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Automated Vacuum Cleaner Robotic System

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Abstract: In today's society, every human living in the family is preoccupied with their jobs and may not have enough time to clean the house. This project presents the outcomes of developing an autonomous intelligent robot vacuum cleaner based on some new concepts in this field during the previous semester approaching artificial life like time management and workability. Other work is based on designing and analyzing some code and sensors for the development of the Internet of Things (IoT) using innovative technology, including smartphones. To bottom-up methodologies were used to design the entire vacuum robot, from the robot's structure to the sensors and electronic components to the software pairing with hardware design procedure, including the proposed design or blueprint. The development of the robot begins with the creation of a simple and effective chassis for the robot, where the robot's body used the electronics parts such as the microcontroller, motor drivers, wheels, and other electronic components on the robot. Then this is followed by the assembly of the components, which includes testing and calibrating the prototype. Its purpose is to make the robot affordable and feasible for the middle-class society. For instance, the developed robot will be helpful in residential applications as well as industries. This aids in keeping the workspace and house clean without the need for physical labor, and also using our gadgets like smartphones will clean the room with a single button press for the convenience of the device itself [1].

Keywords: Autonomous Smart Robot, Internet Of Things, Vacuum Robot, ESP8266

1. Introduction

Automated Vacuum Cleaner Robotic System is designed to make our daily life as a human easier by automating all of the everyday household duties [2]. Consequently, floor cleaning is a well-known residential home chore that is often regarded as unpleasant, demanding, including tedious [3]. As our

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final year project, we opted to design and build a robot capable of vacuuming the floor of a room or area with no human input other than the unit's first start [3]. We saw a need for a low-cost, handy solution that can vacuum a room on its own, leading to saving the time used by certain people [2].

The robot vacuum cleaner operation is selected according to a random path around an area, which is given enough time that will conceivably cover the whole area of the room [3]. However, the robot is programmed to drive straight until it encounters a barrier or different path. At that moment, it will turn and run straight until another impediment is encountered [3]. Nevertheless, there is a lot of the primary purpose in our final year project that comes with various implementations. The points are to create a working prototype that is a Mini-Robot Cleaner and examine how sensors and code can be constructed to achieve decent vacuum cleaner functions [4]. Moreover, due to their effectiveness in assisting humans in floor cleaning applications at homes, hotels, restaurants, offices, hospitals, workshops, warehouses, universities, and other places [5]. With this justify, automated vacuum robotic cleaners have drawn tremendous attention in robotic research [5].

1.1 Project Background

As time passes, households become more innovative and more automated. Home automation provides convenience while also creating more opportunities for people. Because most people are so busy handling their children for online classes and working from home in this day and age, a robotic vacuum will assist them in maintaining intelligent programming, and a limited vacuum floor cleaning system provides house cleanliness. As a result, automation is an effective solution. The autonomous floor-cleaning robot uses the Internet of Things (IoT) and Arduino Uno programming language to operate the system. The Ultra-Sonic sensor is the most crucial component for an autonomous floor because it will move around independently and serves as the Automatic Vacuum's eye. The Ultra-Sonic sensor can be used to turn a robot by sensing an obstacle or a wall. The Arduino Uno programming controls the robot's sensing distance range and zigzag movement. Lastly, the vacuum cleaner and obstacle detector sensors will be integrated and controlled by a remote or mobile phone, which helps clean our home.

1.2 Problem Statement

In the beginning, when the emerging technology IoT is considered, the existing technology is ineffective [6]. Ultra-Sonic Sensors, Relay IS09002, and NodeMCU ESP8266 from the Internet of Things (IoT), we can ensure that efficient waste disposal is around 80% success [6]. So, to get this thing to move smoothly, we have to look upon the problem occurring that affects our daily life. This robotic system can solve the problem of owners who cannot take the time to clean and ensure the quality of floor cleanliness ideally. Users can also schedule the vacuum to operate on specified days or set times to ensure the floor can be cleaned regularly.

Additionally, it can make inadequate for people who suffer from movement difficulties. As an illustration, cleanliness is essential for everyone, but it is significant for someone who has difficulty moving. A moving robot vacuum can freely pass through every corner of the room space to clean the room more efficiently. Ultimately, this may be the best help for those who have mobility problems or need special needs in their lives.

2. Materials and Methods

This chapter will go over everything we need to know about the hardware. This chapter will discuss all the things we need to know about hardware includes techniques, materials, hardware, tools, and

project progress. Our group observed terms of the current system's features, limitations, and strengths. We must use existing systems as a basis for designing much more secure and high-quality systems.

2.1 Materials

Arduino Nano, Ultrasonic sensor, NodeMCU ESP8266, L298N Motor Driver, 5V DC Relay 1 Channel, Switch SPST, and other materials are used in our project. In addition, we use other resources such as the internet, journals, and Google Scholar. Apart from that, the Blynk application, Arduino IDE software, and Proteus software are used in this project to create our schematic diagram on it.

1. First, an ultrasonic sensor is an electronic device that uses ultrasonic sound waves to detect the distance between a target item and transforms the reflected sound through an electrical signal. An ultrasonic sensor capable of measuring the distance from the ground at specified places on a motor vehicle.

2. The L298 Dual H-Bridge Motor Driver Integrated Circuit is the basis for this dual bidirectional motor driver. The circuit will allow you to control two motors in both directions with ease and independence. It is suitable for robotic applications and is ideally suited for connection to a microcontroller component, with only a few control lines required per motor. It may also link to basic manual switches, TTL logic gates, relays, and other devices. This board is outfitted with power LED indications, a +5V regulator on-board, and protective diodes.

3. The module is mostly based on the NodeMCU ESP8266, a low-cost Wi-Fi microprocessor that includes both a full TCP/IP stack and a microcontroller. Espressif Systems, the producer, has introduced it. The NodeMCU ESP8266 is a complicated gadget that combines some of the functionality of an Arduino board with the ability to connect to the internet. Some development boards use simple ESP8266 modules, while others have the chip, flash memory, and antenna all built into the PCB. The NodeMCU is a development board that uses the ESP8266 and has the same name as the firmware.

4. Relay Module with a single 5V DC 1 channel. The Single Channel Relay Module is a handy board for controlling high voltage, high current loads such motors, solenoid valves, lamps, and AC loads. It's made to work with microcontrollers like Arduino, PIC, and others. Aside from that, it may be controlled by any microcontroller's 5V digital outputs.

5. The Arduino Nano ATmega328P is a tiny, comprehensive, and breadboard-friendly board based on the ATmega328 (Arduino Nano 3.0) or ATmega168 (Arduino Nano 2.0) (Arduino Nano 2.x). It offers similar capabilities as the Arduino Duemilanove but in different packaging. It only loses a DC power connector and uses a Mini-B USB cable rather than a normal one.

2.2 Methods

Figure 2.1 shows that the processes for this project are carried out using the flowchart system. As a consequence, we will have a basic knowledge of the automatic vacuum cleaner's operation. This flowchart is a graphical representation of steps for the workflow or process of our vacuum cleaning.

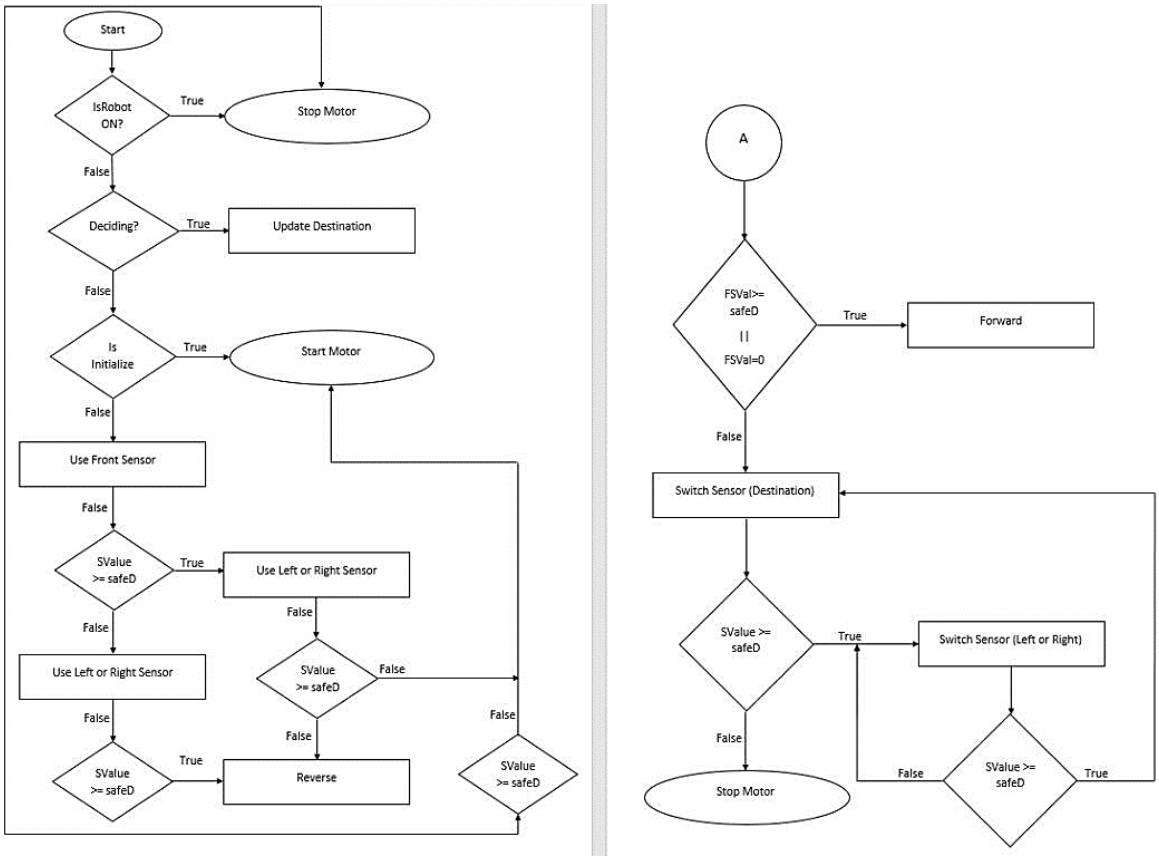

Figure 2.1: Flowchart of the Automated Vacuum Cleaner Robotic System

2.3 Program Codes

Figure 2.2 shows the NodeMCU programming code that reads distance data from an ultrasonic sensor and makes calculations to avoid obstacles in front of the system.

```
#define BLYNK_PRINT Serial

#include <SoftwareSerial.h>

SoftwareSerial mySerial(D2, D3); // RX, TX

#include <ESP8266WiFi.h>
#include <BlynkSimpleEsp8266.h>

char auth[] = "ruPCbp4_E4u-ngfj9ol1n_wbQ3EwtLgZ";

char ssid[] = "yusofintan_2.4G";
char pass[] = "74592155";

void setup()
{
  // Debug console
  mySerial.begin(9600);
  Serial.begin(9600);

  Blynk.begin(auth, ssid, pass);
}

BLYNK_WRITE(V0){
  int state = param.asInt();
  if(state == 1){
    Serial.println("Button V0 is pressed");
    mySerial.write(1);
    Serial.println("Send 1 to FORWARD");
  }
}

BLYNK_WRITE(V1){
  int state = param.asInt();
  if(state == 1){
    Serial.println("Button V1 is pressed");
    mySerial.write(2);
    Serial.println("Send 2 to REVERSE");
  }
}

BLYNK_WRITE(V2){
  int state = param.asInt();
  if(state == 1){
    Serial.println("Button V2 is pressed");
    mySerial.write(3);
    Serial.println("Send 3 to Turn RIGHT");
  }
}

BLYNK_WRITE(V3){
  int state = param.asInt();
  if(state == 1){
    Serial.println("Button V3 is pressed");
    mySerial.write(4);
    Serial.println("Send 4 to REVERSE");
  }
}

BLYNK_WRITE(V4){
  int state = param.asInt();
  if(state == 1){
    Serial.println("Button V4 is pressed");
    mySerial.write(5);
    Serial.println("Send 5 to STOP");
  }
}
void loop()
{
  Blynk.run();
}
```

Figure 2.2: Programming code distance data from an ultrasonic sensor

3. Results and Discussions

The outcomes of the Automated Vacuum Cleaner Robotic System project will be discussed in this chapter. This project is approximately utilizing a smartphone and a manual to control an automatic vacuum cleaner. There are three ultrasonic sensors in this project: one in front, one on the left, and one on the right to detect anything approaching it. When the automated vacuum collides with another item on the left, right, or front, it reverses course to keep the cleaning process running smoothly.

3.1 Results

Figure 3.1 to **Figure 3.6** shows the project results when the system is started. Blynk GUI is used to determine the mode of operation and to control the direction of movement of the system.

Figure 3.1: Automated Vacuum on Reverse

Figure 3.2: Automated Vacuum on Stop

Figure 3.3: Automated Vacuum on Right

Figure 3.4: Automated Vacuum on Left

Figure 3.5: Automated Vacuum on Forward (Press forward button)

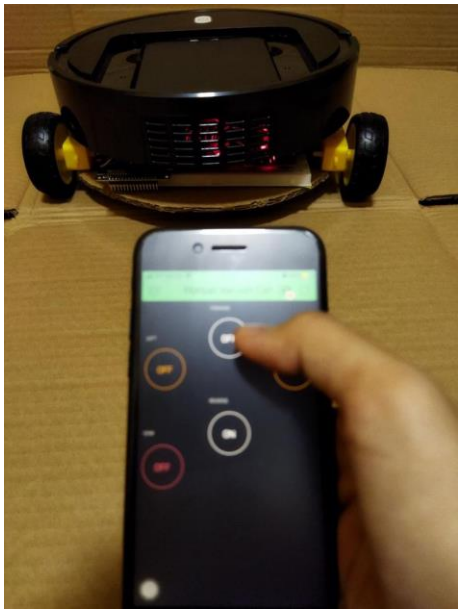

Figure 3.6: Automated Vacuum on Forward (Button is released)

3.2 Discussion

3.2.1 The distance measured using an ultrasonic sensor

Table 1 shows a summary of the findings on the Automated Vacuum Cleaner Robotic System. This distance is evaluated to indicate that the findings obtained are varied and can impact the ultrasonic sensor component's stability, as well as the stability of other components.

Table 1: Results of Project System Analysis

Power Consumed (%)	Ultrasonic Distance (cm)	Work Ability
50	10	Great
30	12	Moderate
10	14	Weak
0	16	Cannot Detect

4. Conclusion and Recommendation

This Automated Vacuum Cleaner Robotic System is mainly made based on modern technology. The Automated Vacuum Cleaner Robotic System's primary purpose is to clean the area or room using border analysis automatically. Furthermore, this Automatic vacuum cannot just move automatically with the help of an ultrasonic sensor but can also be controlled by using Android Mobile Apps, which is Blynk. The vacuum must be connected with the same Wi-Fi as the mobile phone connected.

This Automatic Vacuum Cleaning Robot System gives many advantages to users, whether at home, resort, or hostel. We know many people are currently very busy with their jobs and do not have much time to take care of their homes. This tool will undoubtedly help them. Additionally, it can save time for the user to cleaning their house, and also, if the user wants their house cleaner, the user can manually control using their phone.

The recommendation was very significant when the results and conclusion show that more work needs to be done or when some ways are appraised to resolve a problem or enhance the situation. To provide the best quality of housework, mainly for hygiene, vacuum cleaners have become a must-have household tool to keep the house clean and dust-free.

Our recommendation for this project for future improvement is to install a mop as part of the robotic vacuum to be more sophisticated and practical to maintain the cleanliness of any household. If the vacuum runs out of battery, it will stay in its position. Hence the next project may improvise the algorithm of the vacuum, so it will set the vacuum back to its charging base if it is almost run out of battery or after it is done cleaning the house. Inside the bargain, we also advise making the suction nozzle more sizable and increasing the battery's voltage so that the vacuum will suck the dust in high power. Hence, the cleanliness of the place will be guaranteed. They can also install UV light to kill any microorganism when the cleaning process occurs.

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