Floor Claening Machine By Automatic 4/21/2018

Adnan Ahmed[1], Mohammed Akib[2], Ansari Shamshad[3], Md Hesham[4]
[1]EVEREST EDUCATIONAL SOCIETY
[2] DEPT OF MECHANICAL ENGINEERING

Abstract- *Automatic floor cleaner is a compact robotics system which provides floor cleaning service in room and big offices reducing human labor. Basically as a robot it eliminates human error and provides cleaning activity with much more efficiency. If we clean the floor manually then there is a possibility that the operator will leave some portion of the floor. Also due to manual labor involved this is time consuming and irritating to clean the floor. Also in big offices floor area is very huge and the people involved there for cleaning purpose cannot clean it much more efficiently. This is where the robot comes as an advantage. Also the robot is small and compact in size. So we can carry it and place it wherever we can on the house. Also in industries the robot is very cost effective as compared to manual labor involved. The flexibility, time saving and efficiency make the robot a clean choice for cleaning the floor.*

Keywords- Robotic floor cleaning, more efficient, reduce man power, small and compact

I. INTRODUCTION

Robot is an intelligent device having its own brain fed with computer logic so hat it can do the work according to the algorithm designed. Autonomous movement of vehicle is guided by the logic controller designed. Robots play an important role in each every field of life. It is used in industries, in households and in institutes. The robots are just becoming as intelligent as human now days. Mostly an average human uses 2-3 robots per day in his day to day life.
Various robotics parts are: -

- Pneumatic devices
- Actuators
- Sensors
- Mechanical control devices like valve
- Microcontroller
- Controlling unit

Mechanical control devices are used to control the flow or movement of materials or any other parts present in the device. Actuators are used for controlling a mechanism which ultimately controls a part of the device. Sensors are the sensing devices which transmit a signal and receive the signal and accordingly used to accumulate the various environment information which is ultimately fed to microcontroller for deciding the working of machines. Microcontroller is the brain of robot where program is written and sensors are connected as input and actuators as output. The controlling of the robot is governed by various algorithms like fuzzy controller, machine learning based practices and artificial neural network based algorithms. Depending upon the environment value received to the controller it eliminates the error and transits from one state to another. Basically there are two types of controllers, one is continuous controller and another is PID based controller. Continuous controller is more direct and less effective while PID controller is more advanced and varies according to the current state and gives efficient result.

II. LITERATURE REVIEW

T. Palleja, M. Tresanchez, M. Teixido,[01] In this paper, floor-cleaning coverage performances of some domestic mobile robots are measured, analyzed and modeled. Results obtained in a reduced scenario show that floor-cleaning coverage is complete in all cases if the path-planning exploration algorithm has some random dependence. Additionally, the evolution of the area cleaned by the mobile robot expressed in a distance domain has an exponential shape that can be modelled with a single exponential where the amplitude defines the maximum cleaning- coverage achieved and the time-constant defines the dynamic evolution of the coverage. Both parameters are robot dependent and can be estimated if the area of the room is known and then floor-cleaning coverage can be predicted and over-cleaning minimized.

Spyros G. Tzafestas"9 [2]Introduction to Mobile Robot Control provides a complete and concise study of modeling, control, and navigation methods for wheeled non-homonymic and unidirectional mobile robots and manipulators. The book begins with a study of mobile robot drives and corresponding kinematic and dynamic models, and discusses the sensors used in mobile robotics. It then examines a variety of model-based, model-free, and vision-based controllers with unified proof of their stabilization and tracking performance, also addressing the problems of path, motion, and task planning, along with localization and mapping topics. The book provides a host of experimental results, a conceptual overview of systemic and software

mobile robot control architectures, and a tour of the use of wheeled mobile robots and manipulators in industry and society. Introduction to Mobile Robot Control is an essential reference, and is also a textbook suitable as a supplement for many university robotics courses. It is accessible to all and can be used as a reference for professionals and researchers in the mobile robotics field.

Spyros G. Tzafestas"11 [3] his volume explores the ethical questions that arise in the development, creation and use of robots that are capable of semiautonomous or autonomous decision making and human-like action. It examines how ethical and moral theories can and must be applied to address the complex and critical issues of the application of these intelligent robots in society. Coverage first presents fundamental concepts and provides a general overview of ethics, artificial intelligence and robotics. Next, the book studies all principal ethical applications of robots, namely medical, assistive, and socialized and war robs ethics. It looks at such issues as robotic surgery, children-robot and elderly-robot Therapeutically social interactions and the use of robots, especially autonomous lethal ones, in warfare. In addition, a chapter also considers Japanese rob ethics as well as key intercultural and robot legislation issues. Overall, readers are provided with a thorough investigation into the moral responsibility (if any) of autonomous robots when doing harm. This volume will serve as an ideal educational source in engineering and robotics courses as well as an introductory reference for researchers in the field.

III. TECHNICAL CONTENT

3.1 DESIGN OF PRESENT WORK

The present work is aimed at designing a compact floor cleaner that can be useful for house-hold purpose. The complete process of the machine starts from the front vacuum pump. It is used to suck dry debris from the floor. This is very much useful for the purpose of pre cleaning the surfaces having heavier dirt particles. The debris thus sucked has to be stored so that it could be removed later. This is achieved by using a 12v vacuum pump with a debris chamber attached to it. The next aim is to make the surface wet which is carried out by sprinkling water on the floor. The aim is achieved by using a motor and a sprinkler system. This system has a shower like outlet and a chamber whose outlet is controlled by a dc motor pump. To clean the surface scrubber has to move or scrub over the floor. The dirt should be completely removed and the debris laden water will flow towards the rear of the bot. the scrubber is fixed to the chassis using clamps. The construction of the scrubber includes fixing one side to the motor and the other to the ball bearing. The bearing is clamped to the chassis. At the rear of the system a vacuum mechanism is used to suck the debris laden dirty water. This is also the same type of pump and the chamber. Hence the total system can be sub-divided into different parts, such as:

1) Chassis
2) Vacuum pumps
3) Sprinkler system
4) Scrubber
5) Motor driver
6) Wheels
7) Control system

The complete system is operated automatically throughout the floor of any kind of room.

3.1.1 CHASIS

It is the back bone of the system. All the systems and parts are attached to it. The solidity of the system is greatly affected by the chassis. It size is 40cm length 30cm width.

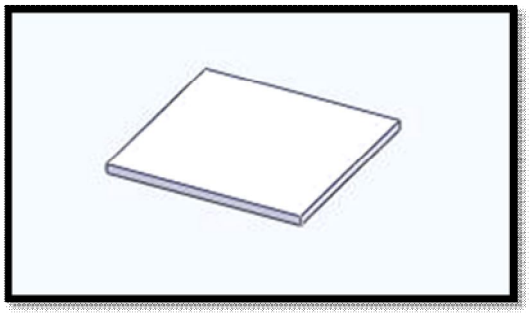

Figure no 3.1.1: Chassis

3.1.2 VACCUM PUMP

2 numbers of vacuum pumps are used for 2 different purposes. Front one for collection of dry debris and the rear one for sucking of dust mixed with water. The flow rate of the pump is 12-15 LPM, vacuum range 0-16” Hg, pressure range 0-32 psi. Input parameters are voltage 12 VDC, power 12w. Motor construction is iron core oil bearing type. Diaphragm material is EPDM.

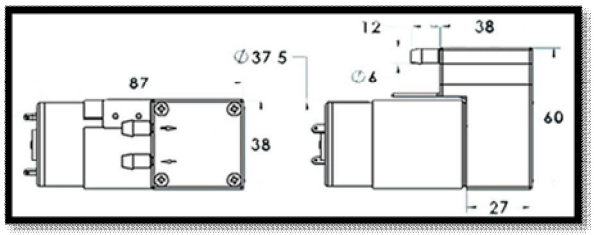

Figure 3.1.2: 12 V Vacuum Pumps

3.1.3 SPRINKLE SYSTEM

The next work of the machine is to make the surface wet. To achieve this we have designed a sprinkling mechanism. Water is stored in a chamber that has a opening controlled by a motor. By putting this motor to ON position water or cleaning liquid starts flowing from the chamber. It is connected to a shower type arrangement via connecting pipe. The sprinkler system has a number of holes arranged sequentially which can be modified manually.

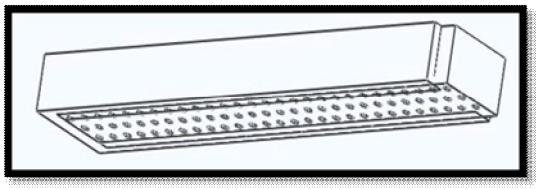

Figure 3.1.3: Sprinkle System

3.1.4 SCRUBBING SYSTEM

As discussed earlier scrubbing of surface is necessary for proper cleaning. For different type of floors different types of scrubbers are to be used. For stone flooring soft cloths, for cement floors hard plastics are used. In our case the scrubber is given a rotational motion to scrub the surface. The rotational motion is achieved by a 12v DC motor having 600rpm. The scrubber is as shown in fig5. One side of the scrubber is fixed with the dc motor which again clamped to the chassis by C-clamp and screw. The other part of the scrubber is connected to a ball bearing which is again clamped to the chassis via C-clamp. The connection of bearing is done by a hub. The hub is a metallic object of cylindrical shape. On one side of the hub a hole is made and the scrubber is fixed. The bearing is fitted by transition fit to the ball bearing. Transition fit is the type of fit when the diameter of the shaft and the hole are same and hence the shaft is fixed by applying continuous force.

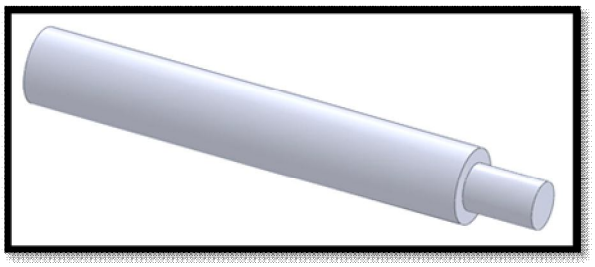

Figure 3.1.4: Scrubber mechanism

3.1.4 MOTOR WHEEL SYSTEM

The complete product is a four wheel drive automation process. 4 wheels are independently connected to 4 different 12v DC motors. The purpose of the wheels is

1.To give the BOT proper motion.
2. Provide traction in all sorts of surfaces.
3. Make the movement easier in all direction.
4. Not to slip off from its path.

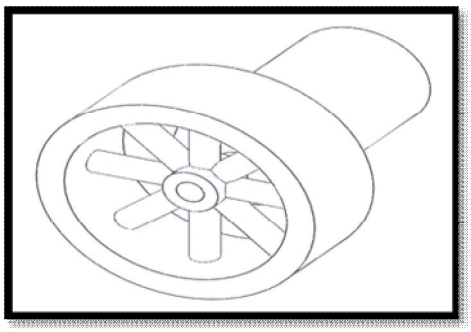

Figure 3.1.5: Motor wheel system

The axis of motor is bolted to the axis of the wheel. The motor-wheel arrangement is fixed to the chassis using L-clamp and screw. The movement of the system can be achieved by giving power to required motor and/or making devoid of power. For example if we need to make the machine give a turn towards right the front right wheel is stopped or slowed down. Again for left turn left front wheel will be slowed. Rear wheels are always in operation to pull the system. The diameter of the wheel is 12.5cm.

3.1.6 CONTROL SYSTEM

The purpose of the control system is to give an automatic motion to the machine. Apart from that it also makes all the parts to operate in sequence and for correct interval. For example while turning it should ensure less flow of liquid through the sprinkler system. Again it has to trace all the parts of a room. In other words no part of the floor should remain untouched. Spiral motion algorithm is used for this purpose which gives 90% accuracy. For avoiding obstacles image sensing technique is used. Sensors are used on 3 sides of the machine: front, left and right. If the front sensor senses any obstacles the next task is to sense from right sensor. If this sensor doesn't show any obstacle, the machine will move towards right. But if right sensor hits any obstacle, the motion will be towards left according to the sensing data found from the left sensor.

3.2.1 DC MOTOR

DC motor is an electrical machine that utilizes electric power resulting in mechanical power output. Normally the motor output is a rotational motion of the shaft. The input may be direct current supply or alternating supply. But in case

of DC motor direct current is used. The mechanism of dc motor is like a bar wound with wire is placed in between 2 magnets having north and South Pole. When it is provided with electric supply the wire becomes energized resulting in rotational motion which leads to rotational output.

Figure 3.2.1: DC Motor

3.2.2 SENSOR

It is a type of electronics component that uses ultrasonic transmitter and receiver pair to send and collect signals resulting in proper sense of obstacles. The more the resonant frequency the lesser will be the wavelength of transmitted radiation and it will provide good surrounding condition. The more directional the sonic wave the more resolution in the measurement comes. Sensitivity helps in decreasing signal to noise ratio

Figure 3.2.2: Sensor

3.2.4 ARDUINO

Arduino plays a major role in automation .It acts as brain of the robot .It operates around the voltage of 3.3 volt. It uses atmega16 on its core which uses ARM processor .It has 54 digital I/O pins and 12 analogy output pins. From 54 digital pins 12 are PWM (Pulse Width Modulation) pins.

2 DAC pins use 16 bit resolution and operates by the help of analogy Write() function. It has 2 USB ports. Such as:-

- Programming USB port
- Native USB Port

We can feed the program through programming USB port. Every program has 2 functions in its body. Such as:-

- loop() function
- setup() function

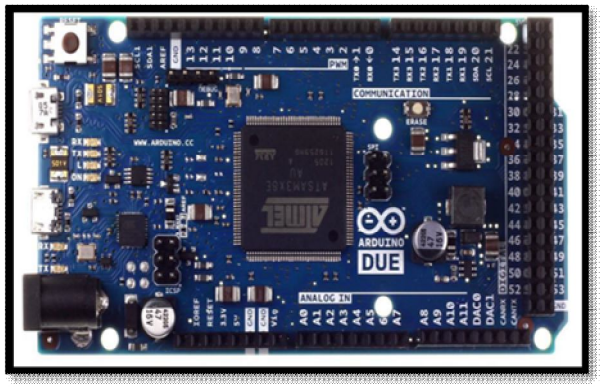

Figure 3.2.3: Arduino

3.2.4 MOTOR DRIVER

We are using here L293D motor driver which has 16 pins 8 on each side. We can control maximum 2 motors connecting on each side.

On the left side two terminals OutputA1 and OutputA2 are connected to two terminals of motor and similarly on the right hand side OutputB1 and OutputB2 are connected to motor terminals. The inputs from the arduino board are connected through InputA1, InputA2, InputA3, and InputA4.Accordingly motor moves forward, backward, left side and right side. If positive terminal of motor (i.e. pin3) is high and –ve terminal of motor (pin6) is low motor moves forward. If pin3 is low and pin4 is high then motor moves backward.If both the terminals are same then motor stops rotating.

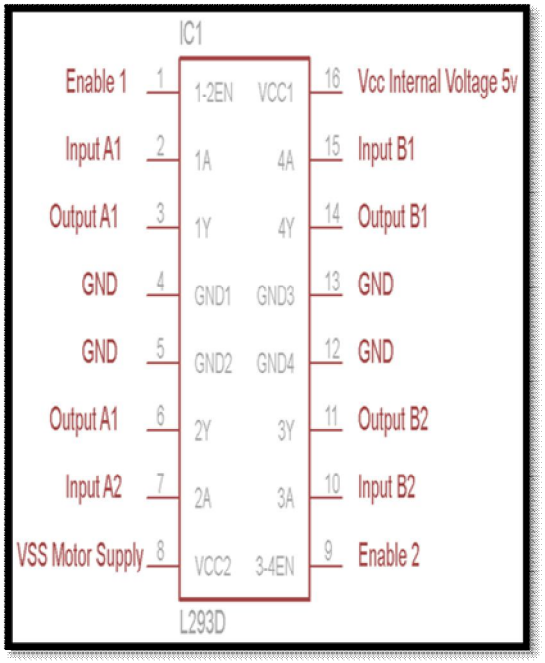

Figure 3.2.4 Motor Driver

First the obstacle is sensed and then the signal to arduino is sent and accordingly showing the distance of obstacle .Then arduino sends a signal to motor driver for respective turning motion of the bot.If the obstacle distance is 19 cm then bot starts rotating either sharp right or left. If the right wheel moves backward and left wheel moves forward then bot takes sharp left movement. If the left wheel turns backward and right wheel turns forward then bot takes sharp right movement.

3.3 APPLICATION

- Automatic floor cleaner is advancement over currently available cleaners.
- This product not only reduces man power, but also saves time.
- They hold around 80% of the market.
- They are using algorithms which approximately provide 70% accuracy. They are not using any image processing algorithms to run their robot.
- As we have utilized exchangeable scrubber, it can be used in any sort of floors. Basically it will be a boon for Indian house-hold.
- This will act like a pheromone like in ant algorithm. In Ant algorithm when pheromone density of ants in particular direction is denser all other ants follow that direction.
- Similarly when the robot will find the particular dust size on floor on one side of it and there are none on other 3 sides, it will head towards dusty area.

IV. CONCLUSION

4.1 CONCLUSION

The product thus developed is fully operational and gives desired motion. It is being tested in a room which results in successful outcome. The scrubber design should be modified in future because the current design has few problems. Few of those are the motor is not detachable and the high rpm leads to vibration of the whole system. If these features will be modified, this will work well. In our case 2 vacuum pumps are used which leads to loss of power. This can be reduced by substituting these 2 pumps with one pump having 2 path ways. This will be the next development stages. This not only decreases cost but also increases reliability of the instrument. Overall the concept is very much helpful and there is scope of a lot of development in mechanical parts. The optimization will continue till achieving the best one. Overall the project is successful to its intent and will definitely change the era robotics and floor cleaning. In the automation part the algorithm are designed to give 90% efficiency which is too high in current scenario. The development can be made in the field of sensing. But this product has the capability to detect as well as move in the direction of dust and thus resulting in better cleaning of floors. As a whole this is a successful product developed that can be used in current Indian house-hold.

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