JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue
JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)
An International Scholarly Open Access, Peer-reviewed, Refereed Journal

Arduino Based Smart Vacuum Cleaner

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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.**

I. 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.

II. LITERATURE SURVEY

[1] M. Manasa et.al., In this project Smart Vacuum Cleaner has been implemented. It operated using pre-written code that was placed into an Arduino UNO. When an impediment is encountered, an RC car will turn to the side. When there is more space between the car and the obstruction.This invention uses a battery-powered vacuum cleaner and a CPU fan to collect dust without the need for human interaction, lowering the risks to human health. This cleaner is easy to use and reasonably priced. However, since cleaning the dust becomes easier, utilising a detachable bag can be preferable.

[2] Pawan kumar Ramkisoon et.al., In this journal, the design and implementation of a smart, autonomous cleaning and mopping robot is presented. The system is powered by a rechargeable dc Lithium Polymer battery of 12 V. The Arduino Mega board is used in this project due to its large number of GPIO pins and a better flash memory storage of 256 kB, compared to other Arduino based microcontrollers. The range of the wireless control is 10 meters. It is observed that the system performs the desired task successfully and works both on an autonomous mode or application-controlled mode.

[3] Yuda Irawan et.al., In this study the Ultrasonic Sensor, Motor Shield L298, Arduino Uno microcontroller, Servo, and Dc Motor are the main components of the full floor cleaning robot. The motor shield L298 drives the DC motor after the Arduino Uno microcontroller processes the ultrasonic sensor as a distance detector and a DC motor as a robot driver. The robot will automatically search for a direction that is not blocking its path if an ultrasonic sensor detects an obstacle in front of it. When the distance read by the ultrasonic sensor is less than 15 cm, the distance value on the sensor has been established. In a distance of> 15 cm, the condition of the prototype cleaning robot for the road floor cleaning is obtained.

[4] Saman Mohammdi et.al., In this article, the authors make a cordless vacuum into a smart vacuum. The cell phone serves as a control panel in the remote- control mode. Due to the suction motor not having to run all the time the energy consumption will be reduced which reduces the cost and increases the life span of the vacuum cleaner. They also included the automatic system which indicates the charging percentage and turns off the robot if the charging is low to prevent the damage of the robot.

[5] Akanksha Vyas et.al., In this journal an efficient and economical floor cleaner is implemented. The cleaner can perform both wet cleaning and dry cleaning. In the process of cleaning the cleaner can sanitize the floor using UV Lamp, by which it can kill more than 90% of the Germicides. By this the usage of this cleaner will be increased in industries.

[6] Li Hung Goon et.al., A simple automatic floor polisher was built through this project. It consists of several important components which are Bluetooth module, ultrasonic sensor, motor driver, DC motors and PC fans. The Bluetooth module was implemented to insert the remotely turn ON and OFF function. The ultrasonic sensor is used to detect the obstacles and avoid them. The robot weight heavier than expected, thus draw more power from power supply to DC motors to run the robot. The PC fan required high voltage supply but it operates at low rpm, and torque, it is not an efficient vacuum system for the robot.

[7] Adeel Saleem et.al., In this paper the algorithm bases its movement on the identification of impediments and accomplishes this with the aid of an infrared sensor. The robot model that has been put into practise produces excellent results in a real-world setting and saves a lot of time while cleaning a space. This version was tested in a real-world setting and is solely intended for use in cleaning rooms. For usage in shopping malls and other applications where the environment is uneven, the intelligent dust cleaner should also be somewhat updated and expanded in size. Having thoroughly studied other waste and obstacle detection.

[8] P. B. Jarande et.al., In this journal they have designed a simple automatic cleaner which can operate from a far distance with the help of wifi. The user can start the vacuum cleaner by having a direct click at www.adafruit.io account id connected to the vacuum cleaner. When message is received from server robot and vacuum cleaner will start. When obstacle is detected then robot will move left then if obstacle is again detected then robot will move right and then vacuum cleaner will start.

[9] Nwe Ni Tun et.al., The axial fan employed in the vacuum cleaner has been researched for this project. Axial fans are created for 0.9 W vacuum cleaners in this project. Utilizing the slip steam hypothesis, the pressure differential across the fan is determined. The calculations reveal a 6.56 pressure differential across the fan. The machine has a 42% efficiency.

[10] Iwan R. Ulrich et.al., In this project an automatic vacuum cleaner is designed which can operate at contour environment with the robots shape tentacle sensor and the algorithm used in this. The robot can detect the obstacles in front of them and avoid them without any damage to the robot.

By considering all the above-mentioned journals, as per our knowledge we observed that In comparison to conventional vacuum cleaners, the arduino-built vacuum cleaners are more cost-effective and efficient. The vacuum cleaners built on an Arduino platform can be operated both manually and automatically thanks to their design. However, the main drawback is that it takes longer than normal cleaner.

III. METHODOLOGY

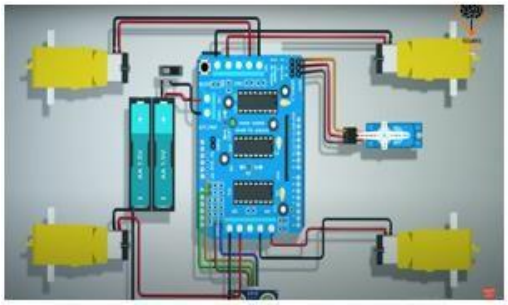

Fig.1. Block diagram of the proposed model

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.

IV. COMPONENTS Hardware

requirements:

- Arduino UNO
- Arduino Motor Shield
- Ultrasonic Sensor
- Servo Motor
- Lithium Ion Batteries
- Geared Motor Wheels
- 6v Motor

Software requirements:

- Arduino IDE

V. WORKFLOW

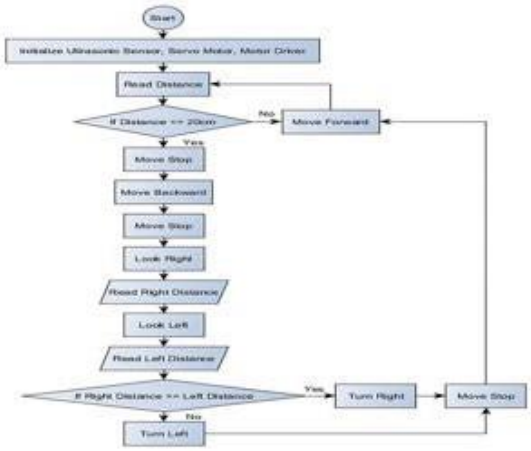

Fig.2. Flowchart showing the working of the model

According to the flowchart above, as soon as the robot is turned on, an ultrasonic sensor measures the space in front of it. If the distance is less than 20 cm, the robot stops moving, and it moves backward while the servo motor rotates at an angle to measure the space on the robot's right and left sides. The robot goes in that direction if the distance is larger than 20 cm, and the process is repeated if the robot encounters any impediments. The vacuum cleaner is turned on at the same time as the robot. The vacuum cleaner cleans the area by sucking up all the dust particles, bits of paper, and other undesired things.

Once the system is turned on, the Arduino is powered by a power source, and the vehicle moves using a motor driver and caster wheel until an obstacle is detected. If an obstacle is detected, the robot changes its direction using the motor driver and program that has been loaded into the Arduino. The robot continuously changes its direction as it moves through the area it covers the entire space of the room. During the movement of the robot the vacuum cleaner is also turned on. The vacuum cleaner picks up the dust particles and cleans the area it moved as shown in figure 2.

VI. CONCLUSION & FUTURE SCOPE

In conclusion, the project to create a smart vacuum powered by Arduino has been constructed and put into use successfully. The core control system of the vacuum cleaner is an Arduino, which enables a number of intelligent features including obstacle recognition, autonomous navigation, and wireless networkAlthough the stated goals of the current project have been met, there is still plenty of room for improvements and

developments. Potential regions for growth in the future include Map-making and path planning: Using cutting- edge algorithms and sensors, a vacuum cleaner can map its surroundings and devise an ideal path for cleaning. Cleaning with artificial intelligence (AI): Using artificial intelligence to analyse the type of filth on the surface and modify the vacuum cleaner's cleaning approach as necessary.Integration with smart home systems: Making it possible for the vacuum cleaner to work seamlessly and more effectively with other smart home appliances and systems, such as voice assistants, home automation hubs or security systems.Multiple floor cleaning:Designing the vacuum with capabilities like multi-level mapping or the capability to negotiate stairs will enable it to manage numerous floors or complex floor plans. Energy efficiency and battery optimisation: Investigating ways to reduce the vacuum cleaner's energy usage and increase the lifespan of its batteries by using power management strategies or effective motors. Noise reduction: Using noise reduction techniques to reduce the vacuum cleaner's operational noise will make it more user-friendly. Cloud connectivity and data analysis Implementing cloud connectivity to store cleaning data and analyse that data to generate individualised cleaning recommendations or maintenance alerts. 8. Robustness and durability:Enhancing the vacuum cleaner's overall build quality and strength will assure its long-term dependability and durability.

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