IoT Based Smart Floor Cleaning Robot

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Abstract: *Households of today are becoming smarter and more automated. Home automation delivers convenience and creates more time for people. Domestic robots are entering the homes and people's daily lives, but it is yet a relatively new and immature market. However, a growth is predicted and the adoption of domestic robots is evolving.*
In this proposed system, we have designed a iot based wireless floor cleaning robot with dual brush cleaning mechanism. The aim of this project work is to develop and modernized process for cleaning the floor; hence it is widely used in house, hospitals, shops, office, etc. This system is designed by using microcontroller, wifi module for wireless communication and ultrasonic sensor for obstacle detection and avoidance.

Keywords: Microcontroller, Node MCU, Motor driver, LCD screen, Brushes

I. INTRODUCTION

In present days, robotic cleaners have taken major attention in robotics research due to their effectiveness in assisting humans in floor cleaning applications at homes, hotels, restaurants, offices, hospitals, workshops, ware houses and universities etc. Basically, robotic cleaners are classified on their cleaning technique like floor mopping, dry vacuum cleaning, sweeping etc .some products are based on simple obstacle avoidance using infrared sensors while some utilize laser mapping technique. All cleaning and operating mechanism of robotic floor cleaners has its own advantages and disadvantages. For example, robots utilizing mapping are relatively faster, and energy efficient but costly, while obstacle avoidance based robots are relatively less time consuming and less energy efficient due to random cleaning. The main objective of this work is to fabricate a smart floor cleaning vehicle using iot based control.

IoT or internet of things is an upcoming technology that makes use of internet to control/monitor electronic/mechanical devices, automobiles and other physical devices connected to the internet. IOT gives user the ability to control and monitor more than digital things easily through a comfortable GUI over the internet. In this proposed system, we have designed a IoT based Wireless Floor Cleaning Robot with Dual Brush cleaning mechanism. The system uses 12V batteries to power the vehicle movement motors as well as the floor cleaning motor. We use a 12V Battery Charger to charge this battery. The Floor cleaning Motor and vehicle motors are interfaced to a Node MCU microcontroller unit that controls the working of all the motors. L293D Motor driver is used to drive 12V DC geared Motors.

Wi-Fi based internet connectivity is provided using ESP866 Wi-Fi Module

To control the Movement of the Robot, iot technology is used. User has to connect this Robot using iot based android Application. Communication between the robot and user is done using Wi-Fi Internet Connectivity. User can access and control the robot Movement wirelessly from anywhere in the world. He / She can control the Robot Movement Left / Right / Forward

/ Backward / Cleaning Brush-Control using this Application. Using this feature, user can clean any corner of the floor using this Application.

In this project Blynk app is used to control the movements of the bot. Blynk is a Platform with iot and Android apps to control Microcontroller,Arduino , Raspberry Pi and the likes over the Internet. It's a digital dashboard where you can build a

graphic interface for your project by simply dragging and dropping widgets. It's really simple to set everything up and you'll start tinkering in less than 5 mins.

Blynk is not tied to some specific board or shield. Instead, it's supporting hardware of your choice. Whether your arduino or Raspberry Pi is linked to the Internet over Wi-Fi, Ethernet or this new ESP8266 chip, Blynk will get you online and ready for the Internet of Your Things.
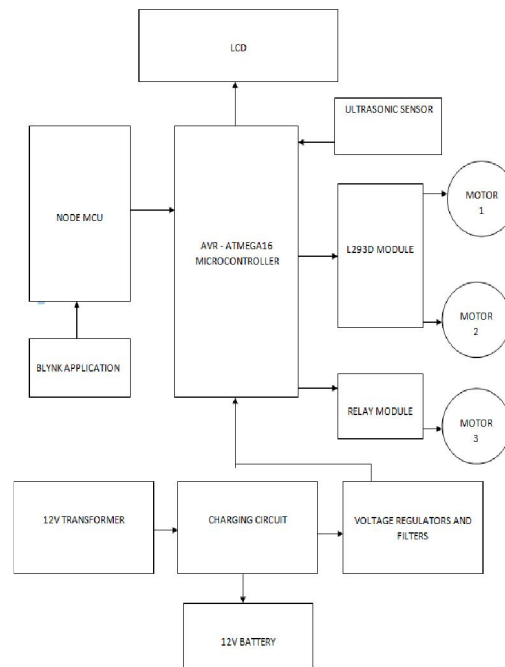
II   BLOCK DIAGRAM

Fig-1: Block diagram

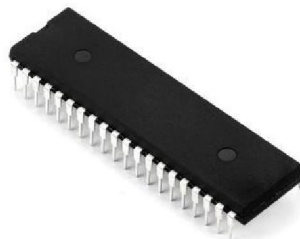## III. HARDWARE USED

Atmega16 Microcontroller

Fig-2: Atmega16 Microcontroller

Atmega16 is an 8-bit high performance microcontroller of Atmel's Mega AVR family with low power consumption. Atmega16 is based on enhanced RISC (Reduced Instruction Set Computing, Know more about RISC and CISC Architecture) architecture with 131 powerful instructions. Most of the instructions execute in one machine cycle. Atmega16 can work on a maximum frequency of 16MHz.

Atmega16 has 16 KB programmable flash memory, static RAM of 1 KB and EEPROM of 512 Bytes. The endurance cycle of flash memory and EEPROM is 10,000 and 100,000, respectively. Atmega16 is a 40pin microcontroller. There

are 32 I/O (input/output) lines which are divided into four 8-bit ports designated as PORTA, PORTB, PORTC and PORTD.

Atmega16 has various in-built peripherals like USART, ADC, Analog Comparator, SPI, JTAG etc. Each I/O pin has an alternative task related to in-built peripherals. The following table shows the pin description of Atmega16.

Node MCU

Fig-3: Node MCU

Node MCU is an open source LUA based firmware developed for ESP8266 wifi chip. By exploring functionality with ESP8266 chip, It supports serial communication protocols i.e. UART, SPI, I2C etc. Using such serial protocols we can connect it with serial devices like I2C enabled LCD display, Magnetometer HMC5883, MPU-6050 Gyro meter + Accelerometer, RTC chips, GPS modules, touch screen displays, SD cards etc.

Node MCU Development board is featured with wifi capability, analog pin, digital pins and serial communication protocols .To get start with using Node MCU for IoT applications first we need to know about how to write/download Node MCU firmware in Node MCU Development Boards. And before that where this Node MCU firmware will get as per our requirement .There is online Node MCU custom builds available using which we can easily get our custom Node MCU firmware as per our requirement.

Ultrasonic Sensor

Fig-4: Ultrasonic sensor

An ultrasonic transducer is a device that converts AC into ultrasound, as well as the reverse, sound into AC. In ultrasonics, the term typically refers to piezoelectric transducers or capacitive transducers. Piezoelectric crystals change size and shape when a voltage is applied; AC voltage makes them oscillate at the same frequency and produce ultrasonic sound .Capacitive transducers use electrostatic fields between a conductive diaphragm and a backing plate.

This economical sensor provides 2cm to 400cm of noncontact measurement functionality with a ranging accuracy that can reach up to 3mm. Each HCSR04 module includes an ultrasonic transmitter, a receiver and a control circuit. It can be used for avoiding obstacles as well as edge detection. In our project we have tested both the cases.
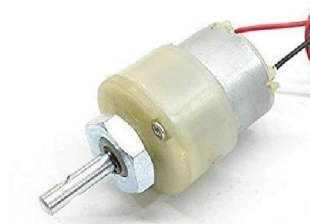
DC Geared Motor

Fig-5: Geared Motor

Geared dc motor can be defined an extension of DC motor. A geared DC motor has a gear assembly attached to the motor. The speed of the motor is counted in terms of rotations of the shaft per minute and is termed as RPM. The gear assembly helps in increasing the torque and reducing the speed. Using the correct combination of gear in a gear motor, its speed can be reduced to any desirable figure.

The working of the gears can be explained by the principle of conservation of angular momentum. The gear having smaller radius will cover more RPM than the one with larger radius. However, the larger gear will give more torque to the smaller gear than vice versa. The comparison of angular velocity between input gear (the one that transfers energy) to output gear gives the gear ratio. When multiple gears are connected together, conservation of energy is also followed. The direction in which the other gear rotates is always the opposite of the gear adjacent to it.

H-Bridge Motor driver

Fig-6: Motor Driver

A **H bridge** is an electronic circuit that enables a voltage to be applied across a load in either direction. These circuits are often used in robotics and other applications to allow DC motors to run forwards and backwards.

It works on the concept of H-bridge, a circuit which allows the high voltage to be flown in either direction. In a single L293D IC there two H-bridge circuit inside there it which can rotate two dc motor independently. Due to its size it is frequently used in robotic application for controlling DC motors.

LCD 2X16 Module

Fig-7: LCD Display

A liquid-crystal display (LCD) is a flat-panel display or other electronic visual display that uses the light-modulating properties of liquid crystals. Liquid crystals do not emit light directly. LCDs are used in a wide range of applications including computer monitors, televisions, instrument panels, aircraft cockpit displays, and signage. They are common in consumer devices such as DVD players, gaming devices, clocks, watches, calculators, and telephones, and have

replaced cathode ray tube (CRT) displays in nearly all applications. In this, it is used to display the status of the bot and it is also used to display the distance between the obstacle and bot with the help of Ultrasonic sensor

Brushes

Two brushes are fixed at the bottom of the bot and these brushes will rotate with the help of 2 motors of 100 rpm. When the motor is switched on, the brushes will rotate along the axis of rotation of motors

Blynk Application

Blynk application is used to control the bot by connecting it to the internet. It consists of controls for switching on/off for the rotating brushes and to move the bot towards the required direction.
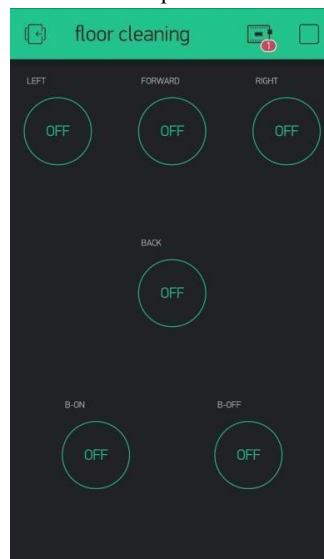

Fig-8: Blynk application overview

IV. RESULTS AND DISCUSSION

When the robot is turned on, the user can connect the robot to his phone through internet and control the robot as his choice. By operating the controls in the Blynk app, the user can move the bot to the required position for cleaning purpose. It was observed that the robot was quite efficient in its cleaning.
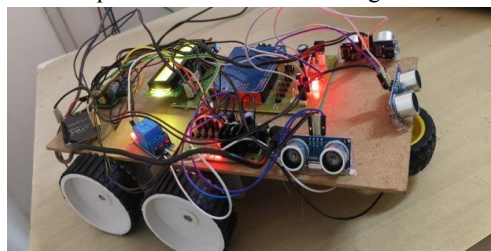

Fig-9: Top view of Floor cleaning robot

V. CONCLUSION

This research facilitates efficient floor cleaning. This proposed work provides the hurdle detection in case of any obstacle that comes in its way. User can operate this robot manually with the help of smartphone. It reduces the labor cost and saves time also and provides efficient cleaning.

Efficient & Smart Cleaning – Automates floor cleaning with IOT and sensors for better efficiency.

Convenience & Control – Enables remote monitoring and operation via a mobile app.

Future Potential – Can be enhanced with AI and advanced sensors for improved performance.

VI. FUTURE WORK

The additional features that may be added in this robot are by adding a camera we can operate this robot from anywhere as it is connected through IoT. And by implementing solar panel in the robot we can charge the battery using light energy which can enhance the robot to operate in power failure condition. By implementing the fuzzy logic in the cleaner robot we can enable artificial intelligence in cleaning.

- AI Integration – Smarter navigation and cleaning using machine learning.
- Self-Charging – Improved battery technology for automatic recharging.
- Advanced Sensors – Better obstacle detection and surface adaptability.
- Voice & App Control – Enhanced smart home integration with voice assistants.

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