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Floor Cleaning Robot Using Android App

Prof. Meenakshi Annamalai Mam, Sonali Ravindra Babar, Asmita Anand Yadav

Professor, Department of Electronics and Telecommunications, JSPM'S Bhivarabai Sawant Institute of Technology and Research Wagholi, Pune, Maharashtra, India

Student, Department of Electronics and Telecommunications, JSPM'S Bhivarabai Sawant Institute of Technology and Research Wagholi, Pune, Maharashtra, India

Student, Department of Electronics and Telecommunications, JSPM'S Bhivarabai Sawant Institute of Technology and Research Wagholi, Pune, Maharashtra, India

ABSTRACT: Households of today are becoming smarter and more automated. Home automa- tion 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 im- mature market. However, a growth is predicted and the adoption of domestic robots is evolving. Several robotic vacuum cleaners are available on the market but only few ones implement wet cleaning of floors. The purpose of this project is to design and implement a Floor Cleaner Robot Autonomous and Manual via Phone Application. Floor Cleaning Robot is designed to make cleaning process become easier rather than by using manual vacuum. The main objective of this project is to design and implement a floor clean robot prototype by using, Node MCU, DC Motor, Relay, LDR Sensor, Real Time Clock, Motor Shield L293D, Ultrasonic Sensor, and IR Sensor and to achieve the goal of this project.

KEYWORDS: Calculate Obstacles distance, Node MCU, Bluetooth

I. INTRODUCTION

Robots are smart machines that can be programmed and used in many areas such as manufacturing, industry, production lines, or health, etc. These robots per- forms hard, dangerous, and accurate work to facilitate our life and to increase the production because they can work 24 hours without rest, and performs like human but more precisely and with less amount of time. Assistive mobile robots that per- form different kinds of work over everyday activities in many areas such as industry, product lines, manufacturing, or health, etc are very commonly used to improve our life. The idea behind this research is to exploit robotics usage in household work. A Smartphone is a mobile phone built on a mobile computing platform, which has more advanced connectivity and computing ability than what a feature phone has. Smartphone's are a more efficient and affordable hand held devices which can be used to support collaborative activities in a community. It is a result of a huge and remarkable advancement in the field of mobile phones technology. Human beings are anxiously working on finding new ways of interacting with machines. Floor cleaner is designed to make cleaning process become easier for human task. This project is a combination of hardware and software which has microcontroller, mo- tor shield, sensor, an android application and finally a Bluetooth module via which the hardware connects the software. Smartphone, a small yet powerful device is rapidly changing its traditional ways of human-machine interaction. Android plat- form brought a big revolution in the field of application development for cell phones, opening for technical exploration. The Android Smartphone can be freely rotated in space, temporarily varying 3D signal data is obtained from the phone's 3-axis accel- eration sensor. This data is transmitted via Bluetooth module of Smartphone using an android app to the robot. Further, this data is processed by a microcontroller em- bedded on the robot to perform desirable motions. In this context, a robot is similar to any machine that is controlled by man varying from a simple toy to heavy ma- chinery. Robots have replaced humans in performing various tasks that human are unable to perform due to physical disability, extreme environments or size limita- tion. Smartphone's have proved to be of much more aid than being a device just for making calls.

II. THE RESEARCH METHOD

Vidyashree, T.S., Bindushree, V., Rao, S. and Gowra, P.S., 2021." Smart Vacuum Cleaner".Global Transitions Proceedings, 2020.

Roshan, D., Bhosle, O., Bhosale, G., Borse, A. and Bandsode, T., 2020. "Blue- tooth Operated Vacuum and Floor Cleaner using Android Mobile."

III. THE REFLECTIVE PROCESS

The RC car is designed. The motor is fitted, motors are attached with wheels. Motors are soldered with wires–positive and negative. RC car is built by using 2 DC motors they run with the speed provided in Arduino IDE code, it uses motor shield to work in desired speed and direction. Ultrasonic sensor attached to RC car detects the distance at which obstacle is present in front of it. So, whenever it encounters any obstacles such as walls, tables, chair or any big things that cannot be consider
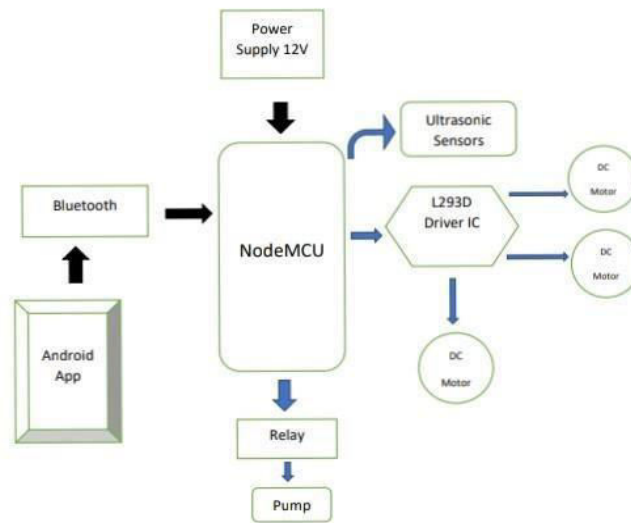

Figure 1. Basic Block Diagram

as garbage or dust, RC car which carries vacuum cleaner changes its direction so that it won't crash and destroy itself. The code fed to the Node MCU runs continuously and the cycle repeats in regular intervals whenever the obstacle is detected.

- **Node MCU**: The microcontroller used in proposed model is Node MCU. It is a open Source Platform for developing electronics projects. It uses ESP8266-12E as a main controller, which is a high integration wireless SOC(System on Chip).
- **Bluetooth:** Bluetooth is a wireless communication protocol running at the speed of 2.4 GHz with the architecture of client-server and which is suitable for forming personal area networks. Bluetooth gives the connectivity between two devices using their MAC address.
- **L239D :** A very easy and safe is to use popular L293D chip. When the enable input is low, those drivers are disabled, and their outputs are off and in the high-impedance state. With the proper data inputs, each pair of drivers forms a full-H (or bridge) reversible drive suitable for solenoid or motor applications.
- **DC Motor :** A DC Motor is a motor where by direct current electrical power is converted into mechanical power. Most often, this type of motor relies on forces that magnetic field produce. Proposed robot is designed with two DC motors to operate in forward and backward direction.

IV. SYSTEM DEVELOPEMENT

HARDWARE DESCRIPTION
1. **Node MCU**
Node MCU is a low-cost open source IOT platform. It initially included firmware which runs on the ESP8266 Wi-Fi SOC from Espressif System and Hardware which was based on the ESP-12 module. Later, Support for the ESP32 32-bit MCU was added.
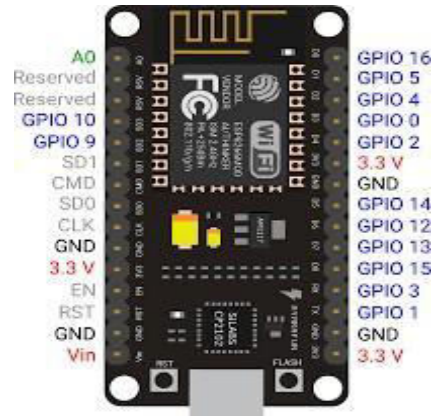
Figure 2:Node MCU

2.Ultrasonic Sensor

An ultrasonic sensor is an instrument that measures the distance to an object using ultrasonic sound waves. An ultrasonic sensor uses a transducer to send and receive ultrasonic pulses that relay back information about an object's proximity. 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

Figure 3: Ultrsonic Sensors

3.Motor Driver (L293D)

It utilizes a maximum peak motor current of 1.2A. A maximum continuous motor current of 600mA is required. The range of supply voltage is 4.5V to 7V. The L293D is a 16-pin Motor Driver IC which can control a set of two DC motors simultaneously in any direction. The L293D is designed to provide bidirectional drive currents of up to 600 mA (per channel) at voltages from 4.5 V to 36 V (at pin 8!)
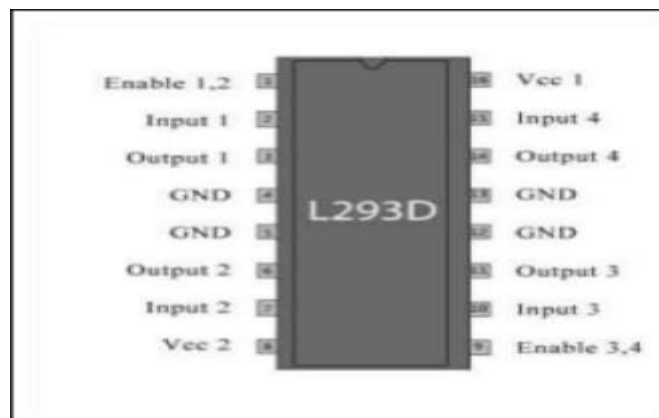

Figure 4: Pin Diagram(L293D)

4.Bluetooth device (HC05)

Used in wireless communication for a range of about 100m. Modulation used is GFSK and uses FHSS technology to send data serially. It uses a power supply of 3.3V to 5V. It is used in a master slave configuration. Bluetooth serial modules allow all serial enabled devices to communicate with each other using Bluetooth.
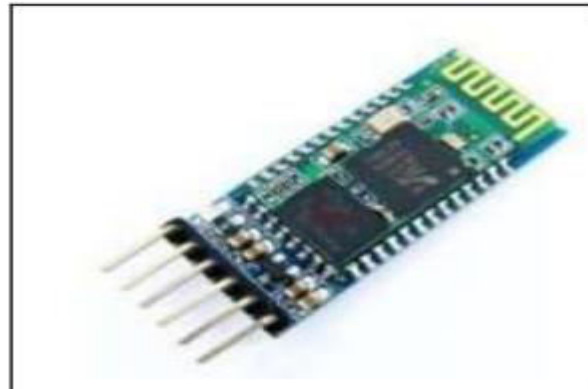

Figure 5: Bluetooth Device(HC05)

5. Power Supply

The power supply is the first and most important part of our project. For our project, we require a +5v regulated power supply with a maximum current rating of 500mA. The 1000µF capacitor serves as a "reservoir" which maintains a reasonable input voltage to the 7805 throughout the entire cycle of the AC line voltage. The 10µF and.01µF serve to keep the power supply voltage constant when load condition changes. However, at high frequencies, this capacitor is not very efficient therefore the .01µF is included to bypass high-frequency changes such as digital IC switching effects, to ground. The ac voltage,
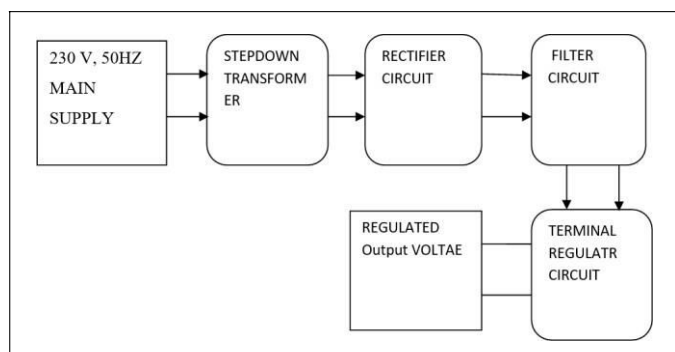

Figure 6: Power Supply

 typically 220V, is connected to a transformer, which steps down that ac voltage down to the level of the desired dc output. A diode rectifier then provides a full-wave rectified voltage that is initially filtered by a simple capacitor filter to produce a dc voltage. This resulting dc voltage usually has some ripple or ac voltage variation. A regulator circuit removes the ripples and also retains the same dc value even if the input dc voltage varies, or the load connected to the output dc voltage changes.

SOFTWARE DEVELOPMENT

1. OPERATING SYSTEM : Microsoft Windows 7 and Above

Microsoft Windows, also called Windows and Windows OS, computer operating system (OS) developed by Microsoft Corporation to run personal computers (PCs). Featuring the first graphical user interface (GUI) for IBM-compatible PCs, the Windows OS soon dominated the PC market. Approximately 90 percent of PCs run some version of Windows.

2 JDK

(Java Development Kit) A Java software development environment from Oracle. It includes the JVM, compiler, debugger and other tools for developing Java applets and applications. Each new version of the JDK adds features and enhancements to the language.The JDK includes tools useful for developing and testing programs written in the Java programming language and running on the Java platform.

Figure 7: JDK (Java Platform)

3 IDE : ARDUINO

The Arduino Integrated Development Environment (IDE) is a cross-platform application (for Windows, macOS, Linux) that is written in functions from C and C++. It is used to write and upload programs to Arduino compatible boards, but also, with the help of third-party cores, other vendor development boards. User-written code only requires two basic functions, for starting the sketch and the main program loop, that are compiled and linked with a program stub main() into an executable cyclic executive program with the GNU toolchain, also included with the IDE distribution.The Arduino IDE employs the program avrdude to convert the executable code into a text file in hexadecimal encoding that is loaded into the Arduino board by a loader program in the board's firmware.
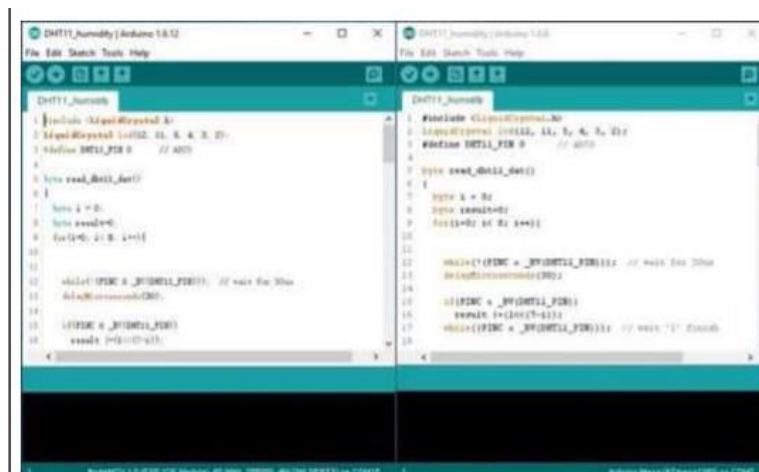

Figure 8 : Ardunio IDE

OPERATIONAL DETAILS
Algorithm

KNN: K nearest neighbors is a simple algorithm that stores all available cases and classifies new cases based on a similarity measure (e.g., distance functions). KNN has been used in statistical estimation and pattern recognition already in the begin- ning of 1970's as a non-parametric technique.
- Determine parameter K= number of neares t neighbor.

- Calculate the distance between the query-instance and all training sample.
- Sort the distance and determine nearest neighbor based on the k-th minimum distance.
- Gather the category of the nearest neighbor.
- Use simple majority of the category of nearest neighbors as prediction value of the query instance.

KNN Pseudo code

kNN (dataset, sample)

1. Go through each item in my dataset, and calculate the "distance" from that data item to my specific sample.
2. Classify the sample as the majority class between K samples in the dataset having minimum distance to the sample.
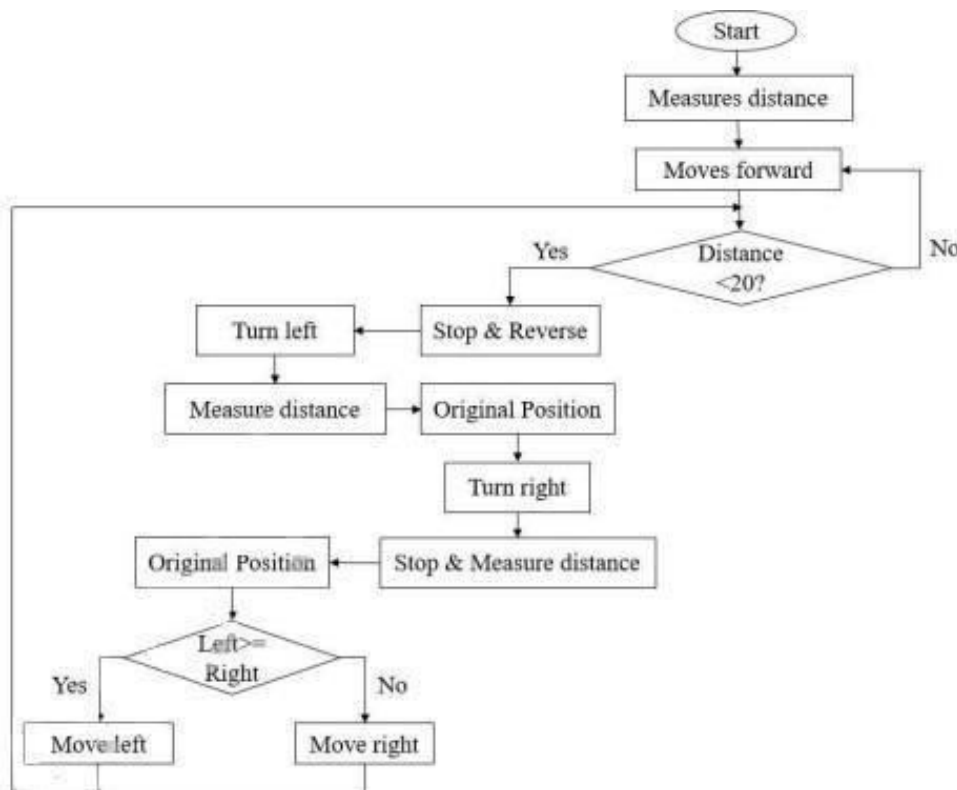
Flowchart

Figure: Robot Path

V. CONCLUSIONS

In this project Floor Cleaning Robot has been implemented. It was works on a pre-defined code inserted in Node MCU. Whenever RC car encounters any obstacle, it turns to the side where the distance between obstacle and car is more. The System consists of transmitter App.

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1.Vidyashree, T.S., Bindushree, V., Rao, S. and Gowra, P.S., 2021." Smart Vacuum Cleaner".Global Transitions Proceedings. RC car which is embedded with a vacuum cleaner is used. This system has an ultrasonic sensor attached to it, that helps in avoiding large obstacles such as tables, chairs, walls etc.[1]

2. Roshan, D., Bhosle, O., Bhosale, G., Borse, A. and Bandsode, T., 2020. "Blue- tooth Operated Vacuum and Floor Cleaner using Android Mobile."The aim of this project work is to design and develop process for cleaning the floor

having wet and dry surfaces. It is very useful for cleaning the wet as well as dry floor   having wet and dry surfaces. It is very useful for cleaning the wet as well as dry floors. [2]

3. Murdan, A.P. and Ramkissoon, P.K., 2020, November. A smart autonomous floor cleaner with an Android-based controller.The user has complete control over the robot either in the autonomous or remote-controlled mode. The implemented cleaning system consists of five main blocks namely the power block (rechargeable dc battery), the motor sys- tem (driving wheels, rotating brush, vacuum fan, water pump), communica- tion block (Bluetooth control, HC 06 Bluetooth module) and software block (Android remote controlled). Upon the implementation and testing of this pro- totype, it was observed that the robot works as programmed, and is equipped with most of the functionalities of a household commercial state-of-art clean- ing robot.[3]

4. Das, N.R., Daga, R., Avte, S. and Mhatre, K., 2019. Robotic automated floor cleaner.

Automated machine cleaners are pivotal in the modern era for modern living due to its elective lowering of the labor cost of a human being, saving both time and money. Most of these cleaners are designed purposely to satisfy the special need of the consumers. The project is a collaboration of Mechanical, Electrical and Electronic streams and employs devices and systems of these fields. It is an assembly of various rigid components like chassis, some motors and various electromechanical devices. Our motive is to present a working model of a cleaning machine which will be used in a household with minimum utilization of the resources available with us.[4]

5. Iwan Ulrich, Francesco Mondada, J D Nicoud "Autonomous Vacuum Cleaner" Robotics and Autonomous systems, In "Autonomous Vacuum Cleaner" (Robotics And Autonomous Systems) by Iwan Ulrich the Authors talk about broad topics which include Selection of shape of robot, selection of Cleaning mechanisms, Sensor systems and map- ping of obstacles using these Sensors. In this paper their Robot relies on the 54 tactile sensors placed on the robot and the area they are trying to clean have uncertain extent and obstacles. So they have assumed only four kinds of ob- stacles (wall, legs, concave and convex corners) for programming purposes. They have also considered the type of vacuum cleaner that needs to be used based upon the power supply available. Navigation is explained in terms of obstacle identification, hypothesis and map creation. [5]

6. T.B. Asafa, T.M. Afonja, E.A. Olaniyan, H.O. Alade "Development of a Vac- uum Cleaner Robot"

The paper "Development of a Vacuum Cleaner Robot" (Alexandria Engineer- ing Journal) by T.B. Asafa gives us information about the characteristics that need to be considered while developing the robot. It gives us an idea about the considerations taken in order to design the aspects like Geometry, sweeper position, Dustbin size, cooling provisions, Electrical equipment, Controllers, Chassis and sensors. [6]

7. Raj Vishaal, Raghavan P., Rajesh R., Sachin Micheal, Mohan Rajesh Elara "Design of Dual Purpose Cleaning Robot".The paper "Design of Dual Purpose Cleaning Robot" (International Confer- ence on Robotics and Smart Manufacturing) by Raj Vishaal gives information about the design of a dual purpose cleaning Robot which can be used for clean- ing walls as well as the floor. The author also gives information about Electric Ducted Fan and how it is used in Adhering the robot to the glass walls. The floor cleaning system is manually controlled using Bluetooth signals from a Smartphone while the wall cleaning is carried out automatically. The robot has been designed in two parts namely the base module and the cleaning mod- ule. These two are attached by the supporting ropes. [7]

8. Vatsal Shah"Floor Cleaning Robot with Mobile-App or Autonomous"

The paper "Floor Cleaning Robot with Mobile-App or Autonomous" by Vatsal Shah deals with the research and development of Manual Phone application controlled as well as fully autonomous Robot. It highlights the key parameters that need to be taken into consideration while designing the robot like Obstacle avoidance, Floor detection, Collision.

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📱 9940 572 462   🟢 6381 907 438   ✉ ijircce@gmail.com

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