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RESEARCH

High-pressure automatic vacuum cleaner using Arduino

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In the modern world, household work has been transformed by new technologies. Some machines were designed to automate tasks previously performed by servants, while others employ new energy sources such as electricity and gas to make dwellings cleaner, safer, and more efficient. This paper proposes a high-pressure automatic vacuum cleaner using Arduino to dry-clean an area automatically. The robot covers the entire room or area by using the border analysis technique. The robot travels in a zigzag path and covers the entire area. It analyzes the obstacle in the room by using an ultrasonic sensor. The high-pressure pump will suck the dust particles while traveling, thus cleaning the entire room.

Keywords: embedded system, Arduino, lithium-ion battery, vacuum

1. Introduction

Floor cleaning is a well-known domestic duty that is often regarded as unpleasant, tough, inconvenient, and dull. Most of the time, cleaners are hired to clean the floors. Using an automatic hoover cleaner can help you avoid doing manual labor. The cost of an automatic vacuum cleaner in the market is very high (1, 2). So here we propose an automatic vacuum cleaner using Arduino, which cleans the entire room or area by using the border analysis technique.

The robot moves in a zigzag path, so it cleans the entire room. It consists of three ultra-sonic sensors for obstacle detection. The robot also has an infrared sensor for stairs detection. The robot consists of three sweepers for sweeping the dust particles and a high-pressure vacuum pump that sucks the dust particles into the dustbin. It will clean the entire room automatically. The cost of the robot is lower when compared with the others that are in the market (3–5).

2. Proposed system

The proposed system is a robot capable of achieving the initial goals, namely, an autonomous hoover cleaner robot capable of randomly navigating across a room or a house with minimal human input.

The robot is created with the following operational components in mind (6): the cleaning mechanism, the directional control, and the obstacle avoidance system. The new Arduino hoover (7) cleaner being developed here will be more compact than most of the cleaning equipment available on the market and will be highly useful.

The ultrasonic sensor will allow the robot to avoid obstacles and travel freely until the room is thoroughly cleaned. A hoover suction cleaner is also linked to the system's rear for dust suction. The robot now moves in a zig-zag pattern, rotating anytime it reaches a corner. It immediately covers the entire region.

3. Design of robot's components

The robot contains wheels, cleaning, vacuum pump, and other electrical and electronic components, which all work harmoniously to achieve efficient cleaning. The electronic components consist of an Arduino Uno, ultrasonic sensor, infrared sensor, motor driver, and battery management system. The electrical components consist of gear motors, a vacuum pump, and a battery.

An Arduino Uno microcontroller is circuited with DC motors, sensors, and shield L298. This DC motor functions as the wheels of the robot, which is connected to the Arduino microcontroller so that it acts as the wheels of the robot and is also used to sweep.

The motor shield functions as a motion regulator connected to the Arduino microcontroller to regulate the motion of the dc motor. A total of six DC motors are used to perform respective operations like the movement of the robot, sweeping, and for the vacuum pump for the suction of dust particles from the ground (8–10). There are three ultrasonic sensors and infrared sensor obstacle detection and one for the monitoring of the dustbin (11, 12). The whole setup is connected to a battery.

3.1. Arduino Uno

The ATmega328P (datasheet) is the basis for the Arduino Uno microcontroller board. It features 14 digital input/output pins as well as six analog input pins. An Arduino Uno microcontroller has 32 pins in total. The Arduino Uno is a low-cost, versatile, and simple-to-use open-source programmable microcontroller board that can be integrated into a wide range of electrical applications.

3.2. Ultrasonic sensor

An ultrasonic sensor is an electronic device that measures the distance of a target object by emitting ultrasonic sound waves and converts the reflected sound into an electrical signal. Ultrasonic waves travel faster than the speed of audible sound.

3.3. L298N motor drive module

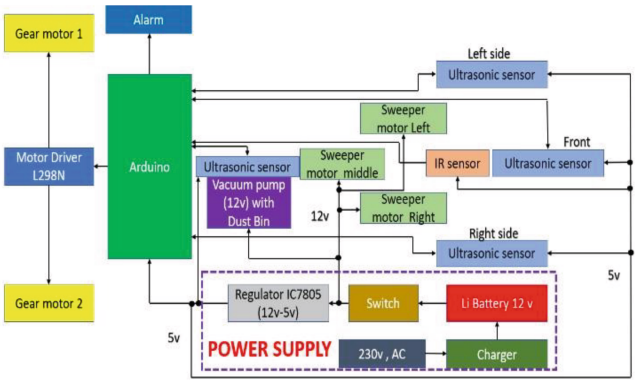
The L298N is a dual H-bridge motor driver that can regulate the speed and direction of two DC motors at the same time. The module can power DC motors with voltages ranging from 5 to 35 volts and peak currents of up to 2 amps.

3.4. DC motor

A direct current motor, sometimes known as a DC motor, is an electrical machine that converts electrical energy into mechanical energy by producing a magnetic field generated by direct current.

DC motors can immediately start, stop, and reverse an essential factor for controlling the operation of production equipment. We can use small dc motors in tools, toys, and home appliances. We can use large dc motors in elevators and hoists in the drives of steel rolling mills.

4. Block diagram



In this block diagram, there are three ultrasonic sensors are connected to the Arduino Uno microcontroller. The transmitting and receiving signals are given through the microcontroller. The sensors are used for obstacle detection.

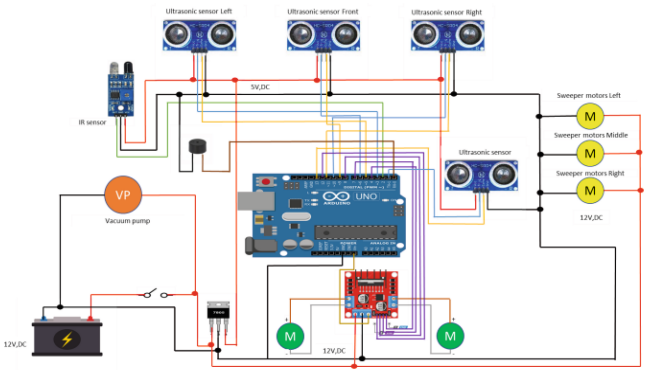
There is an infrared sensor connected to the microcontroller for the detection of stairs. There are two DC gear motors for the wheeling purpose. These two DC motors are connected to a motor shield through the Arduino Uno. The motor shield controls the movement of the DC gear motor. Through the signal from the Arduino Uno.

Also, three DC motors are connected directly to the battery. These DC motors are used for the sweeping purpose.

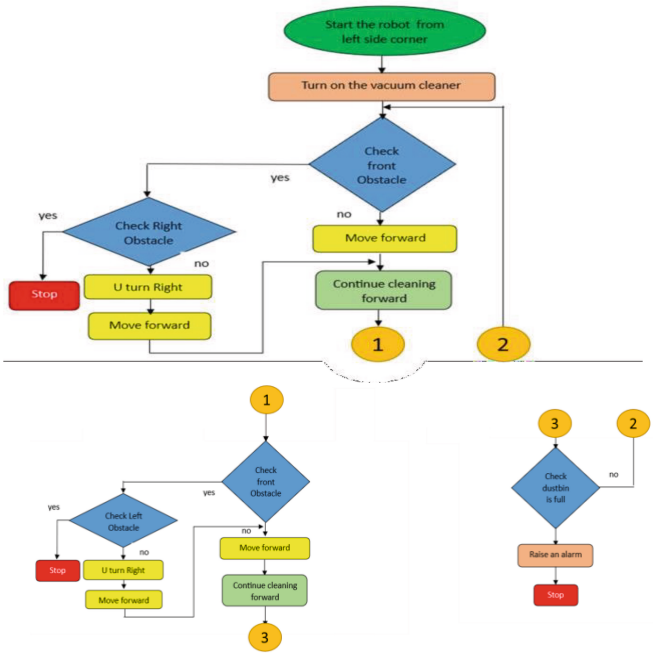
There is a DC motor for the vacuum pump for the suction of dust particles from the ground. A dustbin is connected across the vacuum pump. An ultrasonic sensor is connected to the dust bin for monitoring purposes.

The whole setup is connected to a battery through a switch.5V supply is given to the sensors and the controller through a regulator and 12V supply is to the DC motors.

5. Circuit diagram



6. Flow chart



In operating conditions, the autonomous vacuum cleaner will check for obstacles: if no obstacle is found, the cleaner will move forward. An obstacle is detected by the ultrasonic sensor by transmitting ultrasound from the transmitter of the ultrasonic sensor.

When an obstacle or a wall is detected by the ultrasonic sensor by using ultrasound waves, it will be captured by the receiver of the ultrasonic sensor and, the signal will be sent to the Arduino Uno. U-turn right if an obstacle is present on the right side and in front, U-turn left. Three sweeper motors are used to sweep out the dust. A high-pressure vacuum pump is connected parallel to the sweeper motor three. Thus, the vacuum pump sucks the dust particles and the waste that is present.

An IR sensor is present in front of the vacuum cleaner to detect stairs. An ultrasonic sensor is placed in the dustbin to monitor the level of the dustbin. The vacuum cleaner moves in a zig-zag path and can clean about 90% to 80% of the given room.

7. Conclusion

A High-pressure automatic vacuum cleaner robot has been designed, fabricated, and tested. The vacuum cleaner cleans the entire room or an area. It can clean up to 80 to 90 percent of the given area automatically.

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