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Smart Vacuum Cleaner

An autonomous system using IoT

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Abstract : In our busy lifestyles, cleaning our homes and surroundings has become a tedious task. While vacuum cleaners exist, they still require human intervention to operate. Thus, there is a need for an autonomous vacuum cleaner that can clean areas without human intervention. This project aims to achieve that goal by implementing a new and efficient system. The system consists of an RC car embedded with a vacuum cleaner, making it an autonomous cleaner. To avoid collisions with obstacles like tables, chairs, and walls, an ultrasonic sensor is attached to the car. By measuring the distance between the car and the obstacle, the car navigates towards areas with more distance between the obstacle and the car, ensuring it avoids collisions. The vacuum cleaner is designed with a CPU fan and a pipe attached to the mouth of the bottle. The entire system is powered by batteries. This autonomous vacuum cleaner can be especially useful in hazardous places, reducing the risk of exposure to dust and other pollutants.

IndexTerms **- Arduino , Autonomous system , Obstacle , RC car ,Ultrasonic Sensor , Vacuum cleaner.**

INTRODUCTION

Cleaning our surroundings and keeping the environment clean is a crucial responsibility for everyone. However, cleaning larger areas often requires more people, and sometimes places are too dirty or hazardous for individuals to clean. This is where vacuum cleaners come in handy. They are not only useful for domestic purposes but can also be used in larger spaces like colleges. During the COVID-19 pandemic, social distancing requirements make it difficult for many people to clean together, and digital technology can play an increasingly important role in cleaning efforts.

An automated vacuum cleaner can be designed using an RC car, an ultrasonic sensor, and a battery-powered CPU fan with a dust-collecting space. This system allows for efficient and thorough cleaning of floors while avoiding obstacles. The ultrasonic sensor measures the distance between the car and obstacles, like tables, chairs, and walls, and sends signals to the Arduino microcontroller. Based on these signals, the microcontroller decides the direction in which the wheels of the car should turn to avoid collisions.

Overall, an automated vacuum cleaner has the potential to make cleaning more efficient, save time, and reduce the risk of health hazards associated with cleaning. It is an innovative solution to the problems faced by many people who have limited time, resources, and manpower to clean large spaces. With the advancements in technology, the future of cleaning may involve more automation and smart devices that can make cleaning easier and more effective.

REVIEW OF LITERATURE

I. Several researchers have proposed various designs for cleaning robots that use different technologies and control mechanisms such as Bluetooth, neural networks, LiDAR, IoT, and Android applications.
II. These cleaning robots are equipped with sensors to detect obstacles, plan their movements, and navigate efficiently in different environments.
III. Arduino is a common microcontroller used in many of these robots to control their functions and movements.
IV. Some cleaning robots are designed to perform specific cleaning tasks such as mopping, sweeping, or both, while others can clean solar panels.
V. Many of these cleaning robots are cost-effective and can operate autonomously without human intervention once they are switched on.
VI. Some of these robots can be controlled through mobile applications and can send notifications regarding battery status or cleaning progress to the user's mobile phone.

VII. Overall, the development of cleaning robots is an active area of research that has the potential to revolutionize the cleaning industry by reducing the need for human labor and increasing efficiency.

METHODOLOGY

A smart vacuum cleaner is a cleaning device that uses advanced technologies to automate the cleaning process. It is composed of several components, including an RC car, an ultrasonic sensor, an Arduino microcontroller, a battery-powered CPU fan, and a dust-collecting space.

The RC car serves as the base for the smart vacuum cleaner, allowing it to move around and cover a larger area of the floor. The ultrasonic sensor detects obstacles in the path of the RC car by measuring the time it takes for ultrasonic waves to bounce back, allowing the Arduino microcontroller to determine the direction the RC car should move to avoid the obstacle.

Overall, the smart vacuum cleaner's methodology uses these advanced technologies to create an efficient and automated cleaning system, allowing it to navigate around obstacles and thoroughly clean a larger area of the floor without the need for human intervention.

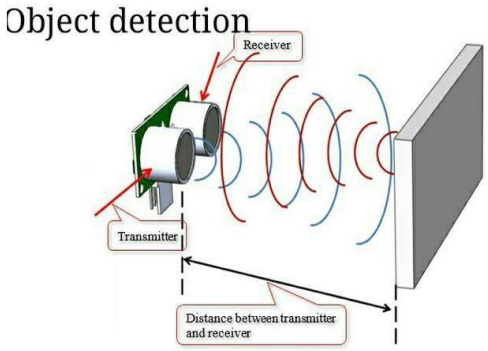
WORKING MODEL

The robot in this project is similar to a regular RC car but is programmed using Arduino software to detect obstacles and navigate accordingly. The robot is equipped with sensors that receive signals and help it avoid obstacles in its path. Additionally, a vacuum cleaner made from recyclable plastic is attached to the robot to clean up dust along its path. The goal of the project is to reduce manual labor and promote clean surroundings. The robot is programmed with a predefined code in the Arduino UNO board that helps it turn in the direction with the most space when encountering obstacles. By using a vacuum cleaner made from a CPU fan and batteries, the robot can collect dust without any human intervention, which helps to reduce health hazards.

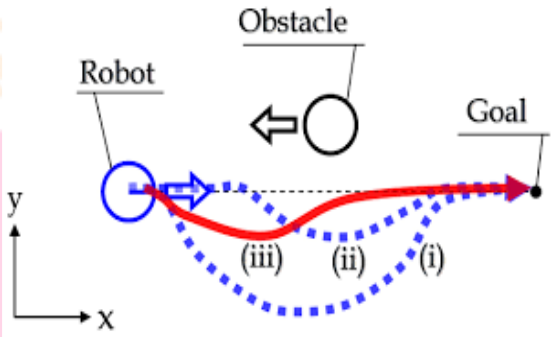
This robot contains following features:

Obstacle Avoidance Theory:-

The obstacle avoidance robot is designed to avoid collision with any object in its path. It uses ultrasonic sensors to detect obstacles and a microcontroller of the 8051 family to control the movements of the robot. The motors are connected to the microcontroller via a motor driver IC. An ultrasonic sensor is mounted in front of the robot to transmit continuous ultrasonic waves. If an object is detected in front of the robot, the ultrasonic waves are reflected back and detected by the sensor. The microcontroller then adjusts the motors to move the robot in a different direction to avoid the obstacle. To control the speed of each motor, pulse width modulation is utilized.



Obstacle Avoidance Theory



Experimental results of Theory

MODULES

- *Functional requirements*

- Obstacle detection
- Path planning

- *Non-functional Requirements*

- usability requirement
- Serviceability requirement
- Manageability requirement
- Recoverability requirement
- Security requirement

- Reliability requirement
- Maintainability requirement
- Regulatory requirement
- Environmental requirement

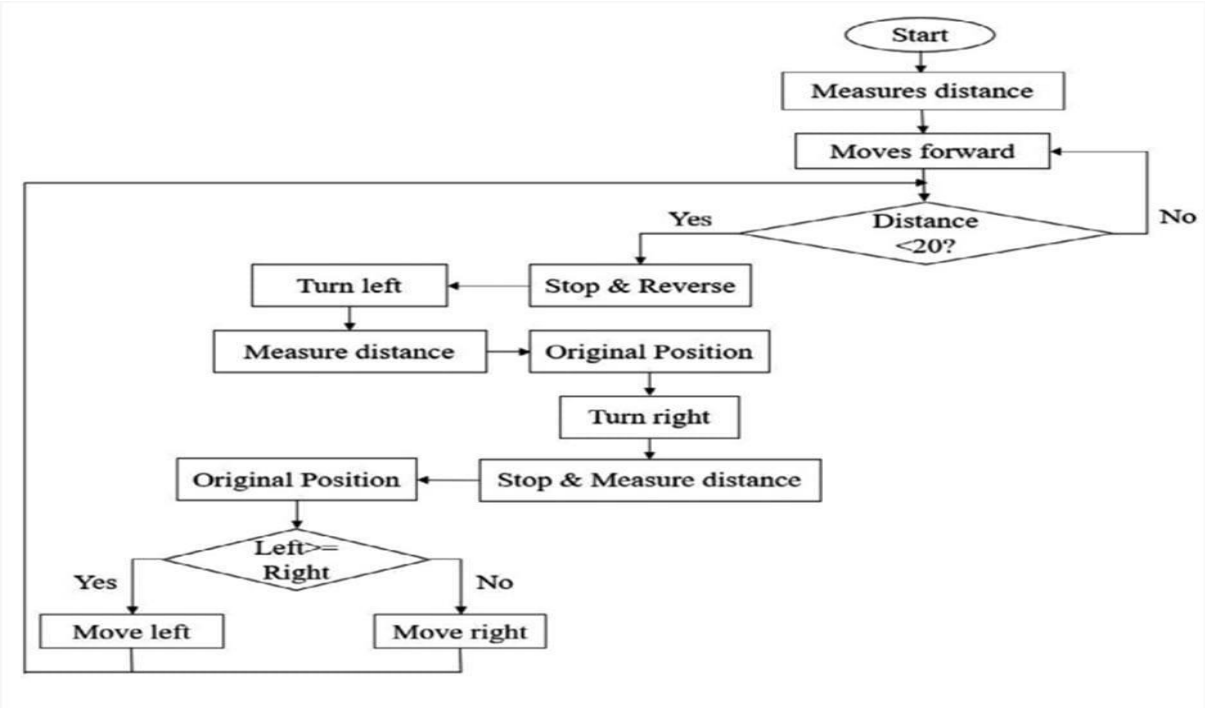
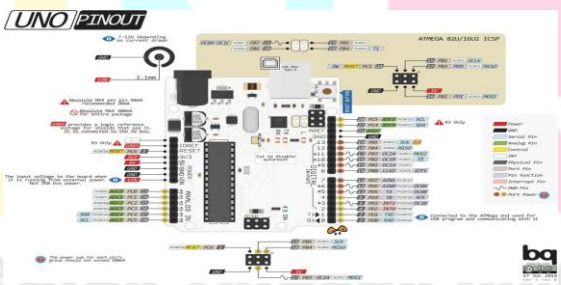


Fig: Flow Chart of Working Model

HARDWARE AND IMPLEMENTATION

1)Arduino UNO:

The Arduino Uno is a microcontroller board that uses the Microchip ATmega328P microcontroller and was created by Arduino.cc. It was first released in 2010 and has a variety of digital and analog input/output (I/O) pins that can be connected to various expansion boards and circuits. The board has 14 digital I/O pins, 6 analog I/O pins, and can be programmed using the Arduino IDE. It can be powered through a USB cable or an external 9-volt battery, with a voltage range between 7 and 20 volts.



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2)Arduino Motor Shield:

The Arduino L293D motor driver shield is a robotics project that involves driving different types of motors. These motors typically require a motor shield or driver IC to be controlled because of their higher current and power ratings. The L293D motor driver shield is a popular choice for use with Arduino as it can control up to four bi-directional DC motors, two stepper motors, and two servo motors with 8-bit speed selection.

The shield can be powered by a shared power supply with Arduino or a separate power supply, and a power jumper must be placed on the shield if using a shared power supply.

3)Servo motor:

A servo motor is a precise type of motor that can rotate an object to specific angles or distances. It consists of a control circuit that provides feedback on the current position of the motor shaft, enabling the motor to rotate with great precision. There are two main types of servo motors, DC and AC, but this tutorial will focus on the DC servo motor. There are also many other types of servo motors based on gear arrangement and operating characteristics.

4)Ultrasonic sensor:

The HC-SR04 ultrasonic sensor is a device that includes both a transmitter and a receiver. Its main function is to measure the distance between the sensor and an object, which is determined by the amount of time it takes for the sound waves to be transmitted and received. This sensor works by emitting sound waves without making physical contact with the object being measured. It has a variety of applications, including measuring direction and speed, burglar alarms, medical devices, sonar, humidifiers, wireless charging, non-destructive testing.

5)Gear motor with wheel:

A gear motor wheel is a type of wheel that is powered by a gear motor. The gear motor is a combination of a motor and a gearbox, which helps to increase the motor's torque while reducing its speed. This combination allows the gear motor to deliver greater force to the wheel while maintaining a controlled speed, which is essential in many applications, including robotics and automation.

Our DC gear motor and wheel set for making robots! These motors are light weight, high torque and low RPM. They can climb hills and have excellent traction, plus you can mount the wheel on either side of the motor with its double-sided output shaft.

6)Lithium ion battery:

A growing number of electronic devices use 18650 Li-Ion batteries. Flashlights use the 18650 battery to power the current hungry LED bulbs and provide a longer standby time when not in use. Previous rechargeable battery flashlights had to be left on the charger almost all the time so that they would be ready to use at a moment's notice. This 18650 Li-Ion battery can be left off the charger for months and still have over 90% of its charge.

- Battery Type: ICR 18600 3.7V 2200mAh Li-ion Rechargeable Battery

TESTING AND OBSERVATIONS:

Testing Stage 1:

A Climbing capacity test was conducted on the robot.

- **Observations:**

1.Robot climbed the rod successfully.
2.The rpm provided during test was too high for the process.

Testing Stage 2:

During the initial testing of the robot, there were problems with the linearity of its motions. To improve this, the pulse width modulation (PWM) was adjusted, but the problem persisted. It was discovered that one of the motors on the front right side had a reduced capacity to provide torque, which was contributing to the issue. In addition, there were some problems with the current rating, so all four motors had to be replaced with new 200rpm Johnson's geared motors. This resolved the issues with the robot's linearity and prevented it from veering off to the right.

Testing Stage 3:

The Effectiveness of the vacuum system was tested using a 9V battery, and the results were satisfactory.

Testing Stage 4:

Once all the components of the robot were assembled, a test was conducted to check the feedback code. This involved running the robot and checking if it responded correctly to the feedback signals generated by its sensors. The purpose of this test was to ensure that the robot was able to navigate through its environment without colliding with obstacles and that its vacuum cleaning mechanism was working as expected.

- **Observations:**

1. Robot navigation was tested and found to be satisfactory.
2. The robot accumulated almost 25 to 30 percent of the dirt samples.

CONCLUSION AND FUTURE SCOPE

The goal of our project is to create an autonomous robot which intelligently detects the obstacle in his path and navigate according to the actions we set for it and collect dust along path.

The autonomous vacuum cleaner is not yet ready for commercialization ,which was never the goal of the project. Many of the achieved result are very promising .the shape of the robot is well suited for the application specially for the task like cleaning along the ball, along legs and corners.

The ultrasonic sensor is able to identified obstacles .The combination of the robot shape and ultrasonic sensor system and its algorithm play well together and make the task of cleaning an unknown and un structure environment feasible.

In the future, the robot's capabilities can be expanded to include new features and functionalities. For example,

- it can be programmed to clean the entire house automatically by taking input from image or video captured by a camera. Additionally, the robot's cleaning mechanism can be replaced by a hand-like structure to enable it to pick up and move objects from one place to another.

- Voice or remote-controlled locomotion of the robot can be added for greater convenience and flexibility in its operation. Finally, an auto-charging feature can be integrated so that the robot can recharge itself without any human intervention.

These upgrades will make the robot more versatile and efficient in performing various tasks, thereby reducing manual effort and increasing productivity.

REFERENCES

[1] M.S Khan, M. Nagageetha (Author) - Bluetooth control cleaning robot using arduino
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[2] Dhariwal, Guarav & Uzairqazi (Author) -Development of Driverless RC Car Department of Mechatronics

[3] S. Yatmono, M. Khairudin, H.S. Pramono (Author) - Development of Intelligent Floor Cleaning