

An Efficient and Cost Effective Approach to Everyday Problems Smart Vacuum Cleaner

Ashutosh Shankhdhar

GLA University

Ashutosh.shankhdhar@gla.ac.in

Prakhar Verma

prakhar.verma_cs16@gla.ac.in

Ravindra Faujdar

ravindra.faujdar_me16@gla.ac.in

Rishabh Mishra

rishabh.mishra_cs16@gla.ac.in

Udit Nayyar

udit.nayyar_cs16@gla.ac.in

Article Info

Volume 83

Page Number: 5569 - 5573

Publication Issue:

May - June 2020

Article History

Article Received: 19 November 2019

Revised: 27 January 2020

Accepted: 24 February 2020

Publication: 17 May 2020

Abstract

Modern time is running in parallel with automation. Home automation not only increases energy efficiency but also improves the functionality of the appliance. They improve flexibility. The use of domestic robots and making the best use of them will become a daily routine in no time. There are various floor cleaning robots available in the market, but only a few can clean the wet floor. The purpose of this project is to minimize human intervention in-floor cleaning. This project focuses on creating such a robot that can clean the wet floor while dancing on the user's tune. Users can control the actions of the robot using the phone application.

Keywords: automation; functionality; flexibility; robots; control

1. Introduction

A domestic robot is a type of service robot that is primarily used for household chores. Appliances like these have come into the market by various companies, but they mostly focus on the automatic vacuum cleaning process. Unlike them, this robot performs sweeping and mopping operations using a detachable mob and can be controlled manually by the user using the mobile application. All hardware and software operations are controlled using the Arduino microcontroller. The robot operates on a 500-volt supply. For obstacle detection, an ultrasonic sensor is used. Whenever an obstacle comes in the path, the robot stops the action and further user can move it back and forward using the app to continue the cleaning process. A water sprayer is used for the convenience of the user, it sprays the water and further, it is cleaned using the mob attached to the robot. RF module is used to

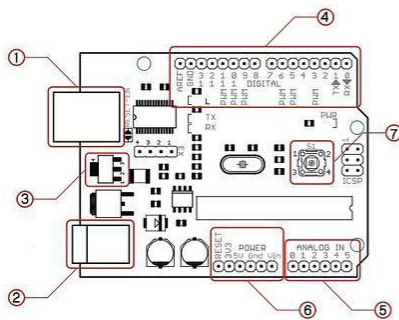
receive and transmit the signals to control the robot using the mobile app.

2. Hardware Components

1. **Arduino Board:** Arduino is an open-source electronics platform based on easy-to-use hardware and software.[1] Arduino board is a microcontroller having ATmega 328 processor. Fig. 1 shows a diagram of the Arduino Board. Its various components are:
 - 1) **USB Connector:** Used to burn the program into the memory.
 - 2) **Power Port:** The board can be powered through an AC or DC adapter or battery.
 - 3) **Analog Input Pins:** It has 6 analog pins labeled from 0 to 5. These pins are used to read the analog data from analog

sensors like the temperature sensor and convert the analog signals into digital signals so that the system can understand.

- 4) Digital Pins: There are 14 digital pins labeled from 0 to 13. They are used as input and output pins, which when used as output pins acts as a source of power supply to the devices connected to them and reads the data when used as input pins.
- 5) Reset Switch: It is used to reset the board and runs the program loaded in the memory from starting.
- 6) Crystal Oscillator: It is used to time the data transfer taking place between the board and the peripheral devices like sensors.
- 7) TX/RX Indicator: TX stands for transmitting and RX stands for receiving. The led connected lights up when any of the operations take place.



The most important parts on the Arduino board high lighted in red:

- 1: USB connector
- 2: Power connector
- 3: Automatic power switch
- 4: Digital pins
- 5: Analog pins
- 6: Power pins
- 7: Reset switch

Fig. 1

2. Ultrasonic Sensor: Ultrasonic Sensor measures the distance to an object using high-frequency ultrasonic sound waves which are above the range of human hearing. The sensor used in the floor cleaning robot is HC-S04. The sensor sends and receives ultrasonic pulses using a transducer which relays back information about an object's proximity. High-frequency waves bounce back from

boundaries to generate different echo patterns. The distance to the object is determined by measuring times lapses between the sending and receiving of the ultrasonic pulse.[2] Fig. 2 shows a picture of the ultrasonic sensor. The HC-S04 has pins:

- 1) Vcc: It used to power the sensor, usually with +5V.
- 2) Trig: It is the input pin. The signal is sent to it to initialize the sending of sound waves.
- 3) Echo: Echo pin is the output pin. The signal is sent to it to capture the incoming sound waves.
- 4) Ground: It is used to ground the sensor.



Fig. 2

3. Motor Driver: The Motor Driver is a module for engines that permits you to control the working pace and bearing of two engines at the same time. This engine driver is structured and created dependent on the L293D IC. L293D is a 16-Pin engine driver IC. This is intended to give bidirectional driver flows at voltages from 5V to 36V. [3]Fig. 3a shows a circuit driver of L293D IC and [4]Fig. 3b shows an L293D based motor driver.

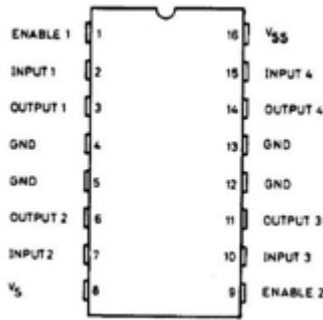


Fig. 3a



Fig. 3b

4. Bluetooth Module: HC-06 Bluetooth module is used in the Floor Cleaning Robot. HC-06 is a slave Bluetooth module designed for wireless serial communication. A Slave module can receive serial data when serial data is sent out from a master Bluetooth device. When the module receives wireless data, it is sent out through the serial interface exactly as it is received. It is to operate it at 3.6-6 volts. Fig. 4 shows a picture of the Bluetooth module.

PIN	FUNCTION / OPERATION
VCC	For powering, +5v is supplied to the Bluetooth module.
GND	Ground the module.
TXD	The serial data is transmitted through this pin.
RXD	The serial data is received through this pin.

5. servo Motor: It is a rotatory actuator used to control objects in terms of angular position. It converts electrical energy into mechanical energy. It works on the length of the pulse. It

takes the angular position feedback which when calibrated with the sensor.

Working Principle of Servo Motor: It is a closed-loop system i.e the input from the sensor is send to the error detector and then further connected to the controller and the motor is connected to the controller. The output generated acts as a feedback to the error detector and hence finishes the loop. If the error detector detects an error in the original position, the signal is sent via the controller to move the motor to a particular angular value, and hence the object connected moves to that particular angle by the physical phenomenon of torque.

PIN	FUNCTION/ OPERATION
VCC	To provide a +5 volt supply.
GND	To provide ground.
SIGNAL	Carries a control signal.

6. Zero PCB: Zero PCB is commonly known as the printed circuit board, has copper patches to solder your wires but it is not connected with each other at any point. A connection can be provided by soldering the wires from components to other devices or connect them by soldering their legs to the wire. It is made of synthetic compounds known as a group of amazingly poisonous mixes involving two benzene rings in which chlorine happens of two or extra hydrogen iotas: notable to cause skin infection and suspicious of causing birth imperfections or malignant growth. Polymer name as polychlorinated biphenyl. [5] There are five types of PCB:

1) Double-layer PCBs

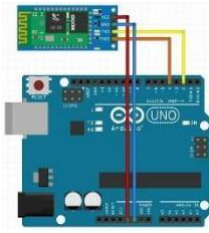


fig 4

- 2) Single-layer PCBs
 - 3) Rigid PCBs
 - 4) Flexible PCBs
 - 5) Multi-Layer PCBs
7. 9V DC Battery: It is a battery of 9V which supplies power to all the components connected to it. It has two terminals, positive and negative. It is durable for long periods and delivers power to the rest of the components.
 8. Water Pump: It converts electrical energy into mechanical energy. It works on 3V - 6V power supply and is commonly used for suction of water from a receptacle. It is light weighted and provides pressurized water to the customer. The main part of the pump is impellers which is a rotating component that is equipped with blades that revolve in our pump. It provides high velocity to the water.
 9. Power Transistor: As its name suggests, it is used to control large voltage and current. It is a three-terminal semiconductor device (base, collector, and Emitter) used to amplify and handle electronic signals and electrical power. It is of three types- BJT, Mosfet, and IGBT. Its base value is 0.7 volts and the collector voltage is 1.6 volts greater than Emitter voltage.
 10. DC Motor: Practically every mechanical improvement that we see around us is polished by an electric motor. Electric machines are strategies for changing over standard essentialness. Motors take electrical essentialness and produce mechanical imperativeness. The electric motor is used to control a few devices we use in normal day by

day presence. An instance of motor used in regular day to day existence is vehicles, sustenance blenders as is a vacuum cleaner.[11] Figure 11 is a picture of DC Motor.

3. Methodology

Typically robots of this sort can cost a lot, making it an unreasonably expensive decision. Simultaneously, this practical automated floor cleaner has been structured chiefly keeping the value edge as the main priority. Subsequently, a generally proficient and lithe cleaning framework is created to accomplish impeccable cleaning as opposed to agreeable cleaning accomplished by a prior unrestrained machine. This venture brought about the result of comprehensive research and examinations with the ordinary plans and exhibitions of different sorts and make. Supervisory authority over these contraptions is made so basic what's more, is that it is cost-productive without a decrease in execution. By limiting human mediation, the recently planned efficient mechanical floor cleaner clears another path in enhancing cheap, simultaneously better home machines. Usability and the basic interface make this venture one of the most valuable gadgets right now in the world of today. To keep our robot as essential as possible, while prepared to play out the basic goals, for instance, a vacuum cleaner robot prepared to clean up a room or an office with the least human assistance.

4. Flowchart

The [6] flowchart in fig. 5 depicts the working of the robot. The flowchart explains that the robot once is started, will take an input of the distance that it has to sweep. Then it will look for any obstacles it might collide with and calculate the distance to the obstacle. If the input distance is lesser than the collision distance, It will continue moving forward and cleaning the area. If the input distance is more than the collision distance, it will change its path based on other metrics (like Left-hand distance, right-hand distance, etc) to move around the obstacle to reach its destination.

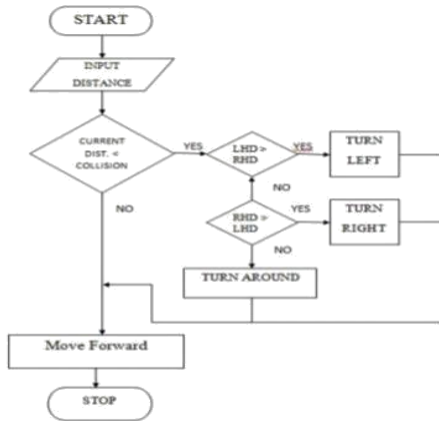


fig. 5

5. Project Images:

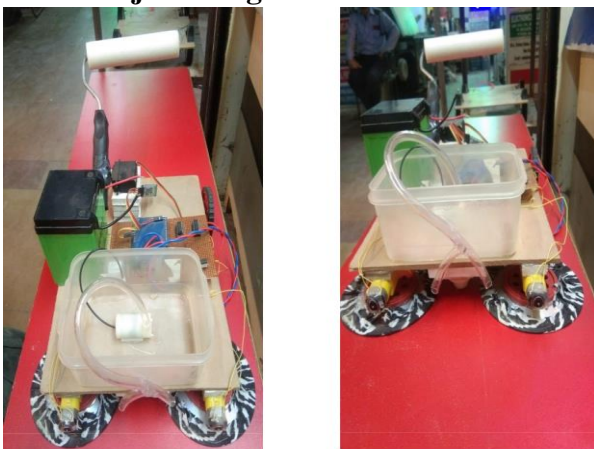


fig 6a fig 6b

6. Conclusion:

This task productive floor cleaning robot with clearing and wiping activities. This robot works in manual mode for client comfort. Bluetooth modules give remote correspondence among the user and robot. It sends the data to the mobile application. A wiper is associated with it which can use the water for cleaning reason and for the comfort of the client. The client can likewise work this robot physically with the assistance of the application. It lessens the work cost and spares time likewise and gives effective cleaning. In programmed mode, the robot works self-rulingly. The activities, for example, clearing, wiping, and changing the way in the event of an obstacle are performed consequently. Since in the project, the floor cleaner is joined with various gadgets like DC motor(s), ultrasonic sensors and so on., so it will be anything but difficult to deal with it, likewise, it

spares time and will work naturally for cleaning reason at homes.

7. References:

- [1] <https://www.google.com/url?sa=i&url=https%3A%2F%2Fwww.elprocus.com%2Farduino-basics-and-design%2F&psig=AOvVaw0mt4MZPUacfXvnF1lNcHpu&ust=1588141202715000&source=images&cd=vfe&ved=0CAIQjRxqFwoTCPCfh5W9iukCFQAAAAAdAAAAABAQ>
- [2] <https://www.google.com/url?sa=i&url=https%3A%2F%2Fcomponents101.com%2Fultrasonic-sensor-working-pinout-datasheet&psig=AOvVaw3WsIAaoj6H1285vSb ekLdh&ust=1588144306826000&source=images&cd=vfe&ved=0CAIQjRxqFwoTCOivnvnKiukCFQAAAAAdAAAAABAD>
- [3] <https://www.google.com/url?sa=i&url=https%3A%2F%2Fobliblog.wordpress.com%2F2012%2F05%2F30%2Fcontrol-motor-arduino-1293d-chip%2F&psig=AOvVaw0RVd2FTxgKwJUSA5KxfL02&ust=1588144604758000&source=images&cd=vfe&ved=0CAIQjRxqFwoTCIDVwuvJiukCFQAAAAAdAAAAABAd>
- [4] <https://www.google.com/url?sa=i&url=https%3A%2F%2Fwww.banggood.com%2F10Pcs-MINI-L293D-Motor-Driver-Expansion-Board-Mini-L293D-Motor-Drive-Module-p-1269353.html&psig=AOvVaw1uY0AwLgFVc9uO0gP1cJNu&ust=1588145587161000&source=images&cd=vfe&ved=0CAIQjRxqFwoTCKjlschNiukCFQAAAAAdAAAAABAJ>
- [5] <https://robu.in/product/46-cm-universal-pcb-prototype-board-double-sided/>
- [6] <https://www.irjet.net/>
- [7] <https://www.ijitee.org/wp-content/uploads/papers/v8i4s/DS2905028419.pdf>
- [8] <http://www.standardsuniversity.org/wp-content/uploads/Smart-Floor-Cleaning-Robot-CLEAR.pdf>
- [9] <http://ethesis.nitrkl.ac.in/7500/1/147.pdf>
- [10] https://www.researchgate.net/publication/299372806_Floor_Cleaning_Robot_with_Mobile-App_or_Autonomous
- [11] <https://www.hackster.io/theSTEMpedia/diy-floor-cleaning-robot-using-arduino-edb194>
- [12] <https://www.instructables.com/id/CleanBOT/>