DAYANANDA SAGAR COLLEGE OF ENGINEERING

Shavige malleshwara Hills, Kumaraswamy Layout, Bengaluru-560111, Karnataka
(An Autonomous College affiliated to VTU Belgaum, accredited by NBA & NAAC)

Department of Electronics & Communication Engineering

II SEM BE MINI-PROJECT (22IDT28) REPORT

on

Robotic vacuum cleaner using Arduino

Submitted in partial fulfillment of the requirement for the degree of

Bachelor of Engineering

in

Electronics & Communications Engineering - ECE

by

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2023-24

Certificate

Certified that the mini-project work **(Course Code : 22IDT28)** entitled "**Robotic vacuum cleaner using Arduino**" carried out by **Sanjana B S** (1DS23EC188), **Sinchana G** (1DS23EC209), **Skanda Udupa** (1DS23EC210), **Nakul Dev Jadhav** (1DS23EC129) are bonafide students of the Department of ECE of Dayananda Sagar College of Engineering, Bangalore, Karnataka, India in partial fulfillment for the award of Bachelor of Engineering in Electronics & Communication Engineering of the Visvesvaraya Technological University, Belagavi, Karnataka for the **II Semester course** during the academic year 2023-24. It is certified that all corrections/suggestions indicated for the mini-project work have been incorporated in the mini- report. This **2nd semester mini- project report** has been approved as it satisfies the academic requirement in respect of mini-project work prescribed for the said degree.

Mini-Project Guide Sign : _____

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Name : **Prof. Nirmala Y N & Dr. Pavithra G**

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External Mini-Project Viva-Voce (SEE)

Name of the mini-project examiners (int & ext) with date :

1 : Signature : _____

2 : Signature : _____

Declaration

Certified that the mini-project work entitled, "**Robotic vacuum cleaner using Arduino**" with the course code **22IDT28** (1 Credit, 100 Marks, CIE & SEE 50 marks each) is a bonafide work that was carried out by ourselves in partial fulfillment for the award of degree of Bachelor of Engineering in Electronics & Communication Engg. of the Visvesvaraya Technological University, Belagavi, Karnataka during the academic year 2023-24 for the II Semester Autonomous Course. We, the students of the 2nd sem mini-project group/batch no. M-3 do hereby declare that the entire mini-project has been done on our own. The results embedded in this mini-project report has not been submitted elsewhere for the award of any type of degree.

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Date : / /2024

Place : Bengaluru

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Abstract

In the current hectic schedule, cleaning houses and surrounding environment is more arduous. At present, there are vacuum cleaners which require humans to handle it. Manual work is taken over the robot technology and many of the related robot appliances are being used extensively also. Here represents the technology that proposed the working of robot for Floor cleaning. Households of today are becoming smarter and more automated. Home automation delivers convenience and creates more time for people. Thus, there is a dire need to implement vacuum cleaner which works without human intervention. An efficient method to clean the desired area has been implemented through this project.

In a present-day situation, people are so occupied with their work that they often lack the capacity to properly clean their homes. The solution to this problem is a home vacuum cleaner robot, such as iRobot Roomba, which can clean the house with the pressof a button. However, commercial products often share a common issue, which is cost. Today, a team has decided to create a simple floor cleaner robot. The new Arduino Vacuum Cleaner that we will create is expected to be cost-effective and practical. Additionally, this robot will have ultrasonic sensors. The ultrasonic sensor will allow the robot to avoid obstacles and move freely until the room is properly cleaned .By using this vacuum cleaner, hazardous places can be cleaned which thereby reduce risks to mankind. This vacuum robot prototype is implemented by using Arduino uno, Motor shield, Ultrasonic sensor and motor with wheels to achieve the goal of this project. The whole circuit is connected with 12v battery. Vacuum robot will have several criterial that are user-friendly.

Keywords : *iRobot Roomba, Arduino uno, ultrasonic sensor, motor shield, 12v battery, vacuum cleaner*

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Chapter-1

Introduction

For many people, returning home after a stressful day at work to a relaxing evening canbe a major relief. However, the realization that they have chores to do, such as cleaning, can be daunting. Cleaning is a necessary requirement for personal hygiene, especially for those with dust allergies and illnesses like asthma. Busy schedules or fatigue can make it difficult for people to carry out cleaning tasks daily.

Having a robotic little friend that can automatically detect dust and clean the floor with the press of a button can provide a big convenience. Robotic vacuum cleaners are able toclean places that regular vacuums can't reach, such as under furniture and in corners that are blocked off to traditional vacuums. They are dust bunny eradicators. These gadgets are particularly useful for busy individuals who desire a clean home even when they don't have the time to do the work themselves. Additionally, watching these robots at work can be enjoyable.

The use of robotics in everyday life has been growing rapidly in recent years, and one area where this technology is becoming increasingly popular is in the realm of cleaning. Robotic vacuum cleaners have been on the market for several years, but advances in sensor technology and microcontrollers are enabling the development of increasingly sophisticated and capable devices.

This project aims to develop a robotic vacuum cleaner using ultrasonic sensors and an Arduino Uno microcontroller to navigate around obstacles and walls in a room while efficiently cleaning the floor. The ultrasonic sensors provide accurate distance measurements, allowing the vacuum cleaner to detect and avoid obstacles and walls. The Arduino Uno serves as the brain of the robotic vacuum cleaner, processing the sensor data and sending signals to the motor to change direction as needed.

Chapter 2

Literature Survey

Author Name	Journal Name	Published Year	Methodology Used
Pawan Kumar Ramkisoon	International Journal of Advanced Research	2021	Design and implementation of a smart, autonomous cleaning and mopping robot using Arduino Mega, powered by a 12V Lithium Polymer battery.
S Yatmono	International Journal of Engineering Research & Technology	2019	Hardware design of a floor cleaning robot controlled by an Android application with master and slave Arduino control modules and ultrasonic sensors.
Ajitha Sukumaranal.	Journal of Student Research	2022	Implementation of an Arduino-based robotic cleaning system with ultrasonic sensors, Bluetooth module, and potential enhancements using Wi-Fi and IoT.
D. C. Patel	International Journal of Emerging Trends in Engineering Research	2017	Development of an indigenous AI vacuum cleaner with a DC motor, Teflon bevel gears, and Arduino programming for commercial cleaning.
R. Radha	International Journal of Advanced Robotic Systems	2020	Hand gesture-controlled robot with obstacle avoidance, dust bag full indication, and battery status monitoring for cleaning tasks in various settings.

Chapter 3

Objective/Aim

The main objective of this project is to design and implement a vacuum robot prototype by using Arduino Uno, Motor, Ultrasonic Sensor, and IR Sensor and to achieve the goal of this project. The whole circuitry is connected with 12V battery. Vacuum Robot will have several criteria that are user-friendly.

Creating a robotic vacuum cleaner using Arduino typically aims to achieve the followingobjectives:

1. Autonomous Cleaning:

- The primary goal is to build a vacuum cleaner that can clean floors without human intervention. The robot should be able to navigate the cleaning area autonomously.

2. Efficient Navigation:

- Implement sensors (e.g., ultrasonic, infrared, bump sensors) to detect obstacles and avoid collisions.

- Develop algorithms for path planning to ensure thorough cleaning coverage andefficient movement.

3. Dirt Detection and Collection:

- Equip the robot with a vacuum mechanism that can collect dirt, dust, and debris fromthe floor.

5. User Interface and Control:

- Provide a simple interface for users to start, stop, and configure the vacuum cleaner.

6. Safety Features:

- Include sensors and programming to prevent the robot from falling down stairs or getting stuck in tight spaces.

Problem Statement

- Cleaning is a necessary requirement for personal hygiene, especially for those with dust allergies and illnesses like asthma.
- For many people, returning home after a stressful day at work to a relaxing evening can be a major relief. However, the realization that they have chores to do, such as cleaning, can be daunting.
- Hence there is a need of bringing revolution in the area of science and technologies, that can perfom these tasks efficiently and safely, reducing human labour and enhancing precision. This project addresses these needs by developing a robotic assistant capable of performing these tasks autonomously.

Chapter 4

Methodology

The methodology for creating an Arduino-based smart Vacuum cleaner entails defining the cleaning requirements, selecting the necessary hardware components, such as motors, sensors, and batteries, writing the software code using the Arduino IDE, assembling the components in accordance with the design, testing and debugging the system to ensure it satisfies the requirements, improving the design to add features, and documenting the design and code for later use. To produce a practical and effective toolthat can carry out particular cleaning activities automatically or manually, this requires a mix of hardware and software design and testing.

When the robot is switched ON, both the motors of robot will run normally and the robot moves forward. During this time the ultrasonic sensor continuously calculate the distance between the robot and the reactive surface. This information is processed by the arduino; if the distance between the robot and the obstacle is less than 20 cm the left wheel motor is reversed in direction and right wheel motor operate normally. This will rotate the robot towards right. This rotation continues until the distance between the robot and obstacle is greater than 20cm.This process continues forever and the robots keeps on moving without hitting any obstacles.

Block diagram and circuit diagram

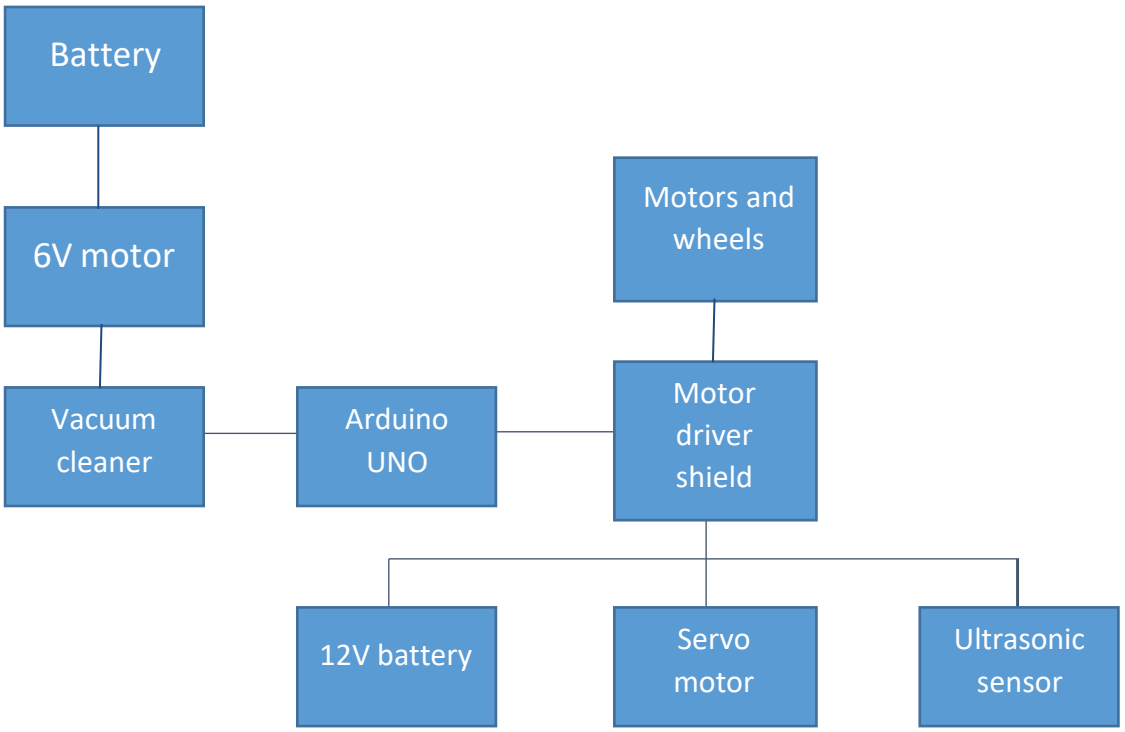

Fig. 4.1 : Block-diagram of the proposed methodology

The block diagram presented in Fig. 4.1 illustrates the proposed methodology for a robotic cleaning system. At the core of the system is the Arduino UNO, which serves as the main controller. Connected to the Arduino UNO. Additionally, the motor driver shield is linked to aservo motor and an ultrasonic sensor, enhancing the robot's maneuverability and obstacle detection capabilities. A 12V battery powers the motor driver shield and its connected components, ensuring consistent operation. The vacuum cleaner, driven by a 6V motor, receives power from an independent battery source, highlighting a modular power distribution strategy within the system. This setup allows for efficient navigation and cleaning, with the Arduino UNO orchestrating the tasks based on inputs from the ultrasonic sensor and commands relayed through the motor driver shield to the motors and wheels.

Circuit diagram

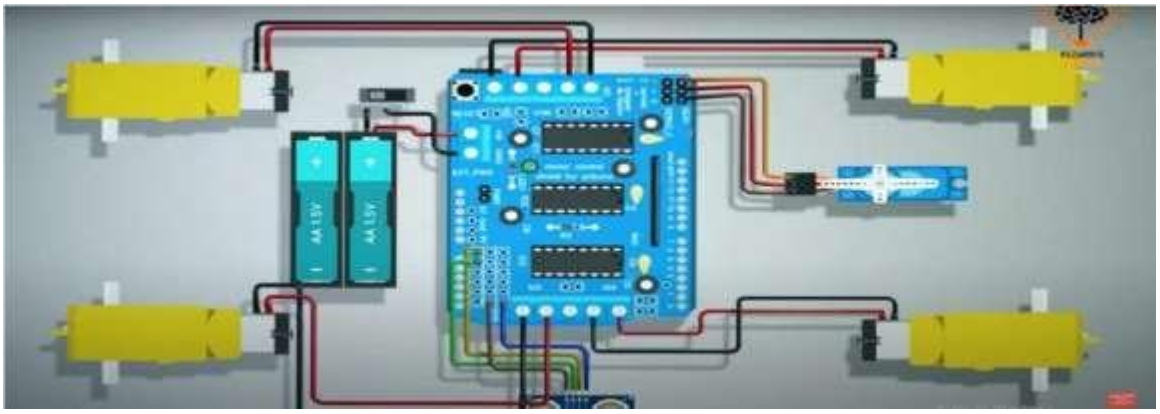

Fig.4.2: Circuit diagram

All connections are done in accordance with the circuit schematic above as shown in figure 4.2

Implementation

A. Programming: The code for an Arduino-based vacuum cleaner is written in the Arduino Integrated Development Environment (IDE) using the C++ programming language. The Arduino IDE is a software platform that allows you to write, upload, and run code on the Arduino board. To start programming an Arduino Uno, you need to connect it to your computer via USB and open the Arduino IDE as shown in figure 4.3.

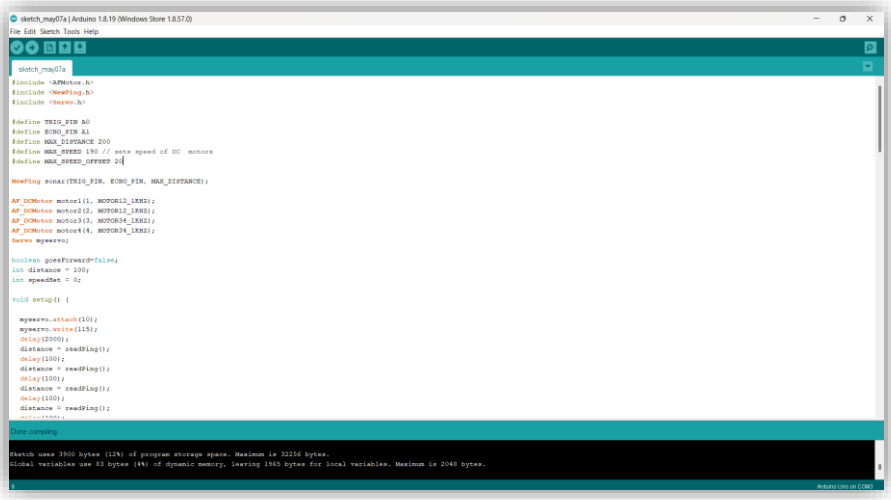

Fig.4.3: coding profile

A. Making of vacuum cleaner

A litre water bottle, a 6 volt motor, a fan, a switch, battery, and a thin mesh net are used to create the vacuum cleaner.

The vacuum cleaner is prepared as shown in the figure. The process of the vacuum cleaner is preparation is done as follows:

1) The bottle's bottom is first chopped off with a knife to be removed.

2) The bottle-shaped portion of a fine mesh is cut. Now wrap the net over a cardboardpiece that was given a bottle-diameter cut out.

3) Attach both the cardboard piece and the net. In the bottle, place the net arrangement.

4) After putting the filter in place, take the 6V motor and, using the wooden sticks assupports, put it inside the bottle.

5) Fix the fan to the motor.

6) The bottle opening has a T-shaped aperture attached to it to extend the suction area, which allows it to clean a larger area.

7) It is provided with a 12V power in order to create the necessary vacuum. Also linkedto the side is a switch. This serves as a controller for turning the vacuum cleaner ON or OFF as shown in figure 4.4.

Fig.4.4: Vacuum cleaner

B. Working principle of the vacuum cleaner

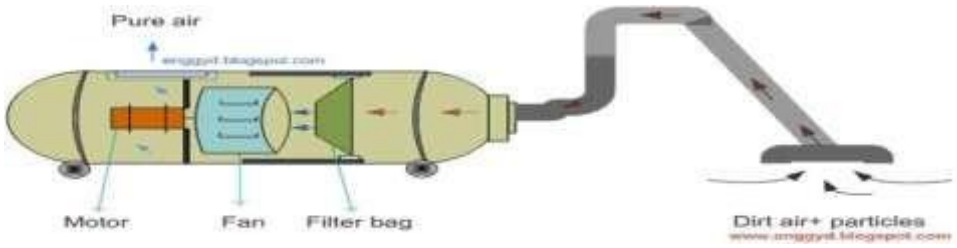

Fig.4.5: working of vacuum cleaner

As shown in figure 4.5, when there is a pressure difference between two places, materials flow from one place to another. The fundamental operating principle of the perfect vacuum cleaner is this phenomena. A centrifugal fan moves the air by introducing external kinetic energy to it while it turns. Negative pressure is created behind the fan as air is drawn in from behind and forced forward with it. This centrifugal fan, which is attached to a motor, is found in the ultimate vacuum cleaner. This device has connections for suction and discharge; on the suction side, a filter bag is installed prior to the hose connection. The discharge is open to the atmosphere and features a second air purifier filter. The motor and centrifugal fan both rotate when electricity is applied. All airborne particles, including cat allergen, mist, dirt, and minute solid particles, are delivered to the suction filter together with the air that is drawn into the device from the suction side. Filtered air is forced out of the discharge aperture while the particles are trapped in the filter.

Chapter 5

Hardware/software tools used

Hardware

- Arduino UNO
- Arduino Motor shield
- Ultrasonic sensor
- Servo motor
- Lithium ion batteries
- Geared motor wheels
- 6v motor

a. Arduino UNO

Fig.5.1:picture of Arduino UNO

The specification of Arduino uno is as follows

- 14 digital input and output pin
- USB power connection
- Include PWM, analog input, reset pin.[6,7,8]

b.Ultrasonic sensor

Fig.5.2: picture of ultrasonic sensor

To recognize the obstructions, we are utilizing the famous HC-SR04 ultrasonic distance sensor or we can call it the hindrance evasion sensors. The working is exceptionally basic, first, the transmitter module sends a ultrasonic wave which goes through air, hits an obstruction, and returns quickly and the beneficiary gets that wave. By working outthe time with Arduino, we can decide the distance. In a past article on Arduino Based Ultrasonic Distance Sensor project, we have examined the functioning guideline of thissensor completely.

Software

- Arduino IDE for programming the microcontroller
- C++ programming is used to write the program

Chapter-6

Photograph of the model

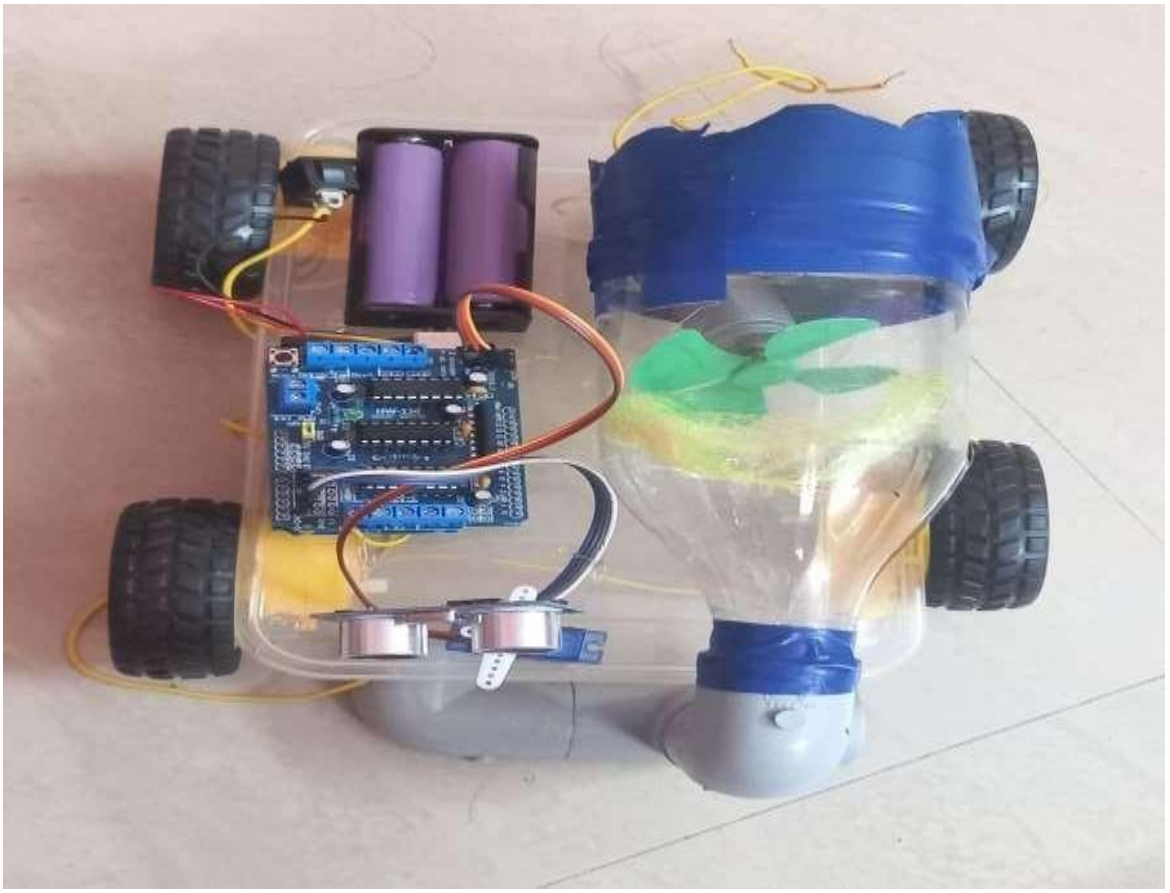

Fig.6.1: photograph of model

Chapter-7

Results and Discussions

The result of using arduino based vacuum cleaner is that it is less cost compared to theregular automatic vacuum cleaners, and it can do the cleaning of the surroundings effectively. The speed of the motors is 40rpm,the suction power the vacuum cleaner is 5000pa to absorb small things such as dust,hair etc.It can absorb the dust particles range in size from 1 to 400 mm.

The following are some benefits of arduino based smart vacuum cleaner.

Cost-effective: Arduino-based smart vacuum cleaners are relatively inexpensive compared to commercially available vacuum cleaners, making it a cost-effective option for those on a budget.

Customizable: Arduino provides a platform for developers to customize their smart vacuum cleaner, allowing them to add features that meet their specific needs.

User-friendly: Arduino's programming environment is user-friendly, making it easier for non-programmers to create their own smart vacuum cleaner.

Scalability: The modular design of Arduino boards allows users to easily upgrade or addnew features to their smart vacuum cleaner as needed.

Flexibility: With an Arduino-based smart vacuum cleaner, users can choose to use different sensors, motors, and other components, allowing for greater flexibility in terms of design and functionality.

Other Available Robotic Vacuum Cleaners vs. the Project

The project's robotic vacuum cleaner can be made more accessible to households as it is cheaper compared to other available robotic vacuum cleaners.

It has simpler and more user-friendly features compared to other available robotic vacuum cleaner.

Chapter-8

Applications

- Cleaning the dry floors
- A floor cleaning assistant at home and offices
- Can clean the inaccessible areas like underneath of sofas bed and table.
- Small particles and can be picked up efficiently.

Advantages

- Cost-effective
- Customizable
- User friendly
- Remote control
- Efficient cleaning

Outcome of the project

1. Functional Robot:

- Navigation and Obstacle Avoidance: The robot should be able to navigate a room,avoiding obstacles using sensors like ultrasonic sensors.

- Cleaning Mechanism: It should include a vacuum mechanism to pick up dust anddebris, often using a small fan or suction device.

2. Autonomous Operation:

- Path Planning: The robot can use algorithms like random walk, wall-following, or more advanced path planning to cover the floor efficiently.

3. Learning and Adaptation

- Mapping: Advanced versions can create a map of the cleaning area using SLAM (Simultaneous Localization and Mapping).

Chapter-9

Conclusion

The use of a smart vacuum cleaner has been implemented in this project. It operated using pre-written code that was placed into an Arduino UNO. When an impediment is encountered, a Vehicle will turn to the side. When there is more space between the car and the obstruction. This invention uses a battery-powered vacuum cleaner and a axial fan connected to the 6v motor to collect dust without the need for human interaction, lowering the risks to human health. This cleaner is easy to use and reasonably priced.

However, since cleaning the dust becomes easier, utilising a detachable bag can be preferable.

Overall, this project showcases the potential of advanced technologies such as ultrasonic sensors and microcontrollers to develop innovative solutions for everyday problems. The robotic vacuum cleaner created in this project has the potential to simplify and enhance cleaning tasks for individuals and families. While there is room for furtherdesign improvements to increase its capabilities and functionality, the project hasestablished a solid foundation for future development in this field.

Future scope

1. It can be updated in such a way that it can be switched on by smart phones.

2. A sensor and a buzzer can be added in the garbage box so that when its full, the buzzer will start ringing and the machine will stop moving.

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[8] https://www.arduino.cc/en/Tutorial

[9] https://www.arduino.cc/en/Guide

[10] https://create.arduino.cc/projecthub/Manikantsavadatti/how-to-make-vaccum

Appendix

A.Programming code using Arduino IDE

```
#include <NewPing.h>        //Ultrasonic sensor function library. #include
<Servo.h>                   //Servo motor library. This is standard library
const int LeftMotorForward = 2; const
int LeftMotorBackward = 3; const int
RightMotorForward = 4; const int
RightMotorBackward = 5;
//sensor pins
#define trig_pin A1 //analog input 1
#define echo_pin A2 //analog input 2
#define maximum_distance 200 boolean
goesForward = false;
int distance = 100;
NewPing sonar(trig_pin, echo_pin, maximum_distance); //sensor function
Servo servo_motor; //our servo name
void setup(){ pinMode(RightMotorForward,
 OUTPUT);      pinMode(LeftMotorForward,
 OUTPUT);     pinMode(LeftMotorBackward,
 OUTPUT);   pinMode(RightMotorBackward,
 OUTPUT);   servo_motor.attach(8);    //our
 servo pin

     servo_motor.write(115);
```

```
  delay(2000);
  distance = readPing();
  delay(100);
  distance = readPing();
  delay(100);
  distance = readPing();
  delay(100);
  distance = readPing();
  delay(100);
}
void loop(){
  int distanceRight = 0;int
  distanceLeft = 0;
  delay(50);
  if (distance <= 20){
    moveStop(); delay(300);
    moveBackward();
    delay(400); moveStop();
    delay(300);
    distanceRight = lookRight();
    delay(300);
    distanceLeft = lookLeft();
```

```
    delay(300);
    if (distance >= distanceLeft){turnRight();
      moveStop();
    }
    else{
      turnLeft();
      moveStop();
    }
  }
  else{
    moveForward();
  }
    distance = readPing();
}

int              lookRight(){
  servo_motor.write(50);
  delay(500);
  int  distance  =  readPing();
  delay(100);
  servo_motor.write(115);  return
  distance;
}
```

```
int lookLeft(){
  servo_motor.write(170);
  delay(500);
  int distance = readPing();
  delay(100);
  servo_motor.write(115);
  return distance; delay(100);
}

int readPing(){delay(70);
  int cm = sonar.ping_cm();if
  (cm==0){
    cm=250;
  }
  return cm;
}
void moveStop(){ digitalWrite(RightMotorForward,
  LOW); digitalWrite(LeftMotorForward, LOW);
  digitalWrite(RightMotorBackward, LOW);
  digitalWrite(LeftMotorBackward, LOW);
```

```
    }
void   moveForward(){
 if(!goesForward){
 goesForward=true;
          digitalWrite(LeftMotorForward,       HIGH);
         digitalWrite(RightMotorForward,      HIGH);
         digitalWrite(LeftMotorBackward,       LOW);
         digitalWrite(RightMotorBackward,  LOW);
       }
     }
void   moveBackward(){
 goesForward=false;

       digitalWrite(LeftMotorBackward,                HIGH);
       digitalWrite(RightMotorBackward,               HIGH);
       digitalWrite(LeftMotorForward,                  LOW);
       digitalWrite(RightMotorForward, LOW);
       }
void                                turnRight(){
digitalWrite(LeftMotorForward,        HIGH);
digitalWrite(RightMotorBackward,    HIGH);
digitalWrite(LeftMotorBackward,       LOW);
digitalWrite(RightMotorForward, LOW);
         delay(500);
```

```
  digitalWrite(LeftMotorForward,          HIGH);
  digitalWrite(RightMotorForward,         HIGH);
  digitalWrite(LeftMotorBackward,          LOW);
  digitalWrite(RightMotorBackward, LOW);
 }

void turnLeft(){

  digitalWrite(LeftMotorBackward,         HIGH);
  digitalWrite(RightMotorForward,         HIGH);
  digitalWrite(LeftMotorForward,           LOW);
  digitalWrite(RightMotorBackward, LOW);

  delay(500);

  digitalWrite(LeftMotorForward,          HIGH);
  digitalWrite(RightMotorForward,         HIGH);
  digitalWrite(LeftMotorBackward,          LOW);
  digitalWrite(RightMotorBackward, LOW);
}
```