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ARDUINO BASED SMARTVACUUM CLEANER ROBOT

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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. 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. By using this vacuum cleaner, hazardous places can be cleaned which thereby reduce risks to mankind. This is achieved by implementing an autonomous system. The main objective of this project is to design and implement a vacuum robot prototype by using Aurdino uno, Motor shield, Ultrasonic sensor and motor with wheels to achieve the goal of this project. The ultrasonic sensor is used to measure the distance between robot and obstacle. The whole circuit is connected with 12v battery. Vacuum robot will have several criterial that are user-friendly.

LITERATURE SURVEY:

The development of intelligent vehicle ultimate cleaning robots is grounded in a comprehensive review of existing technologies and research in autonomous cleaning systems [1]. A thorough analysis of current robotic vacuum cleaners, such as the work of Zhang et al. [2]. Johnson revealed common limitations, including inefficient navigation in complex environments and inadequate adaptation to various surface types [3]. The application of artificial intelligence and machine learning in home automation was explored through the seminal work of Lee and Park, highlighting the potential for significant improvements in decision-making and user personalization. Advanced sensor technologies, particularly the integration of LiDAR and computer vision, were discussed by Ramirez et al. [4]. The study by Brown and Smith (2024) on human-robot interaction in smart homes provided valuable insights into user experience design and intuitive control interfaces [5]. Additionally, recent advancements in battery technology and energy management systems, as presented in a comprehensive review by Patel (2023), informed the power optimization strategies for prolonged cleaning sessions. The integration of IoT capabilities in cleaning robots, explored in depth by Chen et al., offers a framework for seamless connectivity with existing smart home ecosystems [6]. This diverse body of literature has been instrumental in identifying critical areas for innovation and guiding the design principles of the Smart Vac Ultimate Cleaning Robot [7]

INTRODUCTION:

An Arduino-based vacuum cleaner is a cleaning device that is powered and controlled by an Arduino microcontroller. The Arduino board is programmed to control the motors, sensors, and other components that make up the vacuum cleaner. This allows for a high degree of customization and control over the cleaning process, making it possible to program the vacuum cleaner to clean specific areas, adjust the suction power, and even navigate around obstacles. Additionally, an Arduino-based vacuum cleaner can be connected to other devices and systems, such as a smartphone or a home automation system, to provide remote control and monitoring capabilities. This makes the vacuum cleaner not only a practical cleaning tool, but also a fun and educational project for makers and hobbyists interested in robotics and home automation.

A. *Vacuum Cleaner*

A vacuum cleaner, commonly referred to as a vacuum or a hoover, is a machine that creates suction to take dirt off of surfaces like floors, couches, draperies, and other objects. Typically, electricity is used to power it. Either a dust bag or a cyclone collects the dirt for subsequent disposal. Small battery-powered hand-held vacuum cleaners, wheeled canister models for home use, domestic central vacuum cleaners, enormous stationary industrial machines that can hold hundreds of liters of dirt before being emptied, and self-propelled vacuum trucks for cleanup of significant spills or removal of contaminated soil are all different sizes and models of vacuum cleaners that are used in both homes and industry. Both solid objects and liquids can be sucked up using specialized shop vacuums. The performance of a vacuum cleaner can be measured by several parameters:

1. Airflow, in liters per second [l/s] or cubic feet per minute (CFM or ft^3/min)
2. Air speed, in metres per second [m/s] or miles per hour [mph]
3. Suction, vacuum, or water lift, in pascals [Pa] or inches of water.

B. *Obstacle Avoiding Robot*

An obstacle avoidance robot is an autonomous robot that can move through its environment and avoid obstacles in its route without any human involvement. It is outfitted with sensors that identify obstacles in its path and algorithms that allow it to decide how to avoid them. The robot can be built to work in a range of conditions, from straightforward inside settings to challenging outdoor terrains. As they can travel through unfamiliar environments and avoid potential dangers, these robots are frequently utilised in applications including surveillance, exploration, and transportation.

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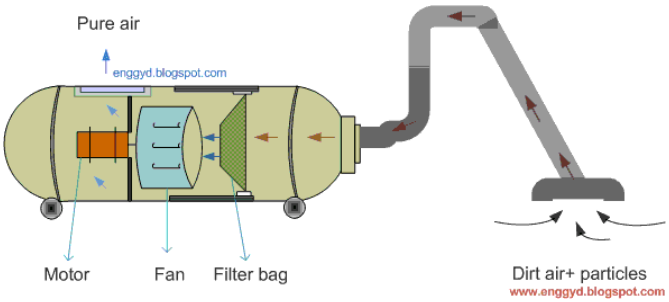
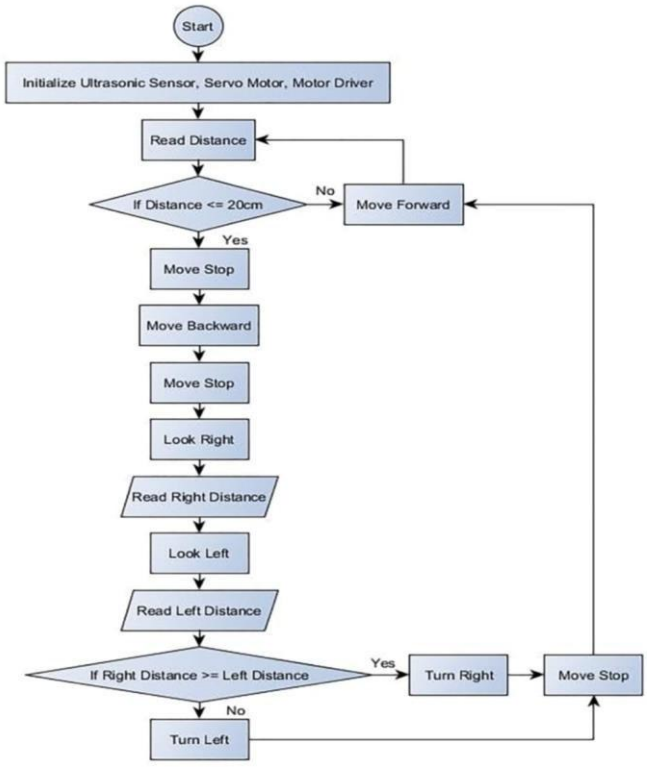
WORKING:

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





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 Advanced Functionality

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

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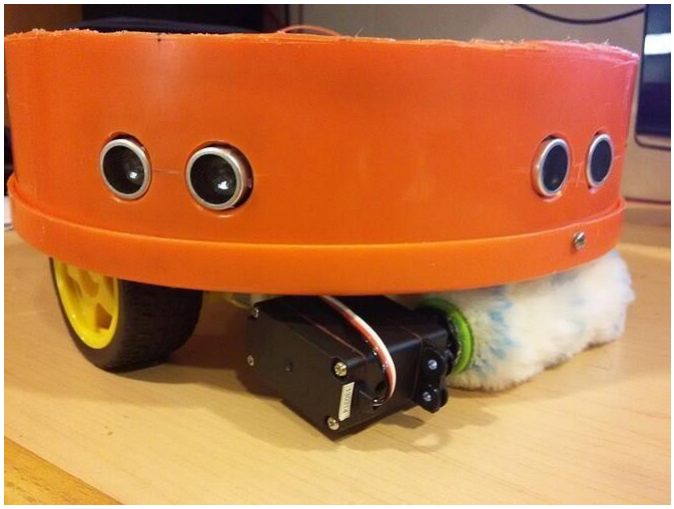
L293D Motor Drive: A medium power motor driver ideal for operating DC Motors and Stepper Motors is the L293D Motor Driver Module. The well-known L293 motor driver IC is employed. It can turn on and off 4 DC motors or control the direction and speed of 2 DC motors. The driver considerably simplifies and 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.

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



CONCLUSIONS:

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

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