DESIGN AND FABRICATION OF ROBOTIC VACUUM CLEANER

Submitted in partial fulfilment of the requirements
Of the degree of

BACHELOR OF TECHNOLOGY

IN

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CERTIFICATE

This s to certify that the thesis entitled — "**Design and Fabrication of Robotic Vacuum Cleaner"** submitted to the Galgotias University, Greater Noida (Deemed University) by **Parmod Kumar, Prateek Rajpurohit, Hari Krishna and Shubham Chauhan** for the award of the Degree of **Bachelor n Technology** in Mechanical Engineering is a record of research work carried out by him under my supervision and guidance. The results presented in this thesis has been, to the best of my knowledge, submitted to any other University or Institute for the award of any degree or diploma. The thesis, in my opinion, has reached the standards fulfilling the requirement for the award of the degree of Bachelor of Technology in accordance with regulations of the Institute.

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Internal Examiner   **External Examiner**

Approval Sheet

This thesis/dissertation/project report entitled by **Design and Fabrication of Robotic Vacuum Cleaner** is approved for the degree of bachelor of technology in mechanical engineering.

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I express my deep sense of gratitude and indebtedness to my guide Prof Dr P. Suresh, Professor of Mechanical Engineering for providing precious guidance, inspiring discussions and constant supervision throughout the course of this work. His timely help, constructive criticism, and conscientious efforts made it possible to present the work contained in this project.

I feel pleased and privileged to fulfil my parent's ambition and I am greatly indebted to them for bearing the inconvenience during my B Tech. course.

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<u>ABSTRACT</u>

An autonomous robot that can be used to do the works like vacuuming, surface cleaning and drying that includes suction part, mop motor 12v , Rubbermaid brushes, connecting link through MDF cardboard and two exhaust fans for drying and the whole setup s settled on 4, 10cm wheels driven by 12v high speed motors, Also, a drive system includes a steering system and control system for integrating operations. The control center includes Arduino uno a combination of microcontrollers with 3 relays installed to give instruction to all above mentioned three functions and connecting wires. Arduino s connected to all IR sensors and Ultrasonic sensors to receive all signals. Then Arduino that contain atmega328 give directory that s preinstalled by software algorithms.

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INTRODUCTION

1. **A BRIEF INTRODUCTION ABOUT THE PROJECT UNDERTAKEN**: Robot is a smart gadget having its own mind took care of with PC rationale so it can accomplish the work as per the calculation planned. Self-ruling development of vehicle is guided by the rationale controller structured. Robots assumes a significant job in every single field of life. It is utilized in ventures, in families and in organizations. The robots are simply turning out to be as clever as human now a days. For the most part a normal human uses 2-3 robots for each day in his everyday life. Different mechanical autonomy parts are:

   - Pneumatic gadgets Actuators

   - Sensors

   - Mechanical control gadgets like valve

   - Microcontroller

   - Controlling unit

   - Mechanical control gadgets are utilized to control the stream or development of materials or some other parts present in the gadget.

Actuators are utilized for controlling an instrument which eventually controls a piece of the gadget. Sensors are the detecting gadgets which transmit a sign and gets the sign and as needs be utilized to amass the different condition data which is eventually taken care of microcontroller for choosing the working of machines.

Microcontroller is the cerebrum of robot where program is composed and sensors are associated as input and actuators as yield. The controlling of the robot is administered by different calculations like fluffy controller, AI based practices and counterfeit neural system dependent on calculations. Contingent on nature esteem got to the controller it kills the blunder and travels starting with one state then onto the next. Fundamentally, there are two sorts of controllers, one's persistent controller and another is PID based controller. Nonstop controller is more

straightforward and less powerful while PID controller is further developed and fluctuates as indicated by the present state and gives proficient outcome.

1.2 OBJECTIVE: The target of the undertaking is to configuration, create and test a vacuum cleaner which is compelling in cost, simple to make and discover its application in various fields, for example, n businesses, in local locations, where dust particles are delivered.

The auxiliary goal is that this machine ought to be worked with no wire and no exertion required by people to work it so it tends to be utilized in local locations and little businesses as a substitute of human sweeper.

The mission is to manufacture and plan a self-governing robot that will help individuals at home who are unreasonably occupied for day by day or week after week floor cleaning, particularly for families with youngsters. Specifically, for the old who live without anyone else and don't have the quality or capacity to clean. Programmed vacuum cleaners in the market are costly and wasteful as far as cleaning time and cleanness. The objective is to plan an omni directional stage with infrared sensors and different sensors on each side to improve the referred to cleaning execution issues.

The automated vacuum cleaner is planned as a machine which gathers dust particles at a specific region. In our machine force will be conveyed by a battery. The vacuum cleaner is the most ordinarily utilized gadget these days that is utilized in each family so as to keep up a perfect and sound condition. An extraordinary wealth of organizations that plan and produce vacuum cleaners can be seen today available. The vacuum cleaners change in a wide range of qualities like sorts, costs, number of capacities, number of extra hardware, sizes, and so forth., with the goal that they can address various issues and needs.

In this undertaking the vacuum cleaner was explored according to another perspective. The attention fell on the availability and ease of use of this sort of item for individuals with debilitations and handicaps and how a vacuum cleaner can address uncommon issues. These days just in Sweden today there are 1.3 million individuals with diminished portability in arms and hands. Then again there are more individuals who develop old and later on there will be greater level of individuals who

will encounter diverse medical issues. Besides, those individuals are turning out to be increasingly requesting with respect to their personal satisfaction and this expands the need of items that a fulfill their prerequisites. Developing old or building up a specific infection influences individuals' everyday life and exercises. Basic undertakings, associated with item use and typically performed unknowingly, will in general become dangerous and baffling since they cause inconvenience, torment and n some they are even inconceivable.

1.3 AIM: The point of this undertaking was to make a structure of an item that cleans with vacuum which can address the issues of enormous gathering of individuals. An away from of the client requests was to made. The fundamental objective of the task was to build up the new item from the client needs and requests further. The new vacuum cleaner idea was to convey answer for issues that clients have had encountered while communicating with such kind of an item.

The fundamental destinations of our task are:

• To display a vacuum cleaner with automated control.

• To spare time and force via programmed control.

• To make the undertaking of cleaning simpler.

• To think of some new thoughts concerning vacuum cleaning.

1.3.1 HELP TO MANKIND

Controlling gives different points of interest over human fueled work. Following are some of them:

- It gives exact outcomes and disposes of plausibility of manual blunder.

- It is absolute first and proficient and the control framework utilized in enterprises are multiple times productive than human work.

- In some piece of the work regions it reduces the human endeavors. Clothes washer goes under this classification.

- It additionally assumes the incredible job in acquiring amusement human life in various work.

REVIEW OF LITERATURE

2.1 Introduction: This section clarifies about the capacity of the fundamental segment that being uses to fabricate the vacuum cleaner robot. This undertaking likewise presented on research to fabricate the cleaner framework that can vacuum the rug and can clean the floor. The undesirable molecule that lay on the floor will be brush-ed away the suck through a gap at that point separated. Along these lines, this technique is extremely natural for the vast majority of designing understudy in this nation where I trust it will bring a great deal of challenge and imagination and I like to change something that can get helpful. This venture is isolated by two section which is vacuuming and cleaning framework and controlling the development of robot. The writing audit can give some unpleasant plans to help on building up the task effectively and have the option to accomplish the targets that have been out-lined. Before any improvement can occur, an exploration must be completed on all the potential segments that will be utilized in the independent robot. The web is where point by point clarifications on a couple of reference and phrasings of comparable undertakings recently made by others can be found and there is no other spot to effortlessly get the information sheets of the parts utilized. Other than that, the self-ruling robot rivalries themselves are likewise another acceptable wellspring of data. The data is exceptionally valuable and supportive to this venture, particularly just the issues, for example, microcontroller, portable stage configuration, circuit format and sensor arrangement. The following are a portion of the significant hypotheses that identified with this venture, for example, IR reflection law that lead to line location of the robot, LCD capacities, essential thought of line following and labyrinth explaining hypothesis, PMW, H-connect utilized in engine driver, etc. These speculations ought to be completely comprehended before beginning the venture.

2.2 SAMSUNG TANGO VACUUM CLEANER ROBOTS: This automated framework, as appeared in Figure 2.1, travels through a room sucking dust from any surface it interacts with it runs on a battery.

CAPABILITIES	LIMITATION
1. Has 13 sensors allowing interaction with environment 2. Some are crash sensors which detects furniture and feet 2cm away 3. Uses remote control for operator ease Has a daily scheduling option	1. Remote control has a limited range in how far t can work 2. Operation time is only 2hrs

Table 1: Capabilities and Limitations of the Samsung Vacuum Cleaner Robot

2.2 REVIEWS

1.<u>Wolfdieter Richter</u>(1980) had chipped away at the development identifies with mechanical assembly for naturally managing a moving item, for example, a vehicle along a pre-decided way, the contraption including two indicators which are mounted in a divided separated relationship on the article, the finders being receptive to the power of electro-attractive waves, for example, X-Rays transmitted along the way. Examination implies for example an isolating circuit is associated with the finders to decide the proportions of the powers of the attractive waves and to give a sign which is followed up on by modification implies that alters the course of development of the item to bring it back onto the way. The creation accommodates illumination implies which s mounted on the item and which causes excitation and emanation of auxiliary influxes of pre-decided frequency from the way.
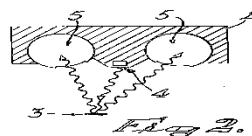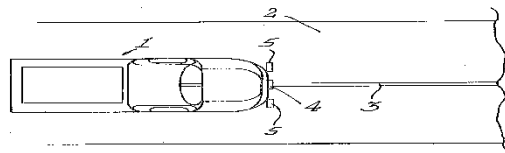
Figure 2.2.1 Automatic guidance apparatus (1)

This innovation identifies with a technique for a mechanical assembly for naturally managing an item comparative with a foreordained way. All the more especially, yet not only, the creation identifies with the programmed direction of a vehicle, for example, in the utilization of street markings.

It was the main patent on programmed vehicle that can follow it's pre-define way that prompts work more on this yet this mechanical assembly can't be utilized as such in our undertaking since we can't make way unfailingly.

2. <u>Joseph L. Jones</u> had dealt with a robot deterrent discovery framework including a robot lodging which explores as for a surface and a sensor subsystem having a characterized relationship regarding the lodging and focused on a superficial level for recognizing the surface. The sensor subsystem incorporates an optical producer which emanates a coordinated bar having a characterized field of discharge and a photon finder having a characterized field of view which crosses the field of outflow of the producer at a locale. A circuit in correspondence with a finder diverts the robot when the surface doesn't involve the locale to stay away from impediments. A comparable framework is utilized to distinguish dividers. Control of position or course in two measurements extraordinarily adjusted to land vehicles utilizing optical position recognizing implies utilizing obstruction or divider sensors(2).
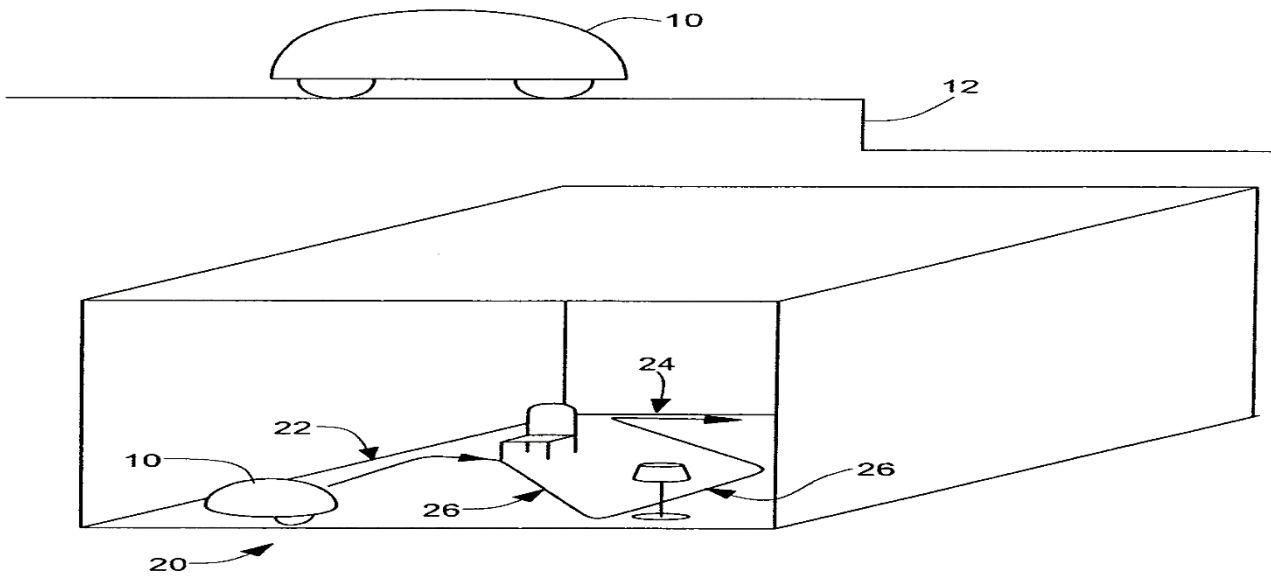
Figure 2.2.2

This invention is an exceptionally accommodating now a days as well and we are additionally utilizing this method to maintain a strategic distance from impacts to objects in the way.

3. <u>Joseph Jones, Newton Mack, David Nudget</u>(2002): I had taken a shot at a self-governing floor-cleaning robot involving a lodging framework including a suspension, a force Subsystem; for giving the vitality to control the self-ruling floor-cleaning robot, an intention Subsystem employable to push the self-governing floor-cleaning robot for cleaning activities, an order and control Subsystem usable to control the self-sufficient floor-cleaning robot to impact cleaning tasks, and a Self-altering cleaning head Subsystem that incorporates a deck mounted in crucial mix with the skeleton, a brush get together mounted in mix with the deck and fueled by the thought process Subsystem to Sweep up particulates during cleaning tasks, a vacuum gathering arranged in blend with the deck and controlled by the rationale Subsystem to ingest particulates during cleaning activities, and a deck changing Subassembly mounted in mix with the intention subsystem for the brush get together, the deck, and the case that is naturally usable n reaction to an expansion in brush torque in Said brush get together to turn the deck regarding Said body. The self-sufficient floor-cleaning robot likewise incorporates a side brush gathering mounted n mix with the frame and controlled by the thought process Subsystem to

entrain particulates outside the fringe of the lodging framework and to direct Such particulates towards the Self-changing cleaning head Subsystem.
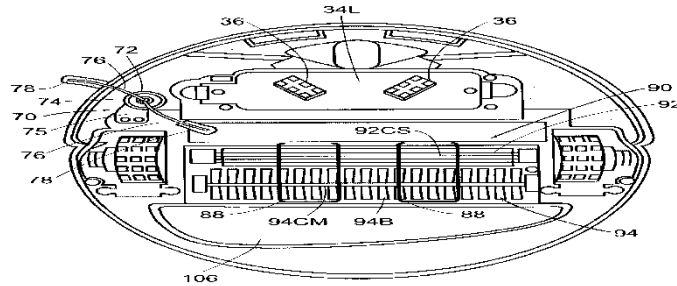
FIGURE 2.2.3

Configuration was productive to the point that it is being utilized for some organizations now a days and yet we are changing in configuration to make it increasingly proficient at corners. Be that as it may, all the things other than was awesome.

4. <u>David Kisela, Robert Vistricle, Wallace Tiller</u>(2003) had dealt with a self-sufficient vacuum cleaner incorporates a first module, a hose associated at a first end to the principal module and a Second module Spaced from the main module and associated with a Second finish of the hose. The primary module includes a Suction Source. The hose is in liquid correspondence with the Suction Source. The Second module incorporates a drive lodging including a drive System to impel the Second module and a spout Section critically mounted to the drive lodging. The spout Section incorporates a Suction opening in liquid correspondence with the hose.

Figure 2.2.4

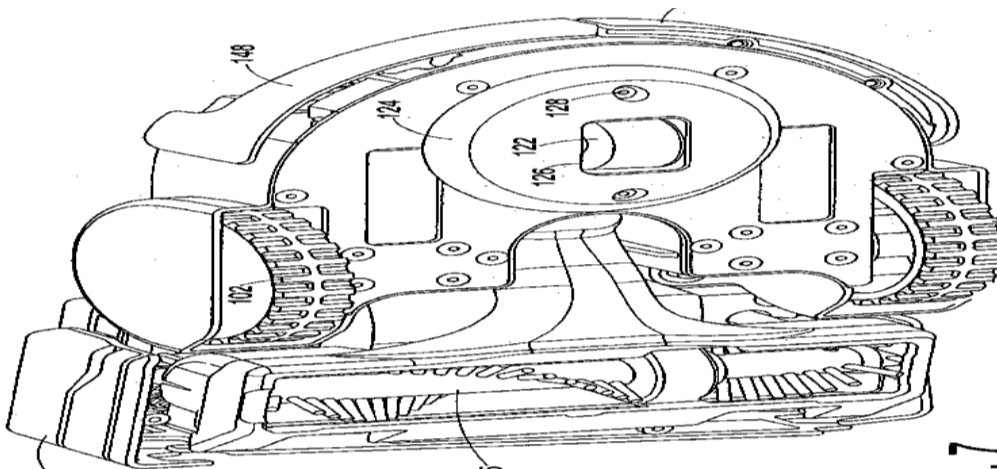That was the main patent on self-sufficient vacuum cleaner and it was introduced well overall and the issue was programming calculation and we are evolving it.

5.Hwi-Chan Jang, Shin Kim(2018): A self-governing cleaner incorporates a body having a first lodging shaped at a front and a subsequent lodging framed at a back of the primary lodging; a brush unit introduced at the main lodging and designed to clear and gather dust from a story; a residue gathering unit introduced at the subsequent lodging and arranged to store the residue gulf into the brush unit; a driving unit to drive the body and coupled to the subsequent lodging to be situated at a parallel side of the residue gathering unit; and a force unit introduced at the subsequent lodging and coupled to be situated at a back of the residue gathering unit. The scaling down of the self-ruling cleaner might be given while simultaneously the limit of a residue gathering compartment and the limit of a battery are increased.

This vacuum is generally excellent however over the top expensive on the grounds that they have offered this cleaner to LG and we can get it over 2 lacs yet we are attempting to make it under spending plan.

6. Shalom Levin, Shai Abramson(2018): A self-sufficient robot, that s for instance, reasonable for tasks, for example, vacuuming and surface cleaning incorporates a payload designed for vacuum cleaning, a drive framework including a directing framework, a route framework, and a control framework for coordinating activities of the previously mentioned frameworks.
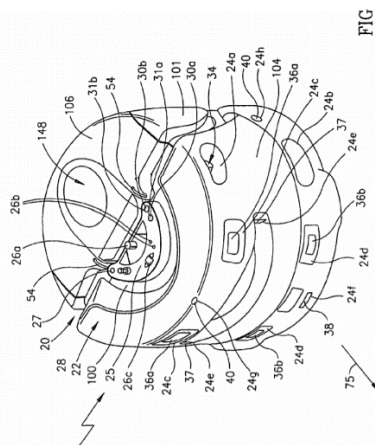

Figure 2.2.6

This venture helped us in creating control framework n our task as t utilizes Arduino as a control framework for the undertaking.

7. <u>Yutaka Takahashi, Yoshihiro Noguchi and Tomohisa mai</u>(1988): A story finder for a force brush of a vacuum cleaner includes a lift sensor S1 and a story sensor S2. The lift sensor S1 has a mobile part which yield capably uproots when the force brush s put on a generally delicate floor while the floor sensor S2 has a portable part which yield capably dislodges when the force brush s put on a moderately hard floor. Every one of mobile individuals s recognized ts development by a comparing light sensor which gives a sign agent of the developments. The signs from the light sensors are sent to a control circuit which controls a drive hotspot for driving the brush individual from the force brush. n this way, the brush part s pivoted when the force brush s set on a moderately delicate floor, for example, a covered floor and s not turned when the force brush s set on a generally hard, level, smooth floor.
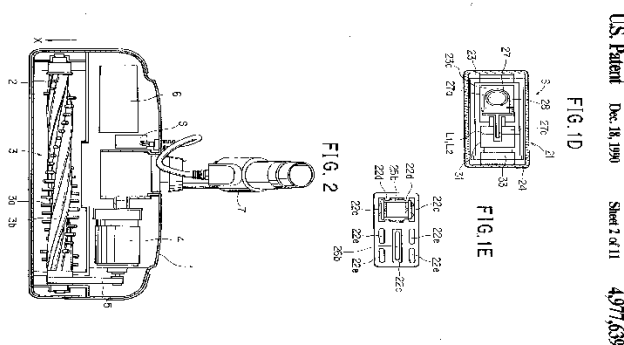
Figure 2.2.7

This patent causes us in recognizing the deterrents that comes n the way of the robot. This patent has given us the idea to utilize calculations for bot to cover the region n great way.

8. <u>Christopher John Morse, Andrew Ziegler and Andrew Ziegler</u>(2009): A self-governing floor cleaning robot incorporates a vehicle drive and control framework organized self-ruling development of the robot over a story for performing cleaning

activities. The robot skeleton conveys a first cleaning zone including cleaning components orchestrated to pull free particulates up from the cleaning surface and a subsequent cleaning zone containing cleaning components summoned to apply a cleaning liquid onto the surface and to from that point gather the tidying liquid up from the surface after t has been utilized to clean the surface. The robot undercarriage conveys a flexibly of cleaning liquid and a waste compartment for stockpiling materials gathered up from the cleaning surface.
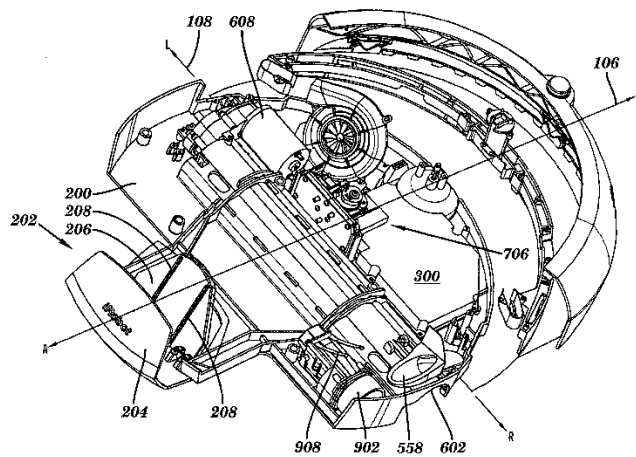
Fig 2.2.8

This patent encourages us for the situating and planning of vacuum siphon introduced in this undertaking. That is the way we have introduced t into front to cover more region and side residue by brushes into dustbin by pull by vacuum.

9. Imprint J. Chiappetta and Joseph L. Jones(2013): A navigational control framework for changing development action of an automated gadget working in a characterized working territory, involving a transmitting subsystem incorporated n mix with the mechanical gadget, the transmitting subsystem containing implies for discharging various coordinated bars, each coordinated bar having a foreordained emanation design, and an accepting subsystem working as a base station that incorporates a route control calculation that characterizes a foreordained activating occasion for the navigational control framework and a lot of location units situated inside the characterized working zone n a known dispersed separated relationship, the

arrangement of discovery units being designed and usable to distinguish at least one of the coordinated bars produced by the transmitting framework; and wherein the getting subsystem s designed and usable to process the at least one recognized coordinated pillars heavily influenced by the navigational control calculation to decide if the foreordained activating occasion has happened, and, f the foreordained activating occasion has happened transmit a control sign to the automated gadget, wherein gathering of the control signal by the automated gadget makes the mechanical gadget actualise a recommended lead that modifies the development movement of the mechanical gadget.

This patent causes us to explore the predefined way to bot by programming calculations for various situations. That let us increasingly compelling n cleaning and spares our valuable time.

10. Jeremy F. Knopow, David Curtis and Everett F. Carter, JR.(2014): A story cleaning gadget that s physically trainable for resulting programmed activity. Before programmed activity, a client prepares the cleaning gadget by physically controlling the gadget through at least one wanted cleaning ways. In the wake of preparing of the gadget, the gadget s designed to consequently start resulting cleaning tasks n agreement with the prepared routine(s). Ideally, the preparation routine incorporates client determination of one of various cleaning modalities that are bolstered by the ground surface cleaning gadget. n expansion to programmed route, the floor cleaning gadget s designed to start an ideal cleaning methodology as an element of the gadget's situation regarding at least one of the prepared routines.

This patent is essentially significant n predicament where the way is distinctive because of sporadic states of operational territory that is the reason this patent discloses to us that how we can let bot to follow t's own way and we have built up this it our own venture likewise to improve it more.

3

PROBLEMS DESCRIPTION

To discover and structure a self-sufficient robot that will help individuals at home who are occupied for day by day or week by week or cleaning, particularly for families with kids. Specifically, for the older who live without anyone else or in mature age homes and don't have the quality or capacity to clean. Mechanical vacuum cleaners accessible in the market are costly and wasteful regarding cleaning time and cleanness. The objective is to structure the robot with infrared sensors, bristle brushes on each side to improve the referred to cleaning execution issues utilizing pic controller.

We have confronted a few issues like:

Establishment of vacuum: The size, force and position s significant n establishment of vacuum. To do so we had done a ton of research then we have introduced t n front with 12v that let us clean all sort of residue particles on floor.

Establishment of wiping part: To introduce the wiping the significant part are brushes that can be wet effectively and don't let leave dust with t since it will require to wash them between each perfect. So, we have utilized Rubbermaid brushes to do likewise.

Pail size: This s likewise significant in light of the fact that if we put huge volume basin t would have expanded load of bot that drop the exhibition so we have introduced 500mL compartment to do likewise.

4

DESIGN OF THE BOT

The mechanical parts incorporate the frameworks that on the off chance that they work in appropriate grouping the floor will be cleaned. This is accomplished by 4 procedures.

- Dry vacuum cleaning

- Sprinkle of water or purifying fluid on a superficial level.

- Sucking of wet flotsam and jetsam

4.1. Dry vacuum siphon

This is the procedure to clean the residue particles from the surface with the goal that the heap will be decrease with the end goal of other activity. On the off chance that we expel this part there will be superfluous burden on scouring and wet sucking. This procedure is accomplished by utilizing a 12v DC vacuum siphon. The channel is isolated into various gaps with the goal that dust everywhere throughout the width can be sucked.
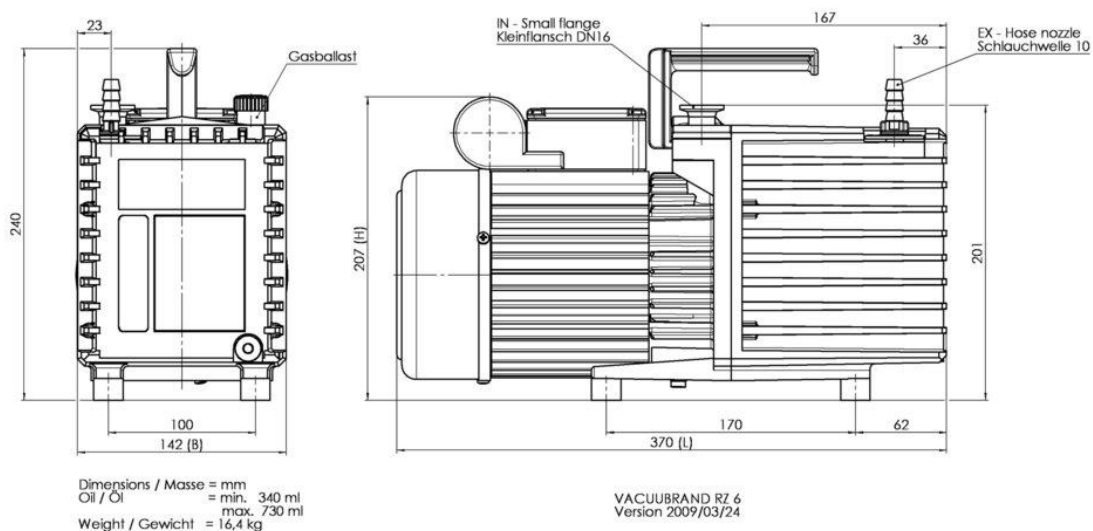

Figure 4.1 Vacuum Pump front view and side view

The outlet is associated with a chamber that gathers dry garbage for removal on a later case. It consists of:

- Vacuum chamber

- Suction element

- Seal between the floor and the suction element

- Blower speed regulator with radiator (made on LM350)

- Blower

- Lid which allows you to empty the vacuum chamber of the dust and other impurities

- Carbon filter which stops dust

- Tray for larger impurities

- Element for directing an air flow

How it works:

Dust and other impurities are sucked in to suction element and later they go to the vacuum chamber. I used element for directing an air flow (E) which allows to separate lighter impurities from heavier ones which settle in the tray. Dust is stopped by carbon filter. Blower creates enough suction that allows smooth operation of the vacuum cleaner with a relatively small power consumption.

4.1.1 The Fan

The most important thing of a vacuum is to choose the appropriate fan with a decent CFM (Airflow cubic feet per minute), it is the force of this airflow across a surface that picks up the dirt and moves it to the dust bag or container. Therefore, the more airflow, the better the cleaning ability of the vacuum cleaner. Most of the big vacuums use more than 60 CFM but since we are using a small battery, we are ok with at least 35 CFM. The AVC fan that I will use has 38 CFM and it actually has a lot of power, but you can use any with the same dimensions.

Installation of Vacuum Setup:
At the very first of the cardboard vacuum setup is installed with very sharp edge of wood at bottom to suck the dust particles. It is able to suck the soil particle that are stick to floor.

4.1.2 The Fan Driver

Since we need a way to control whenever the Fan is On or Off, we need a Driver. I will use the MOS-FET IRF520 which basically works as a switch, whenever it receives a signal from the microcontroller it will supply the input voltage to the output(fan).

4.1.3 The H-Bridge

For the motors we'll need something a bit different from the Fan driver since now we will need to control the direction of each motor. The H-bridge is an array of transistors which allows us to control the current flow, and by controlling that, we will be able to control the motors direction. The L298 is a pretty decent H-bridge that can supply 2A per channel so for our motors it will be perfect! Another example is the L293D but that only gives us 800mA per channel.

Hardware and Frame:

We have taken cardboard of MDF 30*30*1 cm. Then install four motors of 12v to the downside of cardboard and then connect it to wheels(4) of 10cm in diameter. Motors are connected with wood glue.

4.1.4 Motors:

Robot is driven by four high speed DC motors of 12v and they have enough torque to move the robot which weighs about 5kg. I made a separate PCB for motor controller using thermal transfer method. Motor controller is made on L298N dual H-bridge which can handle up to 2 amps per channel. Using square wave with variable filling generated by the microcontroller i can control speed of the engines.

Connection of Motors and H-Bridge:

The first objects that are going to be mounted, are the motors. Mount them using their brackets. Once you have set them, you can start mounting the H-bridge as it is

showed. After that, we shall start connecting the motors on the dual terminals. Don't worry about how the motors shall be connected, you can connect them in any polarity and we can modify the direction of the motors with the code.

4.2. Sprinkle of water or purifying fluid on a superficial level:

The test here is to splash fluid over the width of the machine with appropriate sum. The sum ought to change as indicated by the revolution or development of the machine. While turning the shower ought to be less. This is accomplished by utilizing an engine in the water chamber. This engine controls the measure of water to be showered. The stream everywhere throughout the width is accomplished by a sprinkler system.

4.3 Sucking of wet trash

This is the keep going advance on this procedure. Here another vacuum siphon is utilized to suck wet trash with the goal that the floor will be dry. For this situation likewise the vacuum is similarly conveyed over the width.

The intensity of the siphon is 12v dc. The essence of the funnel is towards the front to expand proficiency of pull.

Installation of Mopping setup:

At the middle of the cardboard a water bottle of 500ml is kept and stabilized by brackets made on it by wooden itself. A water pump has been put into water bottle and connected to pipe that is passed through cardboard to the downside and connected to wall that bring water to both of brushes that are installed with 2 mopping motors connected with brushes to rotate as directed by control system.

BLOCK DIAGRAM OF THE MODEL

```
                  ┌──────────┐                                              ┌─────────┐   ┌────────────────┐
                  │  MOTOR   │                                              │  RELAY  │───│    VACCUM      │
         ┌────────│  DRIVER  │────────┐                                     └─────────┘   │    CLEANER     │
         │        └──────────┘        │     ┌──────────────────┐                          └────────────────┘
         │                            │     │                  │           ┌─────────┐   ┌────────────────┐
         │                            │     │                  │───────────│  RELAY  │───│   WATER PUMP   │
         │                            │     │                  │           └─────────┘   │     MOTOR      │
         │                            └─────│  MICROCONTROLLER │                          └────────────────┘
    ┌────────┐              ┌────────┐      │                  │           ┌─────────┐   ┌────────────────┐
    │  LEFT  │              │ RIGHT  │      │                  │───────────│  RELAY  │───│ MOPPING MOTOR  │
    │ MOTOR  │              │ MOTOR  │      │                  │           └─────────┘   │  SURFACE DRYER │
    └────────┘              └────────┘      └──────────────────┘                         └────────────────┘
         │                       │
         │    ┌──────────────┐   │
         └────│   MOVEMENT   │───┘
              │   CONTROL    │
              └──────────────┘
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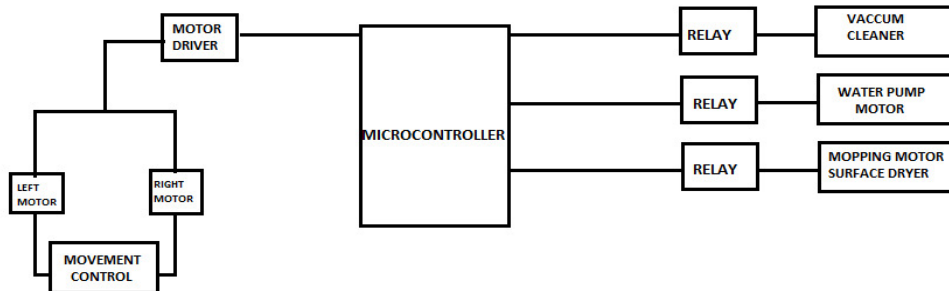
4.4 BODY

The body of the robot has numerous little parts. Like all robots it has sensors, microcontrollers and actuators and different parts. It has 2 vacuum siphons associated in rear just as front side of the robot. A 300 rpm DC engine is associated in the robot with the scrubber. A direction is joined to the hub of the scrubber. 2 DC engines of 100 rpm are associated with the wheels. One microcontroller with 4 ultrasonic sensors is joined to it. This has 2 bread sheets for circuit association which at last can be supplanted in the wake of welding.

For cleaning we are utilizing the brushes rather than fabrics. The scrubber pivots at exceptionally rapid which performs awesome wiping activity.

4.4.1 NAVIGATION SYSTEM

Route arrangement of the robot is fundamentally reliant on the sensors and microcontroller and calculation took care of to it. Fundamentally the information procurement framework (here sensor) first gathers the information from the earth and feeds to microcontroller. The microcontroller utilizes 2 calculations. The 2 calculations are:

- No article at focus

- Item at focus

4.4.2 SPIRAL MOTION

Fundamentally in the wake of detecting the deterrent good ways from outside condition, if the robot has adequate space on its 4 sides it will move in winding way from the start half of its running. The winding way can be against clockwise and clockwise. The winding way can be produced by the diminishing proportion of left engine encoder and right engine encoder.

4.4.3 RANDOM STRAIGHT PATH

Essentially irregular straight way look starting with one hub then onto the next by the assistance of characteristic heuristic hunt. After the winding movement the robot on the off chance that distinguishes a crash, at that point it follows the edge of the divider until it gets enough free space for winding movement once more. After some second on the off chance that it doesn't get a particular clear zone for winding movement, at that point it will move in irregular way for quite a while and the snag recognition and evasion framework will be done by the assistance of ultrasonic sensors. After that robots quit turning if the clock s over. In this procedure we can isolate a specific region in the floor as lattices and move in like manner with the goal that it will have very limit power over the robot. So, it will have network-based quest over the floor for development.

At last we actualized PC vision by the assistance of ultrasonic imaging and examining the picture for the residue particles by the assistance of administered learning and bunching the information. We have actualized here A* look calculation for movement arranging. The expansiveness first hunt actualized here is successful and gives productive outcome to moving.

<div align="center">

5

</div>

AUTOMATION AND CONTROL OF VACUUM ROBOT

5.1 AUTOMATION

We need to mechanize the robot with the goal that it will wander openly on the floor maintaining a strategic distance from all the snags. We need to likewise give a microcontroller in which we need to take care of the code with the goal that it will fill in as a mind of the robot. Additionally, we need to give a legitimate force source and appropriate engine for managing the sprinkling of the robot and engine driver for controlling the course and speed of engine associated with wheel.

5.1.1 SENSORS

<div align="center">

Figure 5.1 Ultrasonic sensor

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Ultrasonic sensors are gadgets that produce or sense ultrasound vitality. They can be isolated into three general classifications: transmitters, collectors and sensors. These are used to measure the distance of the obstacles by spraying Ultrasonic light.
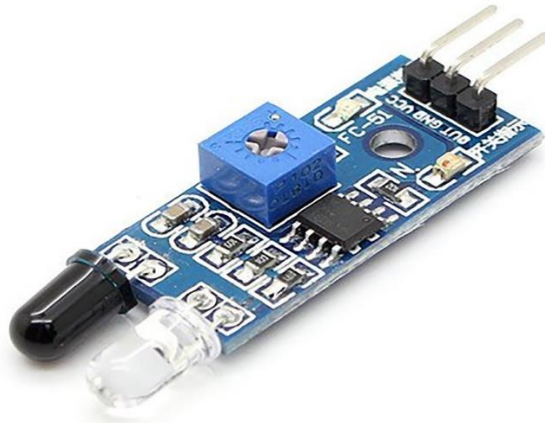
Figure 5.2 IR sensor

This sensor is fundamentally used to identify the obstructions in the way. These are the microchips which are tuned to tune in to infrared light. They are likewise utilized in each remote for television, air conditioning and so forth.

Installation of sensors:

The IR sensor and Ultrasonic sensor both are installed downside of cardboard and faces towards the front of bot. These sensors are connected to microcontroller Atmega328 on arduino uno by wires in the input side to give input signals to arduino.

5.1.2 DISPLAY:

LCD display is coupled together with a micro controller. On the screen are displayed all important messages for the user.

Code for Arduino:

```
const int trig_pin = 12;

const int echo_pin = 10;

void setup()

{

Serial.begin(9600);

}

void loop()

{

 log time,cm;

 pinMode(trig_Pin,OUTPUT);

 digitalWrite(trig_Pin,LOW);

 delaymicroseconds(3);

 digitalWrite(trig_pin,HIGH);

 delayMicroseconds(10);

 digitalWrite(trig_Pin,LOW); // A full square wave is generated with T(on)= 3 and T(off)=10

 pinMode(echopin,OUTPUT);

time = pulseIn(echo_Pin,OUTPUT);

 cm = microseconds_to_Centemeter(time);

 Serial.print(cm);

 Serial.print("cm");

 Serial.print();

 delay(1000);

 }
```

5.1.2 ARDUINO BOARD:

The **Arduino Uno board** is a microcontroller dependent on the ATmega328. It has 14 computerized input/yield sticks in which 6 can be utilized as PWM yields, a 16 MHz clay resonator, an ICSP header, a USB association, 6 simple sources of info, a force jack and a reset button.
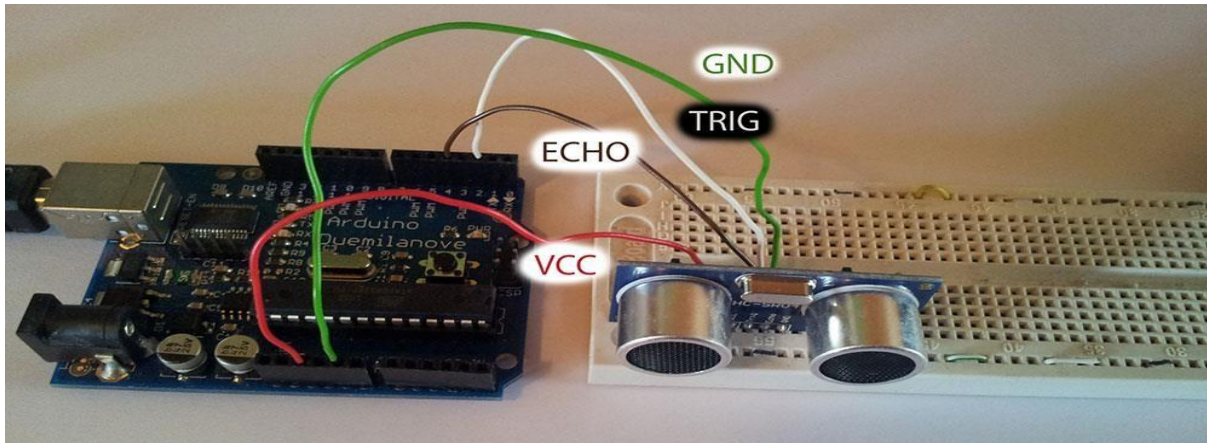

Figure 5.2 Ultrasonic sensor connected with Arduino

The photo above shows the setup of the project. The jumper wires are connected as follows:

Jumper wire is connected with 5v pin on Arduino to the bottom channel of broadband. Another jumper wire from ground on Arduino to the upper channel of broadband. Now Ground pin on ultrasonic sensor to the ground channel on the breadboard. Next connect the Echo pin on the sensor to pin 6 on the Arduino. Now connect the Trig pin on the sensor to pin 7 on the Arduino, and lastly connect the VCC pin on the sensor to the 5volt channel on the breadboard.

5.1.3 MOTOR DRIVER:

For this investigation reason we utilized L293D engine driver. The outline of L293D is as following. It is 16 pin structure-based IC. This L293D engine driver IC has 4 info pins and 4 yield pins and 2 empower pins and engine power flexibly of 7 volt

5.1.4 ALGORITHM

In this bot we are utilizing two calculations:

- Winding way following calculation

- Irregular Straight movement calculation

A motor driver is used to control the two geared DC motors. It can make a motor rotate in either clockwise direction or in anti-clockwise direction according to the control inputs given to it. It provides the control signals to the motor driver IC L293D according to the output of IR sensors. Direction of the rotation of the motor is decided as per the input pins of the L293D.
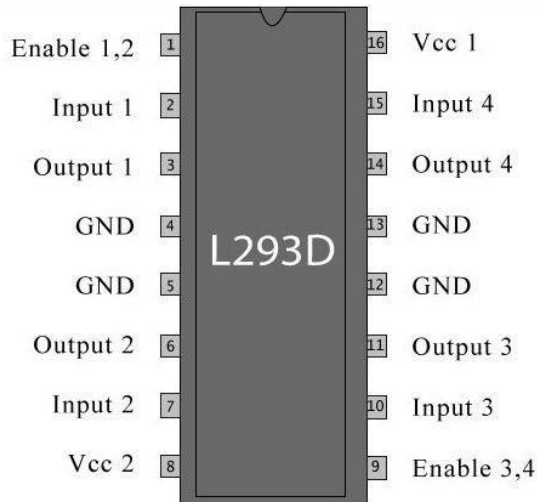
Direction of motor rotation according to IC input
A1 A2 Direction of Rotation
0 1 Clockwise
1 0 Anticlockwise
0 0 Idle
1 1 Idle

5.1.4 RELAY:

A relay comprises of an electromagnet that, when invigorated, makes a switch close or open. Transfers give total electrical disengagement between the control circuit and the circuit being controlled.

These three relays are connected to output pins of arduino uno and another end is connected to dc motor. To gave third person to give access to switch off/on the output of all three functions.

5.1.3.1 Arduino code for DC motor control:

```
// ---- Motors' variable
int motorLeft[] = {2, 3};
int motorRight[] = {7, 8};
// ----Setup function
void setup() {
Serial.begin(9600);
// Setup motors and select the pins
int i:
for(i = 0; i < 2; i++){
pinMode(motorLeft[i], OUTPUT);
pinMode(motorRight[i], OUTPUT);
}
}
// ---- Loop function
void loop() {
driveForward();
delay(1000);
motorStop();
Serial.println("1");
driveBackward();
delay(1000);
motorStop();
Serial.println("2");
turnLeft();
delay(1000);
motorStop();
Serial.println("3");
turnRight();
delay(1000);
motorStop();
Serial.println("4");
motorStop();
delay(1000);
motorStop();
// -- Driving the bot backward and forward, left and right
void motorStop(){
digitalWrite(motorLeft[0], LOW);
digitalWrite(motorLeft[1], LOW);
}
void driveForward(){
digitalWrite(motorLeft[0], HIGH);
digitalWrite(motorLeft[1], LOW);
digitalWrite(motorRight[0], HIGH);
digitalWrite(motorRight[1], LOW);
}
void driveBackward(){
```

```
digitalWrite(motorLeft[0], LOW);
digitalWrite(motorLeft[1], HIGH);
digitalWrite(motorRight[0], LOW);
digitalWrite(motorRight[1], HIGH);
}
void turnLeft(){
digitalWrite(motorLeft[0], LOW);
digitalWrite(motorLeft[1], HIGH);
digitalWrite(motorRight[0], HIGH);
digitalWrite(motorRight[1], LOW);
}
void turnRight(){
digitalWrite(motorLeft[0], HIGH);
digitalWrite(motorLeft[1], LOW);
digitalWrite(motorRight[0], LOW);
digitalWrite(motorRight[1], HIGH);}
```

COMPLETE CODE
(For making ultrasonic transducer and receiver pair)

```
void delay Milliseconds(int ms) {
for (int k = 0; k < ms; k++) {
delayMicroseconds(1100);
}
}
void stop_Transducer()
{
cli();
TCCR1B = 0;
sei();
digitalWrite(9,LOW);
digitalWrite(10,LOW);
}
void start_Transducer(float freq, float duty_Cycle)
{
f (duty_Cycle > 0.5) duty_Cycle = 0.5;
else if (duty_Cycle < 0) duty_Cycle = 0;
cli();
TCCR1B = _BV(WGM13) | _BV(CS10) | _BV(ICNC1);
//f0 = fclk / (2 * N * Top)
long topv = (long) ((float) F_CPU /(freq * 2.0 * 1.0));
ICR1 = topv;
OCR1A = (int) ((float) topv * duty_Cycle);
OCR1B = (int) ((float) topv * (1 - duty_Cycle));
DDRB |= _BV(PORTB1) | _BV(PORTB2);
TCCR1A = _BV(COM1A1) | _BV(COM1B1);
  }
  void setup()
  {
  Serial.begin(9600);
  pinMode(9, OUTPUT);
  pinMode(10, OUTPUT);
  }
  byte a = 0;
  unsigned long t_start = 0;
  unsigned long t_peak = 0;
  unsigned long t = 0;
  byte v_peak = 0;
  const float SPEED_OF_SOUND_20C = 0.0003432; //per micro-second
```

```
}
void setup()
{
 Serial.begin(9600);
 pinMode(9, OUTPUT);
 pinMode(10, OUTPUT);
}
byte a = 0;
unsigned long t_start = 0;
unsigned long t_peak = 0;
unsigned long t = 0;
byte v_peak = 0;
const float SPEED_OF_SOUND_20C = 0.0003432; //per micro-second
float d = 0;
void loop()
{
 start_Transducer(24000.0, 0.5);
 delayMicroseconds(300);
 stop_Transducer();
 v_peak = 0;
 t_start =micros();
 t_peak = t_start;
 delay_Milliseconds(1);
 for (int i = 0; i < 256; i++) {
 a = analogRead(0);
 t = micros();
 if (a > v_peak) {
 t_peak = t;
 v_peak = a;
 }
 }
 t = t_peak - t_start;
 d = (float) t * SPEED_OF_SOUND_20C / 2.0;
 Serial.println(d , 2);
}
```

The code includes:

1. Batter Monitor:
    - It is constantly measuring the voltage and if the battery voltage is below the threshold it will turn off all the motors and the LED will start blinking.

    - When starting it tries to turn on the Fan and if the battery voltage is below the threshold it won't start.

2. Collision avoidance:
    - It measures the distance from the sensors to an object and when it is close it turns to the opposite side.

    - It senses when it is on a corner and turn 180 degrees.

    - When the bumper touches it turn right.

3. Fan Control:
    - Turn off/on the fan.

4. Motor Control:
    - It can rotate forward/backward.
    - Turn off/on for mopping motor.

    After the installation of these three programs into Arduino Uno by Arduino software (IDE) by computer. The whole is installed over cardboard and now connect a 12V battery with the positive terminal connected to the Vin pin and the negative terminal connected to the GND pin. Now the all is done.

6

Commercialisation Possibility

Presently in the programmed floor cleaner showcase iRobot and Scooba are assuming significant jobs. They hold around 80% of the market. Their expenses are around 25000 to 35000.Also the calculations utilized by them are not best. They are utilizing calculations which around gives 70% exactness. They are not utilizing any picture preparing calculations to run their robot. Be that as it may, the robot structured by us is cost effective which will cost around 15000.Also we can utilize camera focal point for little residue molecule recognition, so it will give progressively productive choice in overseeing the movement of the molecule which at last spare impressive measure of intensity and diminish the planning with better effectiveness and affectability. This will demonstration like a pheromone like in subterranean insect calculation. In subterranean insect calculation when pheromone thickness of ants specifically bearing is denser every single other subterranean insect follows that heading. Correspondingly when the robot will locate the specific residue size on floor on one side of it and there are less on other 3 sides, it will head towards dusty zone if hindrance is absent. Time excess and force sparing with minimal effort gives the best chance to promoting this customer item.

7

RESULT AND ANALYSIS

Our final project work has been made to reach its maximum output and efficiency and it looks like this
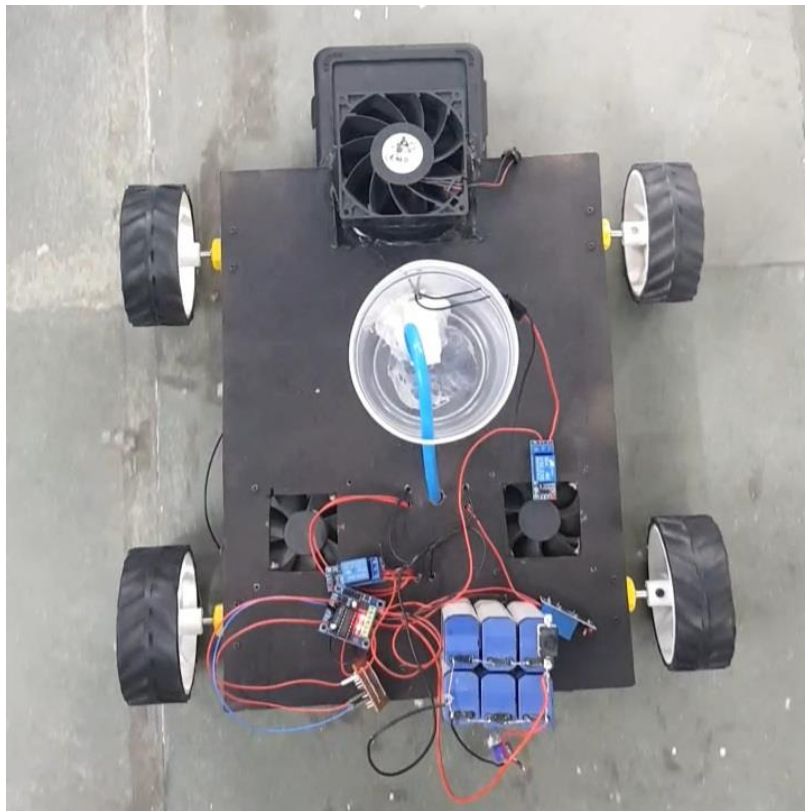

Figure 7.1 Hardware presentation of bot

8

CONCLUSION

The Product created is certainly a significant item in mechanical autonomy and floor cleaning region. The robots created utilizes 2 vacuum siphon which at last gives heaps of vibration and force misfortune in the framework. Additionally, the calculation actualized isn't viable. So, there is unquestionably present degree for development and streamlining till the best item is being created. In the wake of enhancing the calculation and taking it to the heuristic based inquiry like honey bee calculation it will be an extraordinary item and can alter this industry. Certainly, it has exceptionally enormous potential. Likewise, we can utilize 1 vacuum siphon rather two so it will be financially savvy and very vitality sparing item with less vibration and much command over the robot. The robot having 33*30*8 cm in measurement is conservative in nature and can go underneath any furnishings and bed. This is likewise extremely convenient in movability. The scrubber of the robot presently comprises of little plastic filaments. Be that as it may, it very well may be additionally improved so the surface zone of the scrubber will come 90% in contact with the floor. And the auto-movement is very precised by the software algorithms to make it more productive and time saving. Due to which it also able to save power as we have reduced extra effort of it. So this makes our bot an extraordinary in overall performances. That's how this project will change the market famous names in vacuum robots and serve it's best to the human race.

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