DESIGN OF IOT BASED VACUUM CLEANING AND MOPPING ROBOT

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ABSTRACT: Robot is an electromechanical device which is used in various fields. Now-a-days robots are being used for domestic works also.Robotic vacuum cleaners are reliable, battery-powered that suck dirt, debris and dust from carpets and different kinds of floors.The most challenging matter is to manufacture a robotic vacuum cleaner that is affordable.The coverage of the robot in a room depends on the sensors used and the navigation path it follows. This paper proposes the design of an economically feasible autonomous vacuum cleaning robot that is built up of Aurdino Uno board,Ultrasonic Ranging Module,Bluetooth Module and Infrared sensors etc. The proposed robot is collision free type that ensures maximum cleaning area.

KEYWORDS: Aurdino Uno,Ultrasonic Ranging Module,Bluetooth Module,Infrared sensors.

I.INTRODUCTION

Vacuum cleaner - as the name suggests, it is a device used for sweeping with the help of an air pump.It creates vacuum and collects dirt from the floors and from all possible surfaces. The dust is collected using a dirt bin and a porous bag.Vacuum cleaners have their applications in every field.These are available in various sizes,various models and are used for different purposes.In order to reduce the human intervention vacuum cleaners are automatized.

The first robotic vacuum iRobot Roomba,was released in 2002. Right from the initial years of its implementation it has undergone many modifications. In the initial stage,we have to setup virtual walls for navigation and still the vacuum cleaners get stuck behind furniture.The battery-life of them is very low that it barely fulfilled the purpose and also we have to purchase separate devices for carpets and hard floors.

An ideal robotic vacuum cleaner cleaner should be affordable,must have wide coverage area,should detect hairs and dirt and should not fall from steps or furniture.In this paper we proposed a model that satisfies all the above specified requirements.

Proposed architecture of robotic vacuum cleaner is available in two modes.They are:
1.Automatic Mode and
2.Bluetooth Controlled Mode.
Remaining part of the manuscript is organized as follows: Section II contains description of the proposed types of architecture, while the functionality of the robot is described in section III, Design flow of proposed architecture is discussed in Section IV, Operational details are furnished in Section V, Robotic Movement and its applications are highlighted in section VI followed by conclusion in section VII.

II.PROPOSED ARCHITECTURE

The proposed architecture of autonomous vacuum cleaning robot is comprised of: DC Power Unit, Aurdino Uno, Sensors, Motor Driver,Solar Panel, Charging Unit, Vacuum Kit and Mopping Kit. The block diagram of proposed robotic architecture is shown below:

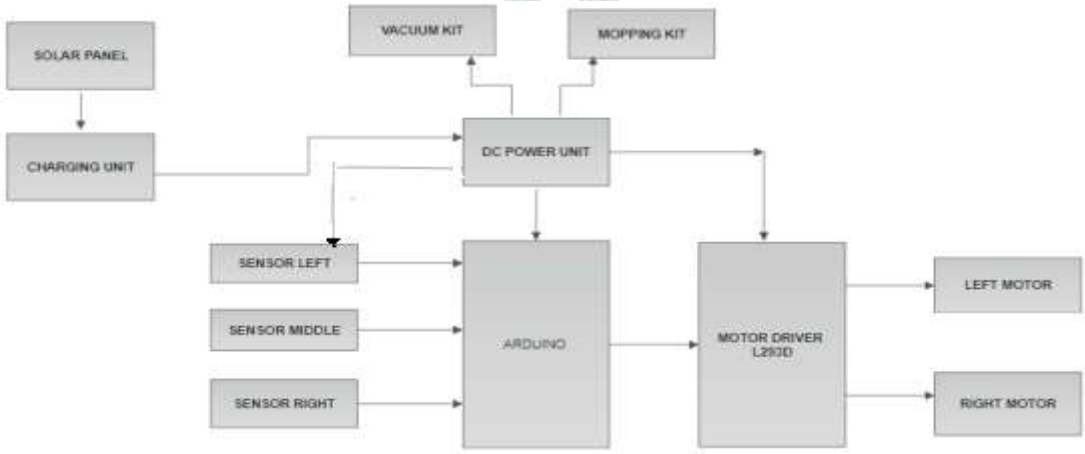


Fig.1 Block Diagram Of Vacuum Cleaning Robot in Automatic Mode

BLOCK DIAGRAM EXPLANATION:
ARDUINO UNO: Aurdino Uno is a single board microcontroller kit used for building devices that can interact and sense as well as control objects in this world.Arduino is used mainly in automatized devices.

MICROCONTROLLER: Microcontroller acts as brain for the robot as it takes important decisions.IT takes data from the Ultrasonic ranging module and IR sensors and analyse them. It processes the data and controls the movement of the robot by giving inputs to the motor driver.

Ultrasonic Sensors and Infrared Sensors are used in the proposed architecture.
ULTRASONIC SENSORS: Ultrasonic Sensors are the electronic devices that emits an acoustic wave that has frequency above the audible range.The distance between the sensor and the object is calculated by the time in which the echo is received after hitting the object.Ultrasonic sensors are used in many applications like generic distance measuring,parking assistance sensors,proximity alarms,medical ultrasounds etc.

INFRARED SENSORS:Infrared sensors are easy to implement and are used for obstacle detection,motion detection and various other applications. A pair of infrared sensors are used for the automatic operation of robot.When an obstacle comes in front of the robot, IR rays gets reflected on the obstacle and falls on IR sensor which turns the IR sensor high.

MOTOR DRIVER: The motor driver IC used is L293D. It can control the movement of two Dc motors simultaneously in any direction.L293D is a 16pin IC that consists of H-bridge which allows the voltage to flow in either direction i.e., the motors can move in clockwise or anti-clockwise direction.

ARDUINO BOARD

The main part of robot is Arduino.Arduino is an open source hardware and software company which manufactures single board microcontrollers for building interactive designs to sense and control objects in physical and digital world.Wide variety of microprocessors and microcontrollers are used in the manufacturing of arduino boards.A set of digital and analog input-output pins are provided for the board.The pins are interfaced to various expansion boards or other circuits.The boards feature serial communication interface that are used for loading programs from personal computers.C and C++ languages are used for programming the microcontrollers. Integrated Development Environment is provided by the Arduino.The Arduino Uno board is shown below:

III.DESCRIPTION

The design consideration of vacuum cleaner mainly relays on motors,sensors,batteries,vacuum kit and physical shape.Most of the vacuum cleaners available today are disk shaped.The main problem faced due to that is corners of the rooms are not cleaned accurately.The main objective of the proposed work is to improve the efficiency of cleaning mechanism. To ensure which, the shape of the front part of the robot is modified to rounded edges.Effective mobility of vacuum is provided by rounded edges and effective cleaning is provided by means of rectangular shape.To work in a normal environment the robot is made robust enough.The chassis is made of strong wood material which is light,rigid and is known for its resistance as well as toughness in order to provide electrical insulation.

L293D is a quadruple high-current half-H driver.Motor driver IC l23D is used to drive the two DC geared motors which are used as the robot base motors.L23D is used to provide bidirectional drive current of up to 600mA at voltages from 4.5V to 36V.

Microcontroller is the heart of the robot and is used for interfacing the robot.Microcontroller receives the data from the sensors,analyze it and takes decisions.It guides the motor driver as well as the other units to perform their intended task and it controls the complete functioning of the unit.

The ultrasonic ranging module and IR sensors are mounted on the right,left and in the middle of the robot.The sensors help in detecting the obstacle when moving in its desired path.

The crux of the proposed design is its vacuum kit meant for collecting the dust. An exhaust fan of 6V dc 0.25A is used in vacuum section incorporated with a dust collecting pipe in the front.Here conical shape is preferred to reduce the pressure near fan and to increase the pressure of absorbing the dust on floor.Two side brushes are provided in the front side of the robot for effective cleaning of the dust.

IV.DESIGN FLOW

The sequence of steps performed by the vacuum cleaning robot en-route is represented in the form of a flow chart as illustrated below:

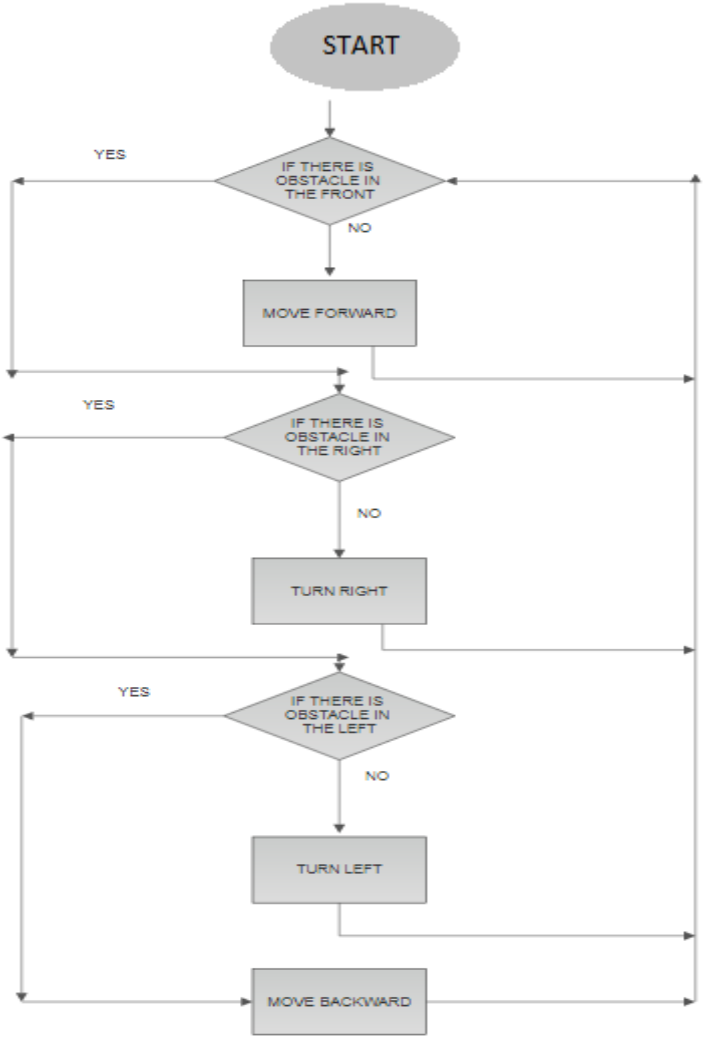


Fig 3: Flow chart of Vacuum Cleaning Robot in Automatic Mode

BLUETOOTH MODULE HC-05

HC-05 module is an easy to use Bluetooth SPP (Serial Port Protocol) module,designed for transparent wireless serial connection setup.The HC-05 Bluetooth Module can be used in a Master or Slave configuration, making it a great solution for wireless communication.This serial port bluetooth module is fully qualified Bluetooth V2.0+EDR (Enhanced Data Rate) 3Mbps Modulation with complete 2.4GHz radio transceiver and baseband. It uses CSR Bluecore 04-External single chip bluetooth system with CMOS technology and with AFH (Adaptive Frequency Hopping Feature).

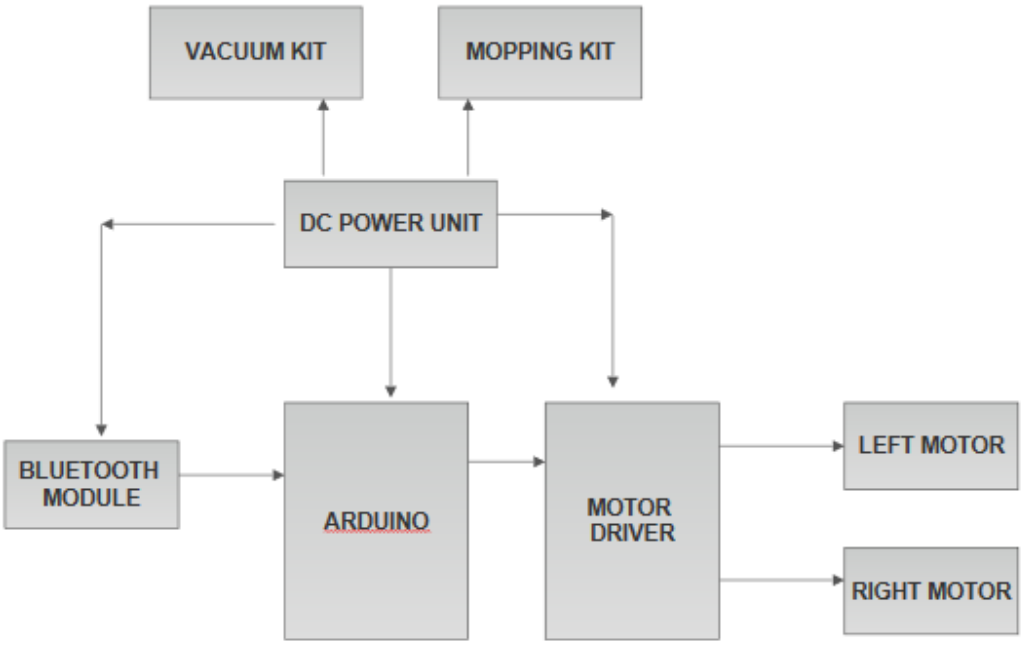


Fig 4: Block Diagram of vacuum cleaning robot in Bluetooth Controlled Mode

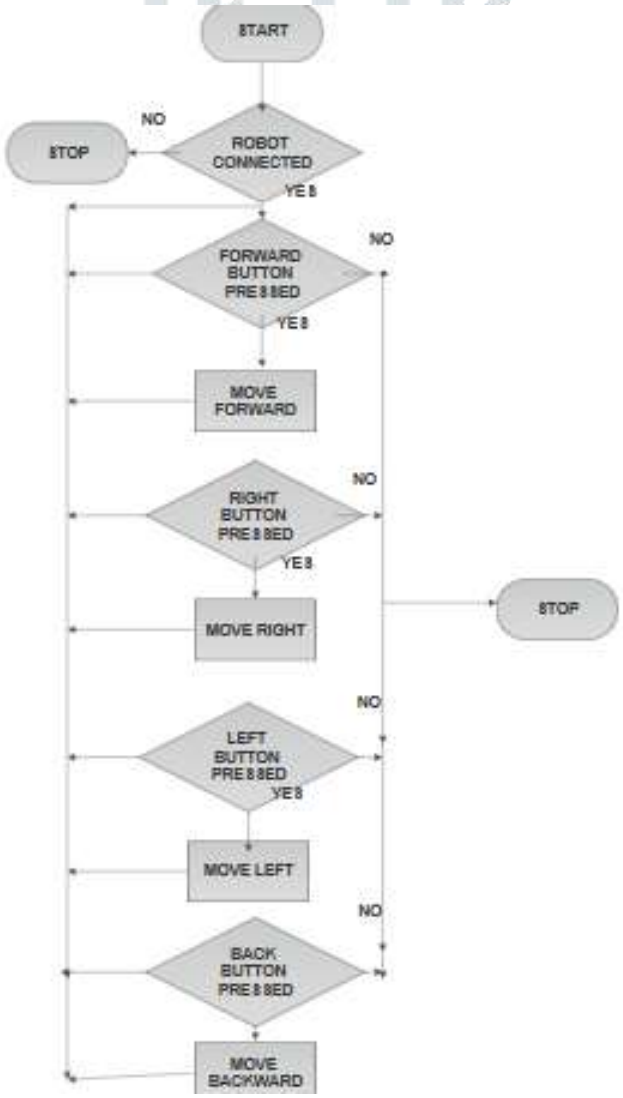


Fig 5: Design Flow Of vacuum cleaning robot in Bluetooth Controlled Mode

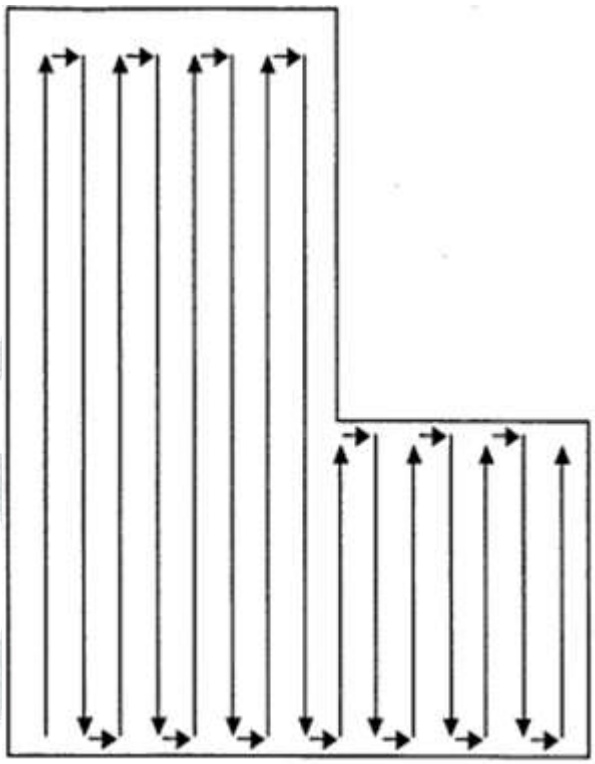
V.OPERATION

Immediately after switching on the proposed vacuum cleaning robot, 12V dc battery provides power to the arduino board. Ultrasonic Ranging module and IR sensors gives input to the arduino.The data from the front,left and right sensors is fed parallel to the arduino.When the IR sensor senses an obstacle its output changes from low to high.The obtained analog input is converted into binary and then into decimal and the movement of the robot is decided.

After switching on the dc power supply,the fan of the vacuum cleaner gets started.The brushes that are connected in front of the robot collects the dust as the robot moves forward.Simultaneously,the water from the water tank is sprinkled through the pipe at the rear end of the robot.The roller with mopping cloth mops the water sprinkled.

VI. ROBOTIC MOVEMENT AND ITS APPLICATIONS

- Proposed vacuum cleaning robot finds its applications in areas where dirt is accumulated like hospitals,restaurants,retirement homes etc.
- It also has its applications where human effort should be reduced.
- Further home automation is the domain in which vacuum cleaners are to be automatized.



VII.CONCLUSION

The proposed design concept helps in saving time and help disabled people and working women.The user can switch on the device and go for any other work to be performed.The robot will automatically detect the obstacles and clean the room in the defined path. Arduino can be used effectively for designing autonomous projects.It modifies and enhances the capabilities of the robot to explore new paths and work efficiently.

For effective movement of the robot around the cliff and boundaries of the room,IR sensors and Ultrasonic sensors are used.If we can give greater resolution to the sensors the entire room can be cleaned smoothly.

As the innovations proceed further new and effective ideas come into creation to improve the existing models adding new features. Some of the new features include addition of GSM module for sending messages over mobile phones indicating the cleaning status of robots, camera for navigation purposes and many others.The advent of all these ideas may lead to a great breakthrough in the modern robotic industry.

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