LITERATURE REVIEW

[1] ArpitJoon, WojceichKowalczyk; Design of Autonomous Mobile Robot for Cleaning in the Environment with Obstacles; Applied Science; 31 aug 2021.
This paper describes design and development of cleaning robot using adaptive manufacturing technology. Adaptive manufacturing technology is used with control algorithm for stability in the robot. LDR sensor and Webcam to clean in sophisticated places. Robot consists of three assemblies – four wheel drive platform, robotic arm with four degrees of freedom and vacuum system. Robot Operating System (ROS) is installed in robot's on-board system. With the help of ROS node-high level controller generates control signals for low-level controller. Material for parts was selected such that it is lightweight, suitable for 3D printing, easy to assemble and have sufficient strength. Two experiments were conducted and their results were compared. For more degrees of freedom, mecanum wheels are suugested.

[2] Mansa M, Vidyashree T S, Bindushree V, Sanjana Rao, Gowra P S; Smart Vacuum Cleaner; Elsevier B.V. on behalf of KeAi; 11 july 2021
The prototype has a vacuum cleaner for cleaning purpose. It uses Arduino board which is programmed to measure distance and clean the floor. This is achieved by using an autonomous system. The system has an ultrasonic sensor attached to it. This helps in detecting obstacles when the machine is moving. The system also uses Arduino UNO, batteries, DC motor, ultrasonic sensor. The vacuum cleaner is designed with a CPU fan and pipe is attached to the mouth of bottle. Batteries are used to run the system. It works on a pre-defined code inserted in Arduino UNO.

[3] Ines Bula, Edin Bula, Edmond Hajrizi; Cost Oriented Autonomous Window Cleaning Robot from Mechatronic Scrap – MechCleanBot; Elsevier; 2021
The prototype uses Mechatronic scrap to make a window cleaning robot. It uses Arduino board for navigation.

[4] TarunVerma, Abhishek Mishra; Development of Robot Model for Cleaning Open Space; Elsevier; 2019
It uses FEA for analysis of frame material. Aluminium is selected for the frame of machine according to the result of analysis

[5] Raj Vishaal, Raghavan P, Rajesh.R, Sachin Michael, Mohan Rajesh Elara; Design of Dual Purpose Cleaning Robot; Elsevier; 2018
The prototype of cleaning module used for wall as well as floor cleaning by using Bluetooth control application. The wall cleaning robot proposed in this paper consists of base module and cleaning module. An electric ducted fan is used. Robot is designed such that the cleaning module alone can also be used to clean the floor. Floor cleaning is manually controlled by Bluetooth and wall cleaning is automatic with help of sensors.

[6] Nazim Mir-Nasiri, HudywayaSiswoyo J, Md.Hazrat Ali; Portable Autonomous Window Cleaning Robot; Elsevier; 2018
The robot uses suckers to stick to outer side of windows and clean them by sponge rollers soaked in detergent.

[7] T.B Asafa, T.M.Afonja, E.A Olaniyan, H.O.Alade; Development of a Vacuum Cleaner Robot; Elsevier; 9 July 2018
Vacuum cleaner is bulky and has a lot of weight. So it is difficult to handle. The paper reports development of a compact and efficient vacuum cleaner robot for potential office and home use. It is controlled by Arduino mega micro-controller. It has two sweepers each driven by 3 V DC motor. The robot navigates via two motor shield controlled rear wheels and a front castor wheel which also governs its turning. Ultrasonic sensors are used to detect obstacles and helps the robot navigate. It is powered by 3 rechargeable batteries. It is lightweight (1.5 Kg) suitable for office and home use cleaning fully autonomously, at full charge, it works continuously for 2 hrs.

[8] VeerjagadeshwarPrabakaran, ThejusPathmakumar, ShunsukeNansai, Mohan Rajesh Elara; Floor Cleaning Robot with Reconfigurable mechanism; Elsevier; march 2018
The project analyses coverage area and navigation performance of robot. To its end, a novel Tetris-inspired reconfigurable floor cleaning robot called hTetro is presented in this paper. It is a robot inspired from a novel – Tetris which can reconfigure itself according to conditions. The experiments indicate that hTetro achieves significantly higher performance as compared to other platforms due to its shape shifting ability in response to navigating its environment.

[9] Mohan Rajesh Elara, Thein Than Thun, ShunsukeNansai, VeerjagadeshwarPrabakaran, ThejusPathmakumar; A Novel Nested Reconfigurable Approach for a Glass Cleaning Robot; Inventions; 2017
This research paper is aimed at the development of glass façade cleaning robot. It is a paper on self-reconfigurable robot that uses nested configuration. A robotic system capable of cleaning vertical glass surfaces a transformable morphology. A reconfigurable robot is a potential solution to realise this adaptability. The brief concept and scheme of nested reconfigurable design principle and the hardware-software challenges associated with it is done in this paper. This article also discusses the capability to maximize the flexibility and modularity of the robot by using intra- and inter-reconfigurations.

[10] ShunsukeNansai, Rajesh Elara Mohan; A Survey of Wall Climbing Robot: Recent advances and Challenges; Robotics; July 2016
The paper gives a detailed information on various wall climbing methods. Wall climbing robots, which are capable of climbing up vertical surfaces, ceilings and roofs, are expected to replace the manual workforce in façade cleaning works, which is both hazardous and laborious work. Such tasks require these robotic platforms to possess high levels of adaptability and flexibility. This paper presents a detailed review of wall climbing robots categorizing them into six distinct classes based on the adhesive mechanism that they use.

III.METHODOLOGY

The proposed system is able to do the whole cleaning process automatically. The user has to keep the machine on the place where the cleaning has to be done. This cleaner is electro mechanical machine with ultrasonic sensor and Ultrasonic sensor is used for obstacle detection in front of the machine and it can also consist of ultrasonic sensor to detect obstacle. Vacuum section consists of a cylindrical broom which is attached to the vacuum cleaner and it is in front of the machine to scratch the floor and a vacuum cleaner with dustbin is used for sucking the dust particles on the way. Mopping section consists of the water pump with small tank and the roller to mop the floor and it is back of the machine. Water pump drips the water on the floor and roller mops to clean the wet floor.

The whole system is depend on the Arduino controller. Arduino controller is programmed using Arduino Integrated Development Environment (IDE), Programming languages used are C or C++. Program is compiled burned using Arduino Integrated Development Environment (IDE). It contains a text editor for writing code, a text console, a toolbar etc. Program written in Arduino Software (IDE) is called sketch. The extension used for Arduino sketches is in. The editor has features for cutting or pasting and for searching or replacing text. The console is used to display text output by the Arduino Software (IDE), including error messages another information. The toolbar contains buttons to verify and upload programs, create, open, and save sketches, and open the serial monitor. We have used the Arduino IDE version 1.6.7.

Blynk is an online platform through which the activities of the machine can be controlled. The name and password of the wireless network used to establish contact of the machine with the online platform are put in the code. Once you connect that network to this online platform, you can remotely control the activities like switch on/of the mop or the vacuum pump.
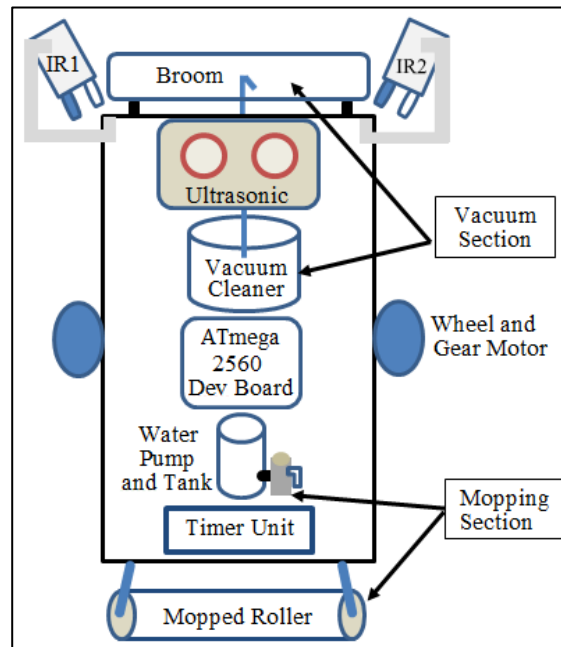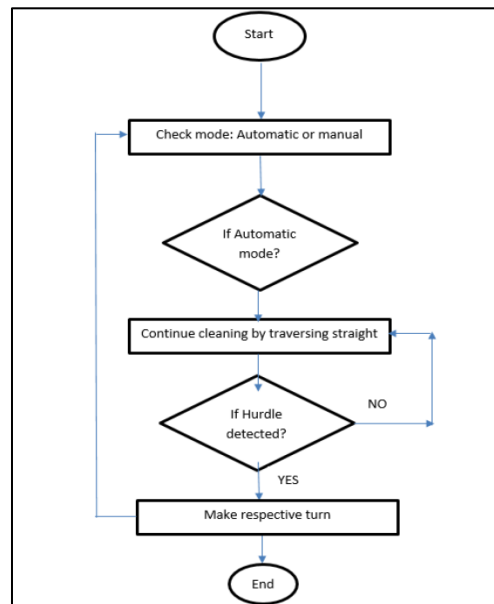
Fig.1.1: Layout of machine
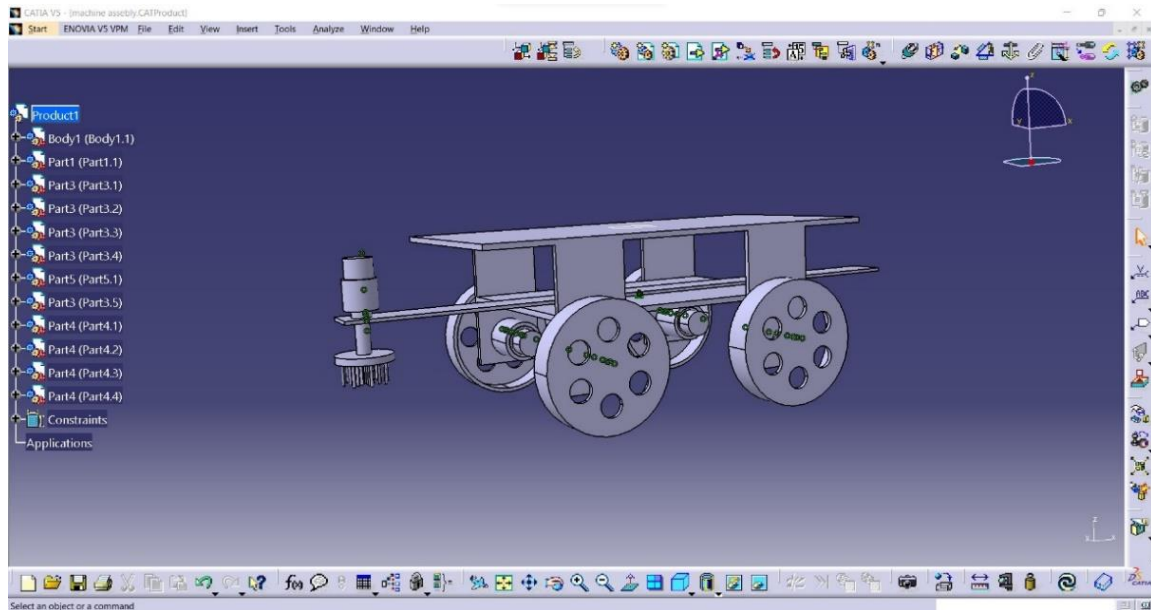

Fig.1.2: Flowchart of working mechanism [11]

IV. DESIGN

Fig 3.1.: Isometric view of model

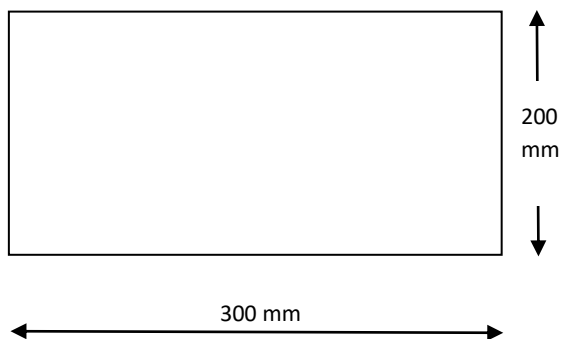**Basic Design Calculation:**

200 mm

300 mm

 Fig 3.3: Dimension of frame

Chassis Length = 300mm

Chassis Height = 100mm

Chassis Width = 200mm

Area = Length x Width = 300 x 200 = 60000 mm

1. Material selection

We know for Mild steel

σ_y= 250 N/mm^2

Factor of safety=2

τ = 0.5 x σ_y / factor of safety

τ = 0.5 x 250 / 2 = 62.5 N/mm^2

2. Calculation of torque of motor

Torque = (I x V x E x 60) / (N (rpm) x 2л)

V= input voltage

I = input current

E = Efficiency of motor

T = (1.3 x 12 x 0.6 x 60) / (100 x 2л)

T = 0.8938 Nm

Fabrication:

Component Used:

1. Chassis

.2. ESP32 Microcontroller

3. Dc motors

4. Ultrasonic sensor

5. Battery

6. Motor Driver unit

7. Relay:

8. PCB board

9. Cleaning Mop

10. Vacuum Pump

11. Water pump

Fig: Final Prototype

V. CONCLUSION

In this paper, we have proposed to make a floor cleaning machine which can clean the floor efficiently and automatic which can detect obstacle while cleaning After taking trials and performance tests of the machine, we concluded that the machine achieved 70% accuracy in cleaning and saves about 40% of time needed for manual cleaning. We encountered some situations where the machine was not able to detect the obstacle because of ultrasonic sensor being placed towards one side. If more sensors would have been used, the cost may have ramped up. Also the battery lasts up to a limited time as the power is consumed by 4 wheel motors, 2 motors for mop, water pump as well as vacuum pump. But the positive side is that the machine works completely fine and is able to detect obstacles and change directions on its own. The machine is controlled with the help of an online platform so it can be controlled remotely. The user doesn't need to be around or move with the machine to maintain the communication of machine with the controlling platform. The scope of this project is to develop an automatic device that can drive from control room by internet of thing that work of sweeping floor without need of personnel and we need to just click a start button of the machine in smartphone application. This project has a scope in the areas like a large floor area, human hazards area in industries like nuclear plant chemical plant and the areas where threat of dangerous gasses presence. Usually designs include spinning brushes or mopping or obstacle detector with vacuum as well. We have constructed a design with brushes for dust collection as well as moping for floor cleaning purpose

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REFERENCES

[1] ArpitJoon, WojceichKowalczyk; Design of Autonomous Mobile Robot for Cleaning in the Environment with Obstacles; Applied Science; 31 Aug 2021[2] Mansa M, Vidyashree T S, Bindushree V, Sanjana Rao, Gowra P S; Smart Vacuum Cleaner; Elsevier B.V. on behalf of KeAi; 11 july 2021

[3] Ines Bula, Edin Bula, Edmond Hajrizi; Cost Oriented Autonomous Window Cleaning Robot from Mechatronic Scrap – MechCleanBot; Elsevier; 2021

[4] TarunVerma, Abhishek Mishra; Development of Robot Model for Cleaning Open Space; Elsevier; 2019

[5] Raj Vishaal, Raghavan P, Rajesh.R, Sachin Michael, Mohan Rajesh Elara; Design of Dual Purpose Cleaning Robot; Elsevier; 2018

[6] Nazim Mir-Nasiri, HudywayaSiswoyo J, Md.Hazrat Ali; Portable Autonomous Window Cleaning Robot; Elsevier; 2018

[7] T.B Asafa, T.M.Afonja, E.A Olaniyan, H.O.Alade; Development of a Vacuum Cleaner Robot; Elsevier; 9 July 2018

[8] VeerjagadeshwarPrabakaran, ThejusPathmakumar, ShunsukeNansai, Mohan Rajesh Elara; Floor Cleaning Robot with Reconfigurable mechanism; Elsevier; march 2018

[9] Mohan Rajesh Elara, Thein Than Thun, ShunsukeNansai, VeerjagadeshwarPrabakaran, ThejusPathmakumar; A Novel Nested Reconfigurable Approach for a Glass Cleaning Robot; Inventions; 2017

[10] ShunsukeNansai, Rajesh Elara Mohan; A Survey of Wall Climbing Robot: Recent advances and Challenges; Robotics; July 2016

[11] N. M. Borkar, Pragya Mishra, Anjali Mishra, AasthaBisen, Tanuj Tiwari; Autonomous Vacuum Cleaner with Smartphone Compatibility; International Journal of Engineering Science and Computing, April 2018

[12] YudaIrawan, Muhardi, RianOrdila, Roni Diandra; Automatic Floor Cleaning Robot Using Arduino and Ultrasonic Sensor; Volume 2, Issue 4; ISSN: 2715-5072 DOI: 10.18196/jrc.2485; July 2021

[13] Dr.AkashRathee, IshantJalan, LakshitaNandwani, Tanya Sharma; Automatic Smart Floor Cleaning Robot Using Arduino – UNO; ISSN : 2454-9150 Vol-05, Issue-12, Mar 2020.

[14] Xueshan Gao, Kejie Li, Yan Wang, Guangliang Men, Daweizhou and Koki Kikuchi; A floor cleaner robot using Swedish wheels; In IEEE international conference on robotics and biomimetics, Sanya, China; December 2018.

[15] Manya Jain, Pankaj Singh Rawat; Automatic Floor Cleaner; International Research Journal of Engineering and Technology (IRJET) Volume: 04 Issue: 04; Apr -2017 e-ISSN: 2395 -0056 p-ISSN: 2395-0072.

[16] Xueshan Gao, Kejie Li, Yan Wang, Guangliang Men, Daweizhou and Koki Kikuchi; A floor cleaner robot using Swedish wheels; In IEEE international conference on robotics and biomimetics, Sanya, China; December 2018.

[17] Manreet Kaur, PreetiAbrol; Design and Development of Floor Cleaner Robot (Automatic and Manual); International Journal of Computer Applications (0975 – 8887) Volume 97–No.19; July 2014.

[18] D. C. Patel, H.S. Patel; Development of Arduino Programme Code for Autonomous Smart Vacuum Robot; International Journal of Emerging Technologies in Engineering Research (IJETER) Volume 5, Issue 11, November (2017)

[19] Lakshmi Bangalore Gangadharaswamy: Design of Autonomous Cleaning Robot Masterof Science Thesis Tampere University December 2019

[20] Amir Talebi Sheikh Sarmast, Taherepourseif, RozhinaEsmaeilNezhad, Mina Mohajeri, SamanMohammadi, Aida Vaezi; Designing a Smart Vacuum Cleaner in Two Modes of Remote and Automatic;International Research Journal of Engineering and Technology (IRJET) Volume: 07 Issue: 07, July 2020

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