ORIGINAL RESEARCH PAPER

Mechanical Engineering

VACUUM CLEANER

KEY WORDS:
Microcontroller, Sensor, Module, Remote Control, Motor Driver Ic,power Supply

Anil Kumar Srivastava Department Of Mechanical Engineering,IIMT College Of Engineering, Greater Noida

Devashish Singh* Department Of Mechanical Engineering,IIMT College Of Engineering, Greater Noida *Corresponding Author

Dushyant Bhati Department Of Mechanical Engineering,IIMT College Of Engineering, Greater Noida

ABSTRACT

In this work we implemented a human friendly cleaning robot with the advancement of technology to make human life easy and comfortable. The conventional automatic cleaning robot already exists, but these robots do not work in sync with humans. This robot can work in any of two modes i.e. "Automatic and Manual". The need of the project has come up because of a busy schedule of a working people. So this has resulted in coming up with an objective of making a automated vacuum cleaner. Vacuum cleaner robot which having components DC motors, wheels, roller brush, cleaning mop, the garbage container and obstacle avoidance sensor & 12V rechargeable battery is used as power supply. The study has been done keeping in mind economic cost of product. Manual work is done by robot technology. RF modules have been used for wireless communication between remote (manual mode) and robot and having range 50m. In this vacuum cleaning robot for obstacle detection IR sensor is used. Four motors are used, two for cleaning, one for water pump and one for wheels. Motor driver IC is used to drive the motors & MOSFET is used for water pump and another for cleaner as switching. In previous system, there was no automatic water sprayer used and works only in automatic mode. In the automatic mode robot control all the operations itself and change the lane in case of hurdle detection and moves back. In the manual mode, the remote is used to perform the expected task and to operate robot. In manual mode, RF module has been used to transmit and receive the information between remote and robot and display the information related to the hurdle detection on LCD. The whole circuitry is connected with 12V battery.

1. INTRODUCTION

In present days, robotic cleaners have taken major attention in robotics research due to their effectiveness in assisting humans in floor cleaning applications at homes, hotels, restaurants, offices, hospitals, workshops, warehouses and universities etc. Basically, robotic cleaners are classified on their cleaning technique like floor mopping, dry vacuum cleaning, sweeping etc. Some products are based on simple obstacle avoidance using infrared sensors while some utilize laser mapping technique. All cleaning and operating mechanism of robotic floor cleaners has its own advantages and disadvantages. For example, robots utilizing mapping are relatively faster, and energy efficient but costly, while obstacle avoidance based robots are relatively less time consuming and less energy efficient due to random cleaning. The main objective of this work is to provide a substantial solution to the problem of manufacturing robotic cleaner utilizing local resources while keeping it low costs [1].

The "Automatic and manual vacuum cleaning robot" has been designed for consumer, office environments, hotels & restaurants. Proposed design is being operated in dual modes. In one of the modes, the robot is fully autonomous and making decisions on the basis of the outputs of infrared proximity sensors. In manual mode, the robot can also be used to clean a specific area of a room by operating it manually [2].

Robot is an electromechanical machine and used for various purposes in industrial and domestic applications. Robot appliances are entering in the consumer market, since the introduction of Autonomous robot. Initially the main focus was on having a cleaning device. As the time pass on many improvements were made and more efficient appliances were developed. Detachable clothes were attached for sweeping and mopping purposes. In this research work a floor cleaner robot based on Atmega18 have been developed. This cleaner robot is an electric home appliance, which operating in two modes as per the user requirement "Automatic and manual". Detachable mop is used for mopping and it works on 12V supply. Movement of robot is controlled by user itself through remote therefore user can move the robot in the desired direction [3].

2. LITERATURE REVIEW

Karthick.T, Ravikumar.A, Selvakumar.L, Viknesh.T, has discussed the idea to develop an autonomous ROBOT that can be move itself without continuous human guidance. The autonomous cleaner ROBOT system which can be consumes very less power on comparing with existing system. The existing system consumes very high power of 500W for suction whereas "Automatic and manual vacuum cleaning robot" required 10W for suction[4].

Uman Khalid & Muhammad faze baloch in had presented the design, development and fabrication of prototype smart floor cleaning robot (clear) using IEEE standard 1621. This ROBOT is specially made on the basis of modern technology. Clear has all the features which are required for a vacuum cleaner. It can work automatically and manually[5].

Naman Aggrawal, Piyusha Chaudhari, Anshul Mishrain in 'Review paper based on cleaning ROBOT'. This paper a human friendly cleaning ROBOT system for the domestic over all environment through conventional automatic cleaning ROBOTs already exist. A prototype of the rotating brush device is made manually to ensure the cleaning effect of the proposed system. From this all research paper we conclude that the drawback of this research is the robot can be work automatically as well manually from that now us going to implement the robot which can be work without human effort [6].

3. RECENT DEVELOPMENTS

In 2004 a British company released Airider, a hovering vacuum cleaner that floats on a cushion of air, similar to a hovercraft. It has claimed to be light-weight and easier to maneuver (compared to using wheels), although it is not the first vacuum cleaner to do this — the Hoover Constellation

predated it by at least 35 years.

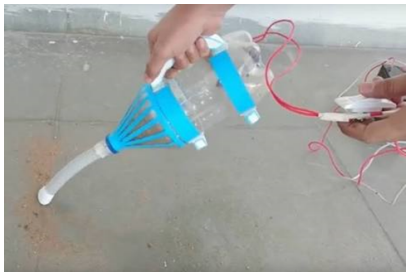
A British inventor has developed a new cleaning technology known as Air Recycling Technology, which, instead of using a vacuum, uses an air stream to collect dust from the carpet.[16] This technology was tested by the Market Transformation Programme (MTP) and shown to be more energy-efficient than the vacuum method.[17] Although working prototypes exist, Air Recycling Technology is not currently used in any production cleaner.

The name "vacuum cleaner" is a bit of a giveaway when it comes to understanding how your machine works: vacuum cleaners work by *suction*. ("Suction cleaner" would be a better name than vacuum cleaner, in fact, because there's no actual vacuum involved. There is a difference in air pressure, but nowhere is there is an absolute vacuum.) If you've ever tried that cleaning trick with a tissue paper and a comb, you'll know how effective suction can be for removing dirt. If not, try it now! Wrap a piece of tissue paper around a comb. Breath out as far as you can and hold your breath. Place the comb and paper against your mouth. Now lean against a dusty armchair and press your mouth and the comb against it. Breath in sharply so, effectively, you are breathing straight through the comb. Take the comb away from your mouth and inspect the tissue paper. See how dirty it is!

Now imagine what would happen if you could keep this trick up for hour upon hour, just like a vacuum cleaner. Eventually, the dirt would build up on the tissue paper to such an extent that air would no longer flow through it properly. Your ability to clean—as a human vacuum cleaner—would be greatly impaired. This is a very important point: for a vacuum cleaner to work effectively, it has to maintain powerful airflow the whole time. If its bag is full or its filters are clogged up, its airflow will be dramatically reduced and it won't pick up dust. This is a problem that plagues almost every type of vacuum cleaner—even the bagless, cyclonic ones that are now so popular on, the motor whirred into action, sucking in air and dirt and blowing them into the bag.

Think back to the "suck and filter" comb trick and you'll understand straight away how these old-style, bag vacuum cleaners work. In place of your mouth, there's a powerful electric motor attached to a fan that sucks in air. Instead of a tissue paper and comb, there's a dirt bag (sometimes a disposable paper bag inside a fabric bag), which catches the dust sucked in so you can use the cleaner for some time without worrying about where all the dirt is going. The bag isn't completely airtight, as you might think. Air can pass out of it, though not dirt, so it effectively acts as a filter; the air is sucked into the bag and then escapes through it, leaving the dirt behind inside it.

3.1 This diagram summarizes what's happening inside a conventional vacuum:



1. Electricity outlet supplies energy to the cleaner's electric motor.
2. In a typical cleaner, the electric motor is rated at about 500– 1000 watts, so it uses five to ten times as much energy as an old-style (incandescent) lamp.
3. Rubber belt (blue) powered by electric motor turns brushes and beaters on the roller at the front of the machine.
4. Vigorous beating and brushing loosens dirt from the carpet or rug.
5. Fan attached to the electric motor sucks air and loosened dirt in through the front of the machine.

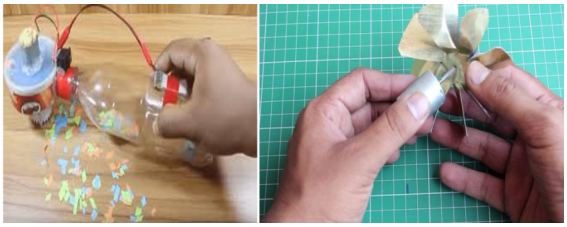
3.2 TECHNOLOGY OVERVIEW

Each component of a vacuum cleaner is important for the overall energy consumption and performance. In the report the following components are explained in depth:

- **Motor;**
- **Fan;**
- **Receptacle;**
- **Filters;**
- **Hose;**
- **Nozzles;**
- **Batteries;**
- **Plug and power cord**.

Based on this component analysis and data from APPLiA and GfK, the average technology and best available technologies were determined for each of the following vacuum cleaner types:

- Mains-operated household vacuum cleaners;
- Commercial vacuum cleaners;



4. DESIGN/ MATHEMATICAL FORMULATION

4.1 VOLUMETRIC FLOW RATE OF SUCTION FAN

A. Volumetric flow rate of suction fan (Q) $= \pi \times D \times L \times N$

$$\pi \times 0.4572 \times 0.0762 \times 3$$

$$= 328.34 m^3/min$$

B. Storage Capacity of Cylinder

Storage capacity of cylinder $= \pi \times R^2 \times L$

$$= 3.14 \times (0.225)^2$$

$$= 79 \text{ lit}$$

C. Total Power Consumption (P_T)

1) Power consumed by suction fan (P_F) $= 12 \times 10 = 120$ Watts

2) Power consumed by brush motor (P_M) $= 12 \times 2$

$$= 24 \text{ Watt}$$

3) Total power consumption (P_T) $= 120 + 24$

$$= 144 \text{ Watts}$$

4.1 SPECIFICATIONS OF SUCTION CYLINDER

Particulars	Details
Material	Mild Steel
Gauge size	21
Diameter	45 cm
Height	90 cm

Battery used in this project is the main source wer to run the Axial Flow Fan which is sible for the production of Suction Pressure. attery used is of 12V/26Ah rating.

	TABLE	
	SPECIFICATIONS OF BATTERY	
Sr.N	Particulars	Details
1	Current rating	26 A
2	Voltage rating	12 V

5. CONCLUSION

This robot is specially made on the basis of modern technology. System has all the features which are required for a vacuum cleaner. It can work automatically and manually. It has the feature of the scheduling and it can auto drain itself. CLEAR has many competitors who are selling same product in high prices. This research clear the way for efficient floor cleaning with sweeping and mopping operations. An automatic water sprayer is used which sprays water for mopping purpose. User can also operate this robot manually with the help of remote. It reduces the labour cost and saves time also and provides efficient cleaning. In automatic mode, the robot operates autonomously. The operations such as sweeping, mopping and changing the path in case of hurdle are performed automatically. Nonetheless, there are still new ideas to improve the developed system and to add new functionality to it. Further, the robot can be made to move randomly in any direction and its speed can be controlled. It has a vacuum cleaning system which consume very less as comparing with other system. Power consumption will reduced greatly and hence the operating cost is very low.

REFERENCES

1. Forlizzi, J. How robotic products become social products, 2nd ACM/IEEE International Conference on Human-Robot Interaction - HRI '07, pp. 129-136, 20 April 2016.
2. Vuorimaa, P., Harmo, P., Hämäläinen, M., Itälä, T. & Miettinen, R. (2012). Active Life Home: a Portal-Based Home Care Platform, Proceedings of the 5th International Conference on Pervasive Technologies Related to Assistive Environments - PETRA '12, Paper 28, 18 April 2016.
3. Karthick. T. Ravi Kumar. A, Selvakumar. L, Viknesh. T "Simple Autonomous Cleaner Robot" International journal of Science, Engineering & Technology Research (IJSER), Vol. 4. Issue 5 May 2015.
4. Uman Khalid, Haseeb Haider, Tahseen Amin Khan Qasuria " Smart Floor Cleaning Robot (CLEAR)" in IEEE standard 2015.
5. Naman Aggrawal, Piyusha Chaudhari, Akshay Mahalkar "Review Paper Based on Cleaning Robot", vol.3 No.5 May 2016.