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Smart Floor Cleaner using Mobile Application

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Abstract - Automatic floor cleaner is a compact robotics system which provides floor cleaning service in room and big corporate spaces reducing human labor. Basically, as a robot it eliminates human error and provides cleaning activity with much more efficiency. If floor is cleaned manually then there is a possibility that the operator will leave some portion of the floor. Also, due to manual labor involved, floor cleaning becomes time consuming and irritating. Additionally, human errors, leaves by labor may affect the continuity of task. In big corporate places, floor area is very huge, and the people involved there for cleaning purpose cannot clean it with high efficiency. This is where the robot comes as an advantage. The robot is small and compact in size making it easy to carry and place wherever in the house. In industries the robot is very cost effective as compared to manual labor involved. The flexibility, time saving capability and efficiency makes the robot a good choice for cleaning the floor. Along with ease, functionality is also taken into account of. Enabling an app extension to the robot, the user gets access to features such as direction control and potential of many more, as demonstrated in this project.

Key Words: Smart Floor Cleaner, ESP8266, Vacuum Cleaner, IoT, Wi-Fi, Controlled motion

1. INTRODUCTION

In the present-day scenario, people are so busy with their work that they don't have the time for cleaning their house properly. The solution to the problem is very simple. You just need to buy a domestic vacuum cleaner robot which will clean your house with the press of a button. But such commercial products share one common issue, which is cost. So, a simple **Floor Cleaning Robot,** which is not only simple to make but costs less compared to commercial products available in the market can be considered. The proposed **Vacuum Cleaner** will be compact and more practical. On top of that, this robot will have an ultrasonic sensor and Wi-Fi module. The ultrasonic sensor will allow the robot to avoid obstacles so that it can move freely until the room is properly cleaned. The structure of the robot is made as such to provide maximum reach of flooring space. Considering the basic key features, the aim is to bring about technological development in yet another way. Using android app will make the device to operate in a portable way and in well controlled manner.

Further part of paper is organized as Section 2. Literature Survey then Section 3. System Architecture with flowchart, execution pattern for motors and simulation details. Later System Implementation is elaborated in Section 4. After that paper concludes with Section 5.

2. LITERATURE SURVEY

[1] Automatic floor cleaner: This project presents the design, development and fabrication of prototype automatic floor cleaner. The mechanical design of robot including vacuum cleaning mechanism, phenol tank, DC fan, pick and place etc. The main objective of this project is to provide a substantial solution to the problem of manufacturing robotic cleaner utilizing local.

[2] Smart floor cleaning robot: Subject robot operates in autonomous mode as well as in manual mode along with additional features like scheduling for specific time and bag less dirt container with auto-dirt disposal mechanism. This work can be very useful in improving life style of mankind.

[3] Automatic floor cleaning robot: This robot makes floor cleaning process easy and fast utilizing a wireless robotic cleaning system. This wireless system consists of a micro controller application which allows the robot to follow its logic programmed in its micro controller. The proposed robot consists of Arduino controller which has twelve digital input/output pins, cleaner with vacuum pump for efficient cleaning.

[4] Service Robots in the Domestic Environment- a Study of the Roomba Vacuum in the Home: This paper presents ethnographic research on the actual use of these products, to provide a grounded understanding of how design can influence human-robot interaction in the home.

From this Literature it can be concluded that the project needs to be more controlled and it has huge demand in the market. Further section will explain the working architecture of system.

3. SYSTEM ARCHITECTURE

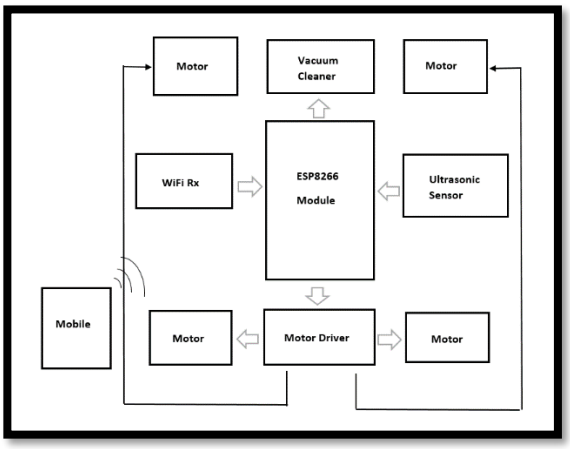

Fig -1: Basic System Architecture

The architecture as shown in Figure 1 consists of an ESP8266 module serving as the main controlling unit to which the peripherals are connected. The peripherals consist of motor driver which is used to drive the chassis. The Ultrasonic sensor is used to detect obstacles on the basis of which the robot navigates. The main cleaning mechanism consists of a vacuum cleaner which on movement of the robot cleans the immediate area surrounding it. A go to feature consists of app enabled access wherein the mobile phone can be directly connected to the ESP8266 module and the components attached enabling them to be controlled with just a tap.

The ESP8266 Wi-Fi module is system on chip integrated with TCP/IP protocol stack that can give any microcontroller access to Wi-Fi network. An ultrasonic sensor transmits ultrasonic waves into the air and detects reflected waves from an object. The ultrasonic sensor will help prevent the model from getting damaged by avoiding any obstacles around it. An android app can be installed on mobile through which the device can be controlled properly.

With reference to other researches made on the topic variations can be seen in terms of the implementation.

- Certain projects have made use of Arduino Uno or Nano but in this case ESP8266 has been used considering the ease of Wi-Fi integration.
- With respect to the above point there is no need of a separate module(s) for connection over the internet or with that of mobile.
- Instead of Bluetooth module, Wi-Fi module has been used for higher range.
- Motor driver used here is L298N. Other's such as L293D can also be used.
- The shape of the chassis may vary according to the requirement.
- Certain cleaning mechanisms may be included in place of or alongside a vacuum.

The articles referred [5]-[17] helps to get the appropriate knowledge and motivation for the project work. Making it smart through Wi-Fi Module is one of such outcome.

Flowchart

The following Figure 2 represents the flow of execution of tasks.

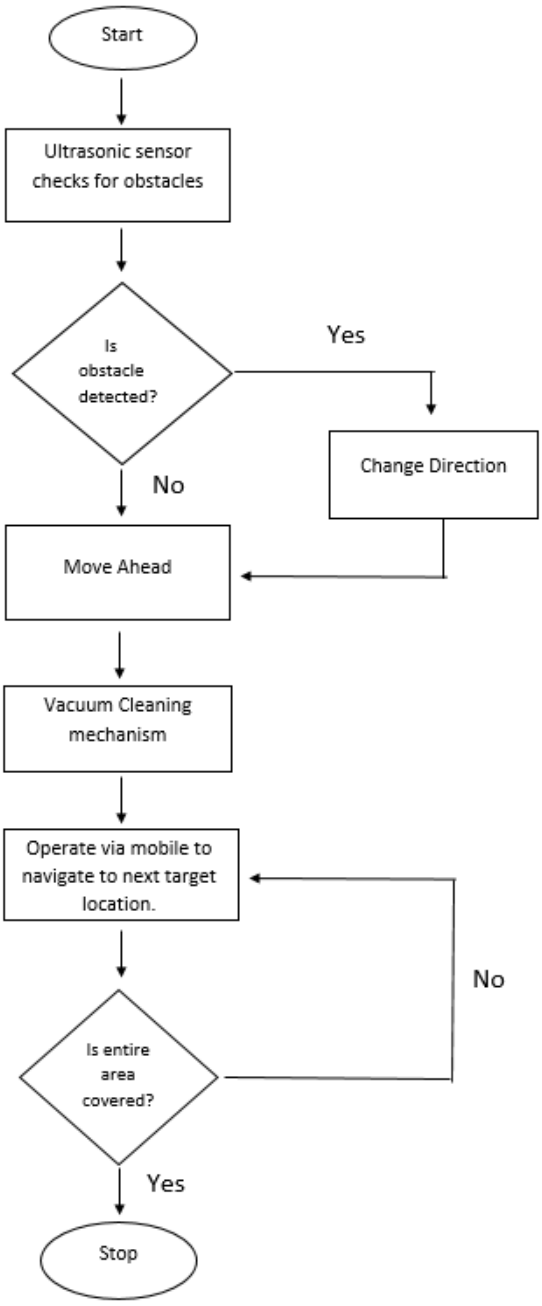

Fig -2: Flowchart

The Ultrasonic sensor checks for any obstacles. If detected, the robot stops or changes its direction. If no obstacles are present, the robot moves forwards and vacuums the floor space. The robot is navigated until the entire intended floor space is cleaned after which the activity stops.

Execution pattern for motors

Movement	M1	M2	M3	M4
Forward	1	0	0	1
Backward	0	1	1	0
Right	1	0	1	0
Left	0	1	0	1
Stop	0	0	0	0

Table -1: Motion of motors

The following Table 1 represents the logic states of the inputs given to the motors. Based on these inputs, the wheels attached rotate determining the direction of motion of the robot.

Simulation

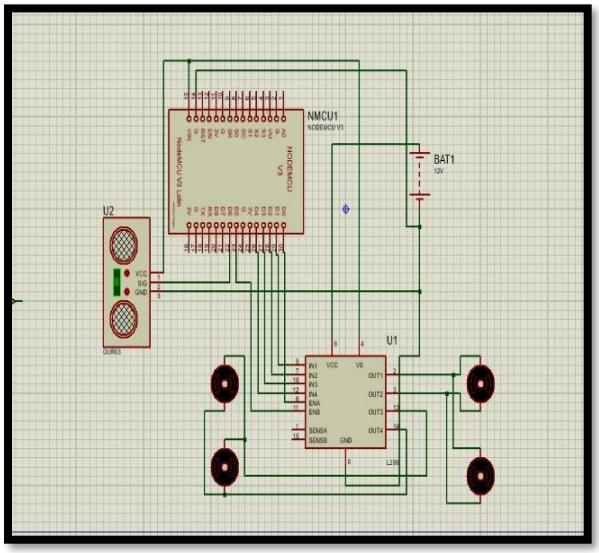

Fig -3: System Simulation

Figure 3 shows a representation of the simulation platform. The design has been simulated using the Proteus software to ensure proper operation of the floor cleaning robot.

ESP2866 is a Wi-Fi module using which internet connection is established. Ultrasonic sensor is connected to ESP using D6 pin. It is used to detect obstacles.

Pins D0 and D5 of ESP are connected to enable A & B of motor driver respectively. The inputs of L298N motor driver is connected to D1-D4 data pins of the ESP. The motors are connected to output of motor driver, which controls the direction of rotation of motors. PWM is applied for speed control. By varying the inputs given to the pins the movement of the robot can be determined. An external battery source powers the module.

4. SYSTEM IMPLEMENTATION

The images showcase the demonstration of the cleaning mechanism.

Fig -4: Floor before being vacuumed

In Figure 4 the robot has been positioned in the area where the floor is to be cleaned. The vacuum head is positioned just above the waste particles which then get sucked inwards.

Fig -5: Floor after being vacuumed

In Figure 5 the floor has been cleaned. The robot will then be positioned to the next floor space to be cleaned. The robot can be controlled via the mobile phone in a similar manner.

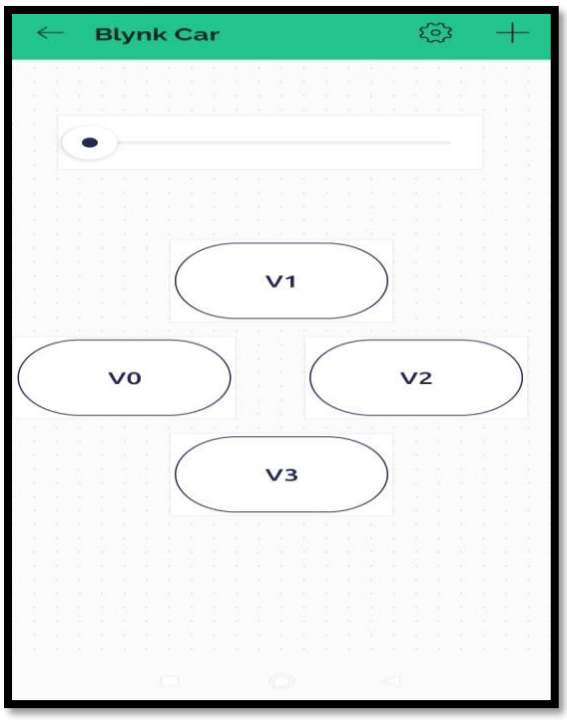

Fig -6: App controlled functionalities

Blynk is an IoT platform for iOS or Android smartphones that is used to control Arduino, Raspberry Pi and NodeMCU via the Internet. It is open source hence making it widely used. This application is used to create a graphical interface or human machine interface by compiling and providing the appropriate address on the available widgets.

It can control hardware remotely, display sensor data, store data and visualize it. In Figure 6, V0, V1, V2 & V3 are virtual pins that control the motion of bot. They move the bot front, right, down & left respectively. The speed bar allows us to change the speed of the robot by PWM.

Servers relay the signals and commands to and fro the edge device and the mobile devices. Protocols like HTTP and MQTT are provided which are more secure. Different programming languages are supported by this app like Python, C, C++, Java, Kotlin and Ruby.

The app provides a wide range of widgets. This project can be further developed for vacuum suction process which can also be controlled through BLYNK app along with water mopping system.

5. CONCLUSION

The paper shows an overview of the design and implementation of a controlled vacuum cleaning mechanism. Various types of technology have been created to facilitate human activities in their work every day. This proposed floor cleaning machine reduces the time and cost of labour. Floor cleaning process can be done in an easier and more efficient manner by this machine. The machine will identify the obstacles and avoid collision. The areas which usually remain unclean will be cleaned by this device by collecting the particles. It provides a newer approach to the daily essential task and a means of modernized living. The audience pertaining to it is large consisting of people of various backgrounds and age groups.

6. FUTURE SCOPE

This proposed floor cleaning machine can be extended vastly to all big or small-scale companies in addition or replacement to office staff. Floor cleaning process can not only be used for day-to-day cleaning but also in ease of cleaning during parties or gatherings.

The cleaning mechanism can also be extended with a mopping mechanism. Niche areas can be targeted more effectively.

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