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Automatic Vacuum Cleaner UsingArduino

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Abstract :- The rapid advancement in technology has led to the development of smart home devices, and one such innovation is the automatic vacuum cleaner. This project focuses on designing and implementing an automatic vacuum cleaner using Arduino, a versatile open-source hardware platform. The system combines various sensors and actuators to create an intelligent cleaning solution that can navigate through a given space, avoiding obstacles while efficiently cleaning the environment.

The core of the automatic vacuum cleaner is an Arduino micro-controller, which serves as the brain of the system. The cleaner is equipped with infrared sensors for detecting obstacles and avoiding collisions. Additionally, it utilizes proximity sensors to identify the presence of walls and furniture, enabling it to navigate through confined spaces.

This project not only provides a cost-effective solution for automating household cleaning tasks but also serves as a platform for learning and experimenting with robotics, sensors, and automation. The open-source nature of Arduino encourages further customization and improvement, making it an accessible and versatile option for DIY enthusiasts and developers alike.

I. INTRODUCTION

An Arduino-based vacuum cleaner is a cleaning device that is powered and controlled by an Arduino micro-controller. 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.

2. 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 tool that can carry out particular cleaning activities automatically or manually, this requires a mix of hardware and software design and testing.

This includes understanding the types of surfaces the vacuum cleaner will clean, the desired cleaning patterns, and any additional features

3. MAIN COMPONENTS

Gear motor with wheels : The Gear motor with wheels main purpose is to allow the reduction from an initial high speed to a lower one without negatively affecting the mechanism.
In addition to this adjustment, a gear motor is in charge of adjusting the mechanical power of a system.

Motor Driver : A motor driver takes the low-current signal from the controller circuit and amps it up into a high-current signal, to correctly drive the motor. It basically controls a high-current signal. using a low-current signal.

Arduino Uno : Arduino UNO is a low-cost, flexible, and easy-to-use programmable open-source micro-controller board that can be integrated into a variety of electronic projects.This board can be interfaced with other Arduino boards, Arduino shields, Raspberry Pi boards and can control relays, LEDs, servos, and motors as an output.

Servo motor : A servomotor (or servo motor) is a rotary actuator or linear actuator that allows for precise control of angular or linear position, velocity, and acceleration. It consists of a suitable motor coupled to a sensor for position feedback.

Ultrasonic sensor : The module has two eyes like projects in the front which forms the Ultrasonic transmitter and Receiver. The HC-SR04 ultrasonic sensor uses sonar to determine the distance to an object. This Ultrasonic Sensor module is a transmitter, a receiver, and a control circuit in one single pack.

6v motor

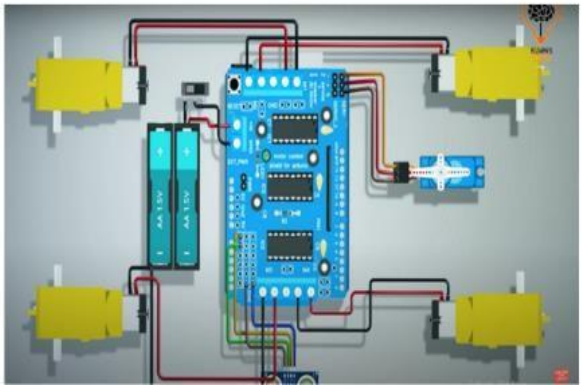
Lithium–ion battery cell

Power Supply : A reliable power supply, such as rechargeable batteries or a power cord, is necessary to ensure the continuous operation of the automatic vacuum cleaner.

Infrared Sensors: Infrared sensors are essential for detecting obstacles and avoiding collisions. These sensors help the vacuum cleaner navigate around furniture and other objects in its path.

DC Motors: High-torque DC motors drive the rotary brushes and suction fans of the vacuum cleaner. These motors are responsible for the cleaning mechanism and movement of the device.

4. FABRICATION OF ROBOT



The required rectangular shape is created by cutting the board. The hardwood board's sides and edges are smoothed off by grinding. At this point, glue is used to secure the geared motor wheels in place at the bottom of the board. As seen in the illustration, the Arduino UNO is mounted on the motor shield. According to the code provided to Uno through the Arduino IDE software, the motor shield controls all the motors and wheels that are wired to it.

Over the servo motor, an ultrasonic sensor is mounted. This sensor identifies any obstructions in the robot's path and allows it to avoid collisions that could harm it. It is the robot's front that the servo motor is mounted on. The motor shield's slots are occupied by
the pins of the servo motor and the ultrasonic sensor, respectively.

The lithium ion battery, which is mounted on the robot's back side, powers the entire circuit. The robot can be turned on and off whenever necessary using a switch.

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

5. 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 cardboard piece that was given a bottle-diameter cutout.

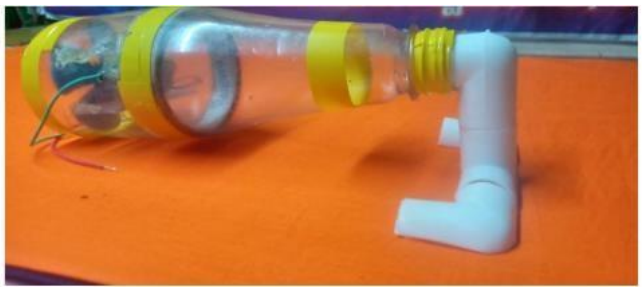
3) Attach both the cardboard piece and the net. In the bottle, place the net arrangement.

4) After putting the filter in place, take the 6V motor and, using the wooden sticks as supports, 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 linked to the side is a switch. This serves as a controller for turning the vacuum cleaner ON or OFF as shown in figure .



It's worth noting that safety precautions should be considered when working with electrical components and power sources. Additionally, the effectiveness of this DIY vacuum cleaner will depend on the power of the motor, the design of the fan, and the overall sealing of the system to create sufficient suction. Experimenting with the design and making improvements based on performance testing can enhance the effectiveness of the vacuum cleaner.

6. WORKING PRINCIPLE OF VACUUM CLEANER

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.

This system effectively cleans the air by using a combination of a centrifugal fan, a filter bag, and additional filters to capture and remove particles, providing a clean and filtered air discharge. It highlights the importance of the interplay between the fan, motor, and filtration components in creating an efficient vacuum cleaning system.

7. RESULTS

The results of using an Arduino-based vacuum cleaner are :-

1. **Cost-effectiveness:**
   - Arduino-based smart vacuum cleaners are cost-effective compared to commercial alternatives.
2. **Customizability:**
   - Users can customize their smart vacuum cleaners by adding features that meet specific needs.
3. **User-friendly:**
   - Arduino's programming environment is user-friendly, making it accessible to non-programmers.
4. **Scalability:**
   - The modular design of Arduino boards allows easy upgrades and additions to the vacuum cleaner.
5. **Flexibility:**
   - Users have the flexibility to choose different sensors, motors, and components for varied designs and functionality.
6. **Remote Control:**
   - The vacuum cleaner can be controlled remotely through a smartphone or tablet.
7. **Real-time Monitoring:**
   - Equipped with sensors, the vacuum cleaner can monitor its environment in real-time, providing data on dirt levels.
   -
8. **Efficient Cleaning:**
   - Programming allows the vacuum cleaner to optimize cleaning patterns for efficiency in time and energy consumption.

These results highlight the advantages of an Arduino-based smart vacuum cleaner, including its affordability, customization options, user-friendliness, and advanced features like remote control and real-time monitoring.

8. CONCLUSION

Implementation of Smart Vacuum Cleaner:

- The project implemented a smart vacuum cleaner operated by pre-written code on an Arduino UNO.
- The cleaner turns to the side when it encounters an obstacle and adjusts its position based on available space.

2. **Battery-Powered Operation:**
   - The vacuum cleaner is powered by a lithium battery with an input power of 3.6 watts.
3. **Effectiveness:**
   - The vacuum cleaner's effectiveness is reported to be 29.79%.
4. **Health and Safety:**
   - The project aims to reduce health risks by using a battery-powered, automated vacuum cleaner.
5. **Ease of Use and Affordability:**
   - The cleaner is described as easy to use and reasonably priced.
   - The suggestion of utilizing a detachable bag for easier dust disposal is provided.

The conclusion emphasizes the successful implementation of a smart vacuum cleaner with specific features, including automation, battery power, and health-conscious design. The reported efficiency and user-friendly aspects contribute to the overall positive evaluation of the Arduino-based vacuum cleaner.

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