ARDUINO BASED SMART VACUUM CLEANER ROBOT

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1. ABSTRACT

People are becoming more career-oriented in recent years, which makes it difficult to maintain both home and office at the same time because of their erratic work schedules. They hire cleaners to clean their homes, offices, etc. most of the time, yet they have little faith in the cleaners. The Smart Vacuum Cleaner uses more advanced technology to solve this issue and is built to automate the cleaning process. The Arduino controlled mini smart vacuum cleaner robot is a work that involves the development of a small cleaning robot that can navigate a small areaand clean it without human intervention. The robot is built using an Arduino microcontroller board, a suction system, and wheels. The robot can be controlled through a push-button switch. The car avoids colliding with obstacles by driving in the direction where there is a greater space between the obstruction and the car after measuring the distance with a sensor. The concept seeks to address the issue of cleaning tiny spaces in an easy and affordable manner. The primary purpose is to create a prototype utilising the Arduino Uno, L293D motor drive, motor, and ultrasonic sensor.

2. INTRODUCTION

The advancement of technology has enabled the development of smart home devices that make our lives more convenient and efficient. One such innovative creation is the Arduino- based smart vacuum cleaner robot. This intelligent robot combines the power of Arduino, an open- source electronics platform, with the cleaning capabilities of a vacuum cleaner. By integrating various sensors, motors, and programming logic, this robot can autonomously navigate through your home, clean the floors.

An Arduino-based smart vacuum cleaner robot is a robotic device that utilizes the Arduino microcontroller platform to perform automated cleaning tasks. It combines the power of Arduino's hardware and software capabilities with sensors to create an intelligent cleaning system.

The main objective of this robot is to navigate a given space, detect and collect dirt, dust, and debris from the floor, and ensure efficient and thorough cleaning. Here's a breakdown of the key components used in smart robot vacuum cleaner model: Arduino Uno Microcontroller, ZK 2 Smart car, Motor drive L239D, Ultrasonic Sensor and DC motor.

3. HARDWARE COMPONENTS

Arduino Uno: Based on the ATmega328P microcontroller, the Arduino Uno is a well-known and extensively used microcontroller board. It is one of the most common boards in the Arduino family andis often the go to choice for beginners and enthusiasts due to its simplicity and versatility.

Key features and characteristics of the Arduino Uno are :

1. Microcontroller
2. Digital and Analog I/O
3. Programming
4. Communication Interfaces
5. Shields and Expansion

Figure 1: Arduino Uno board

ZK 2 Smart car: ZK 2 smart car is the high price of car chassis built specifically for robot entry car motor,power supply can support 3V to 12V. It is very much suitable for expanding the test.
The components available with the ZK 2 Smart car are:

i) Gear Motor – 2
ii) Chassis - 1
iii) Battery box
iv) Wheel – 1
v) Switch
vi) T type small bracket
vii) M3 nuts
viii) Encoder
ix) M3*8Screws
x) M3*8 copper cylinder
xi) M3*30 Screws

Figure 2: ZK 2 Smart car

Ultrasonic Sensor: An ultrasonic sensor is a device that detects things and measures distances using sound waves at a frequency higher than what is audible to humans. It does this by releasing ultrasonic waves and timing how long it takes for the waves to return after striking an object in order to determine how far away the object is from the sensor. Here is a quick rundown of how an ultrasonic sensor functions:

- Emission: The ultrasonic sensor emits a short burst of ultrasonic waves. These waves aretypically in the range of 20 kHz to several tens of kHz.
- Reflection: When the ultrasonic waves encounter an object in their path, they reflect off thesurface of the object.
- Reception: The sensor has a receiver that detects the reflected ultrasonic waves.
- Time Measurement: The sensor calculates the amount of time that it takes for ultrasonic waves to travel from the emitter to the target and back.

This time measurement is often referred to as "time of flight.".
Distance Calculation: The sensor determines the distance between itself and the object by applying the following equation, which takes into account the speed of sound in the medium (often air), which is roughly 343 metres per second at room temperature Distance = (Speed of Sound × Time of Flight) / 2.

1. Ultrasonic sensors are frequently employed in a variety of applications, such as robotics, industrial automation, parking sensors, and proximity sensing, for measuring distance and identifying objects.

L293D Motor Drive: A medium power motor driver ideal for operating DC Motors and Stepper Motors is the L293D Motor Driver Module. The well-known L293 motor driver IC is employed. It can turn on and off 4 DC motors or control the direction and speed of 2 DC motors. The driver considerably simplifies and improves the convenience of using microcontrollers to operate motors, relays, and other devices. With a maximum DC current of 600mA, it can drive motors up to 12V.

DC Motor: An electrical device that transforms electrical energy into mechanical energy is a DC motor. Direct current, the electrical energy used as an input source in a DC motor, is converted into mechanical rotation. A current-carrying conductor gains torque and starts to move when it is kept in a magnetic field. In other words, a mechanical force develops when magnetic and electric fields interact. The DC motors function using this theory. The fan, which serves as the primary component of the vacuum cleaner's suction mechanism, is further connected to the DC motor.

Gear Motor: An electric motor and a gearbox are combined to form a gear motor. It is made to combine high torque production with exact speed control for a variety of applications. The gearbox that is connected to the motor aids in lowering motor speed and boosting output torque. Different combinations of output RPM and torque can be achieved depending on the number and kind of gears. Higher RPM and lesser torque are the results of having fewer gears, and vice versa. Any mounting position is possible for it.

Figure 3: Sensor, L293D Motor drive, Dc motor and Gear Motor

4. SOFTWARE REQUIREMENTS

Arduino IDE

The Arduino software (IDE), an integrated development environment created by arduino.cc, is free and open source software that is used to program Arduino boards. Permit Arduino boards to be programmed and uploaded with code. It also includes a number of libraries and a collection of miniature project examples.

The C/C++ programming languages are supported by the Arduino software (IDE), which is compatible with multiple operating systems (Windows, Linux, and Mac OS X). Beginners and more experienced users can both

easily utilise the Arduino software. It is used to create interactive prototypes and get started with robotics and electronics programming. Software like Arduino can be used to create new objects. everyone (children, hobbyists, engineers, programmers, etc.) can design and develop new electronic projects.

How to use Arduino software

Using the input/output pins on the Arduino board following the installation of electronic components. After using a USB cable to connect the Arduino board to the computer, the Arduino software is launched.

1. The first thing to do is to select the Arduino board you are using by clicking "Board" under "Tools" in the menu.

2. Next, select the Serial port that we attached our Arduino board to by clicking on "Port" in the menu and then clicking on "Tools" once more.

3. The third step is to write the programming code in the "Code editor" and then click "Verify" to ensure that it is right.

The code is uploaded to the Arduino board by clicking "Upload" in step 4. As a result, we used the Arduino program to program the Arduino board.

Figure 4: Arduino IDE interface

5. WORKING OF VACUUM

Dust in the home comprises environmental toxins such perfluorooctanoic acid (PFOA), carbon dioxide, nitrous oxide, and sulphur oxides as well as bacterial, fungal, allergenic, and mist particles. In cities and metro areas, the concentration of environmental contaminants dramatically rises as a result of automobile use. One method for maintaining a clean environment in the home is to utilise a hoover cleaner. It aids in lessening the allergic atmosphere in the home. Modern hoover cleaners employ microfiltration bags that can capture 99% of dust particles up to 0.3 microns in size. Robotic hoover cleaners use an obstacle sensor to automatically traverse around rooms. Obstacle sensors, which are often found on the vacuum cleaner's bumper, are intended to prevent the cleaner from hitting objects in its path such chair and table legs, sofa cushions, toys and anything else. An autonomous robotic vacuum cleaner with a restricted vacuum floor cleaning system coupled with sensors and robotic drives with programmable motors is referred to as a "robotic vacuum cleaner" as a generic term.

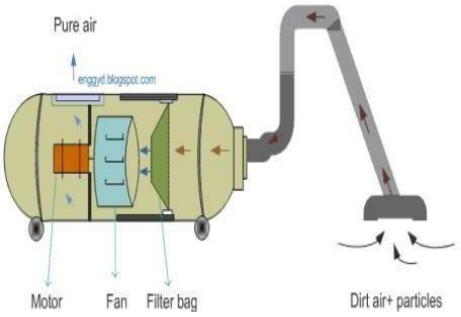

Figure 5: Vacuum model

6. WORKING OF SMART ROBOT

The Arduino is powered by a power source once the system is turned on, and the vehicle moves with the help of a motor driver and caster wheel until an impediment is identified. The Arduino's motor driver and program allow the robot to adjust its trajectory in the event that it encounters an obstruction.

Robots are machines having movements that have been preprogrammed to move in specific directions or patterns. Robots can now analyse information; they can acquire information about their environment from electronic sensors and make decisions based on that knowledge.

Small robots can be built using Arduino boards, and their controls are definable by basic logic. However, because onboard computing power and software are sometimes constrained, developers are frequently unable to advance to more complicated robots.

The robot goes continuously in a different direction throughout the room, covering the entire area. The robot's hoover cleaner is also turned on while it moves. The hoover cleaner sweeps the area it moved clean by collecting the dust particles.

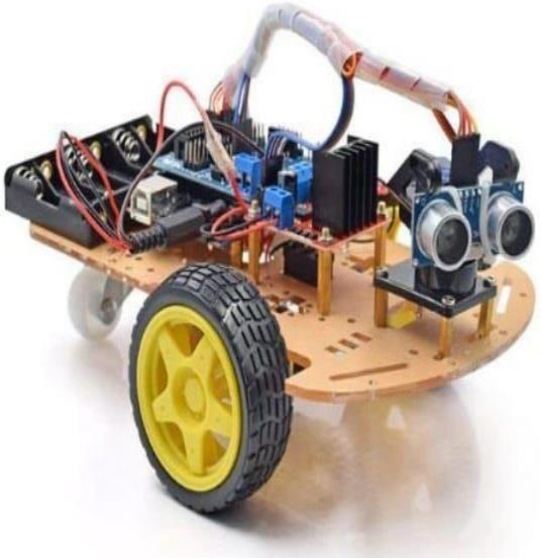

Figure 6: Robotic car

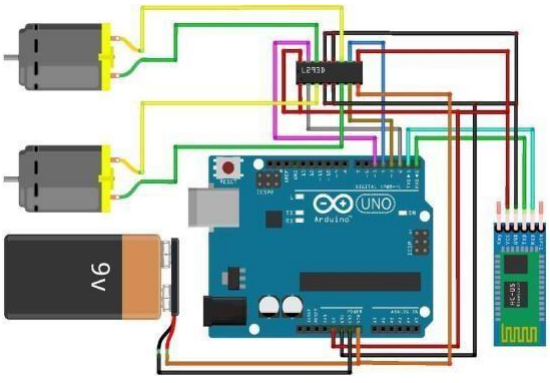

Figure 7: software model of Smart robot

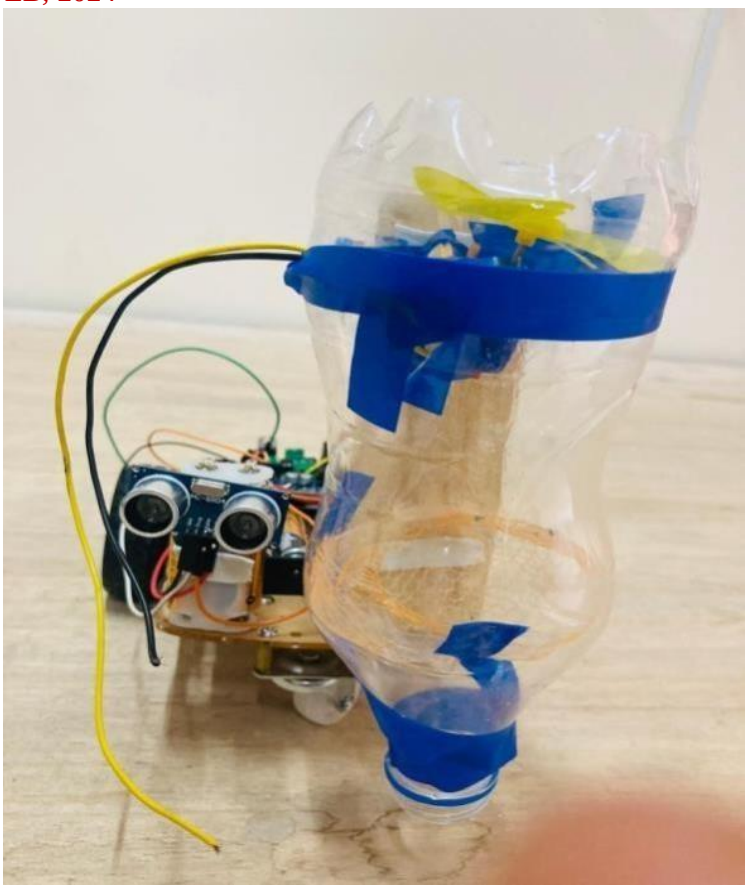

Figure 8**:** Smart Vacuum cleaner robot final prototype front view

CONCLUSION

The Arduino based smart vacuum cleaner robot project demonstrates the potential of combining robotics and automation with the power of Arduino microcontrollers. By utilizing sensors, programming capabilities, and connectivity options, the robot can autonomously navigate and clean spaces while providing convenience and efficiency. The project showcases the flexibility and adaptability of the Arduino platform, allowing for customization and expansion of functionalities according to specific needs. With its user-friendly interface and a supportive online community, the Arduino Uno-based smart vacuum cleaner robot project offers an accessible and cost-effective solution for creating intelligent cleaning devices that can revolutionize household chores.

REFERENCES

[1] Manasa, Vidyashree TS, Bindushree V, Sanjana Rao, Gowra PS "SMART VACUUM CLEANER" Global Transitions Proceedings (2021), Volume: 2 Issue: 2, Pages 553-558, November 2021,

[2] Anshu Prakash Murdan, Pawan Kumar Ramkissoon "A SMART AUTONOMOUS FLOOR CLEANER WITH AN ANDROID BASED CONTROLLER" Institute of Electrical and Electronics Engineers IEEE Pages 235-239 November 2020

[3] Yuda Irawan, Muhardi, Rian Ordila, Roni Diandra "AUTOMATIC FLOOR CLEANING ROBOT USING ARDUINO AND ULTRASONIC SENSOR" Journal of Robotics and Control (JRC) Volume 2, Issue 4,ISSN: 2715-5072 DOI: 10.18196/jrc.2485, July 2021

[4] Amir Talebi Sheikh Sarmast, Tahere pourseif, Rozhina Esmaeil Nezhad, Mina Mohajeri, Saman Mohammadi, Aida Vaezi "DESIGNING A SMART VACUUM CLEANER IN TWO

MODES OF REMOTE
AND AUTOMATIC" International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056 Volume: 07 Issue: 07 | p-ISSN: 2395-0072, July 2020
[5] Akanksha Vyas, Satyam Chourasia, Shubham Antapurkar, Raghvendra Prasad "ARDUINO BASED DRY & WET AUTOMATIC FLOOR CLEANER" International Journal of Engineering Technologies and Management Research Volume: 2, Issue: 2, DOI: 10.29121/ijetmr.v5.i2.2018.607 ISSN: 2454-1907, Pages: 18 – 24, April 2020.