CONTENTS

ABSTRACT

The project is a smartphone-controlled floor cleaning robot which cleans a dirty floor automatically using a set of commands given to your device by a smartphone. It has two modes: Manual and Automated modes. These two variations can be dedicatedly used in various applications and can break the manual labor in terms of cleaning.

Manual mode allows user to control the robot manually while automated mode involves the robot avoiding various obstacles in its path. This will be achieved with HC - SR04 Ultrasound IR Sensors. On simple click of a button, the user can switch between the two modes. A Water pump attached with a reservoir will be used to spray water whenever required either manually pressed or automatically after every 5-7 minutes, and a VPLLEX multipurpose cleaning device with a cloth attached to a Velcro can do the cleaning and mopping operations.

The device communicates through Bluetooth technology via a HC05 Bluetooth module that will be used to exchange commands to the microcontroller -Arduino Nano. This certainly helps to pay more attention to the cleanliness of the room environment. The design of this automatic floor cleaning robot based on a microcontroller and smartphone control uses Arduino Nano as a system controller.

The robot is given power by 18650 lithium-ion battery pack, the apt voltage requirement used for all motors here. The driver motors use 100 rpm type. The L293D motor driver board controls the speed and direction of the robot. Essentially the robot has a very discrete design in terms of compactness and usability as it is very handy and easy to operate. 3 Ultrasound IR sensors (HC-SR04 model) are used to detect any obstacles that might come in the robot’s path

Chapter 1

INTRODUCTION

1.1 INTRODUCTION

Floor Cleaning has always been an integral part of the daily health and hygiene routine, be it a household or an industry. Floor cleaning is mainly of two types- Dry cleaning, which mainly involves removal of dust and particulate matter and wet cleaning, which involves cleaning of the surface with the use of water and other floor disinfectants to clean the floor of liquid waste. Present day floor cleaning robots are way too expensive for the general public to afford.

To overcome this problem, an automatic floor cleaning robot based on a microcontroller and smartphone control was designed which can also run in automated mode. This is certainly an attraction to take advantage of the facilities and pay more attention to the cleanliness of the room environment. The design of this automatic floor cleaning robot based on a microcontroller and smartphone control uses Arduino Nano as a system controller.

1.2 PROBLEM STATEMENT

The current problem lies in the traditional manual cleaning methods for floors, which are time-consuming, labor-intensive, and often inefficient. There is a need for an innovative and a cost-effective solution to automate and optimize the floor cleaning process.

The traditional method of cleaning floors using manual labor is time-consuming, labor-intensive, and often requires harsh chemicals that can be harmful to both the environment and human health. Additionally, it can be difficult to maintain cleanliness and hygiene standards in high-traffic areas or spaces that require frequent cleaning.

To address these challenges, an IoT-based floor cleaning robot can be designed for cleaning process while minimizing the use of harmful chemicals and ensuring consistent and effective cleaning while not having human hands touch the chemicals involved.

1.3 OBJECTIVES AND SCOPE OF THE PROJECT

Automation and Manual Operation: Develop a robotic system capable of autonomously navigating the floor, detecting and removing dirt and debris, and returning to a docking station for charging, all without human intervention.

Efficiency, Performance and cost-effectiveness: Design a cleaning robot that can efficiently clean large areas while ensuring thorough and consistent cleaning and at the same time the robot comes at an affordable price.

Remote Monitoring and Control: Enable remote monitoring and control of the cleaning robot through IoT connectivity. Avoiding Interaction of human hands with harmful chemicals.

Cleaning Mechanism: The robot should be equipped with an efficient and effective cleaning mechanism suited for different types of floors (hardwood, carpet, tile, etc.).

IoT Connectivity: The robot should have IoT connectivity capabilities to enable remote monitoring, control, and data exchange.

Scalability and Flexibility: The robot's design and architecture should allow for scalability to accommodate different floor sizes or environments.

Safety and Robustness: The robot should prioritize safety features to prevent accidents and damage. This includes collision avoidance mechanisms, emergency stop capabilities, and fail-safe measures to ensure safe operation in different scenarios.

Commercial Viability: The scope should consider the market viability of the IoT-based floor cleaning robot, including factors such as cost-effectiveness, durability, maintenance.

1.2 MOTIVATION OF PROJECT

Efficiency and Convenience: Cleaning large areas manually can be time-consuming and labor-intensive. An IoT-based floor cleaning robot can automate the cleaning.

Remote Monitoring and Control: IoT connectivity allows for remote monitoring and control of the cleaning robot. Users can check the cleaning progress, receive alerts or notifications, and adjust the cleaning modes and features.

Sustainability and Cost Reduction: IoT-enabled robots can optimize energy consumption by operating during off-peak hours or in response to occupancy patterns.

Data-Driven Insights: IoT-based floor cleaning robots can collect and analyze data during their cleaning operations. This data can provide valuable insights into cleaning patterns, room occupancy, maintenance requirements, and even energy usage.

Improved Cleaning Performance: Floor cleaning robots equipped with advanced sensors and algorithms can provide thorough and consistent cleaning.

Chapter 2

LITERATURE SURVEY

The Internet of Things (IoT) has revolutionized various industries, including the robotics sector. In recent years, there has been significant research and development in the field of IoT-based floor cleaning robots. These robots utilize IoT technologies to enhance their capabilities, enabling efficient and autonomous floor cleaning in both residential and commercial settings.

This literature survey aims to provide an overview of the existing research, advancements, and challenges associated with IoT-based floor cleaning robots.

The “A Floor Cleaning Based-Robotic Combines a Microcontroller and a Smartphone”[1] paper by Zafar Shadiq describes the various components that are needed for a manually operated floor cleaning robot. It also describes some of the basic essentials that are needed in every floor cleaning robot.

This is also seen in the paper “A smart autonomous floor cleaner with an Android-based controller”[2] by Anshu Prakash that describes the same features of the robot but also goes in depth about the manual control of the robot through an android controller app called Bluetooth Serial Controller.

In continuous, the paper work on “Smartphone-controlled floor cleaning robot with obstacle detection using ultrasonic sensors”[3] was carried out by K.Srinivasa,K. Siva Sankar and T. Rama Rao that aimed to create an autonomous cleaning solution that could navigate efficiently and avoid obstacles in real-time by incorporating ultrasonic sensors to detect obstacles by emitting sound waves and analyzing the reflected signal.

Further,R.Senthil Kumar, Vaisakh KP, Sayanth A Kumar and Gaurav Dasgupta conducted research on “Remote Controlled Autonomous Floor Cleaning Robot”[4] that aimed to develop a versatile cleaning robot that could be operated remotely and posses autonomous navigation capabilities through which robot could effectively navigate,detect obstacles and clean floor without human intervention.

Subsequently,the paper work on “Smart Floor Cleaning Robot using Android”[5] was carried out by Shritika Wayker, , Prashant Tiwari, Vishal Kumar, Kunal Limbu and Amay Tawade which focused on developing a floor cleaning robot that could be controlled using Android Device which aimed to create smart cleaning solution where users could conviently control the robot’s movement and cleaning function through their Android devices.

Further,the paper work on “Autonomous Smart Floor Cleaning Robot”[6]was carried out by Kuldeep Soni that focused on developing a floor cleaning robot with autonomous capabilities which aimed to create a smart and efficient cleaning solution that could navigate and clean floors without human intervention.

Lastly,the paper work on “Development of intelligent Floor Cleaning Robot”[7] was conducted by Sigit Yatmono,Mohammad Khairudin, Herlambang Sigit Pramono and Andik Asmara with an objective to develop a smart and efficient cleaning solution that could navigate autonomously and adapt to different floor surface.Yatmono successfully designed and implemented a robot that incorporated intelligent algorithms and advanced sensors to detect dirt,optimize cleaning patterns,and adjust its cleaning mechanisms accordingly.

Chapter 3

Requirements

3.1 SOFTWARE REQUIREMENTS

-Arduino IDE with the developed code

-Bluetooth Serial Controller (for manual control)

3.2 HARDWARE REQUIREMENTS

-Arduino Nano

-HC-05 Bluetooth Module

-L293D Motor Driver Board

-3x HC-SR04 Ultrasonic Sensors

-3x Clamps for Ultrasonic Sensors

-16x2 LCD Display

-Single Channel 5V Relay Module

-2x 100 RPM Geared Motors

-2x Wheels for Motors

-2x Clamps for Motors

-12V Diaphragm Water Pump

-18650 Lithium-ion Battery pack with adapter for charging.

7805 Voltage Regulator

-1K, 2K, 10K resistors

-Male/Female Headers

-Screw Terminal

-Latching Push Button

-On/Off Switch

-Perf Board

-Female to Female Jumper Wires

-Wire

-Nuts & Bolts

-Vinyl Tubing

-Glucose Drip Pipe

-A Small Water Bottle

-Velcro

-Cloth

-VPLLEX Multipurpose 360 Degree Rotating Brush Spin Hand Push Broom Sweeper -Dust Collector device

-Wooden board

Chapter 4

SYSTEM DESIGN

4.1 EXISTING SYSTEM

There are several existing systems in the market that offer IoT-based floor cleaning robots. Here are a few examples:

1) iRobot Roomba: iRobot's Roomba series is a popular line of robotic vacuum cleaners that incorporate IoT capabilities. These robots use a combination of sensors, including cliff sensors, bump sensors, and optical sensors, to navigate and clean floors. They can be controlled and monitored through a mobile app that connects to the robot via Wi-Fi.

2) Neato Botvac Connected: Neato Botvac Connected is another IoT-enabled floor cleaning robot. It utilizes laser scanning technology to map the environment and plan efficient cleaning paths. The robot connects to the internet through Wi-Fi, allowing users to control and schedule cleaning tasks remotely using a mobile app.

3) Ecovacs Deebot: Ecovacs Deebot series offers a range of robotic vacuum cleaners with IoT capabilities. These robots use sensors and mapping technology to navigate and clean floors. They can be controlled via a mobile app that provides scheduling, real-time monitoring, and remote control options. Some models also support voice commands through integration with popular smart home platforms like Amazon Alexa or Google Assistant.

4) Samsung POWERbot: Samsung POWERbot is a line of Wi-Fi connected floor cleaning robots that utilize advanced sensors and mapping technologies for efficient cleaning. These robots can be controlled remotely through a mobile app or voice commands using platforms like Amazon Alexa or Google Assistant. Some models even offer a camera for live streaming video and monitoring the cleaning process.

These are just a few examples of existing IoT-based floor cleaning robots. Each system may have its own specific features and capabilities, but they generally share the common goal of providing automated cleaning while offering remote control and monitoring through IoT connectivity.

4.2PROPOSED SYSTEM

[1] A smartphone-controlled robot that cleans your house's floor. A VPLLEX multipurpose cleaning device on the front of the robot along with a cloth with Velcro at the back can do the job perfectly.

[2] There's also a water pump and water reservoir which can be switched on when required to throw water on the floor and make the mops moist for a proper clean. The pump can either be manually operated or automatic pumps happen every 5-7 minutes.

[3] The VPLLEX multipurpose cleaning device the front of the robot help in effective dry cleaning of the floor it scrubs the ground and also has a vacuum functionality. Also, speed controls for the driver motors would be given.

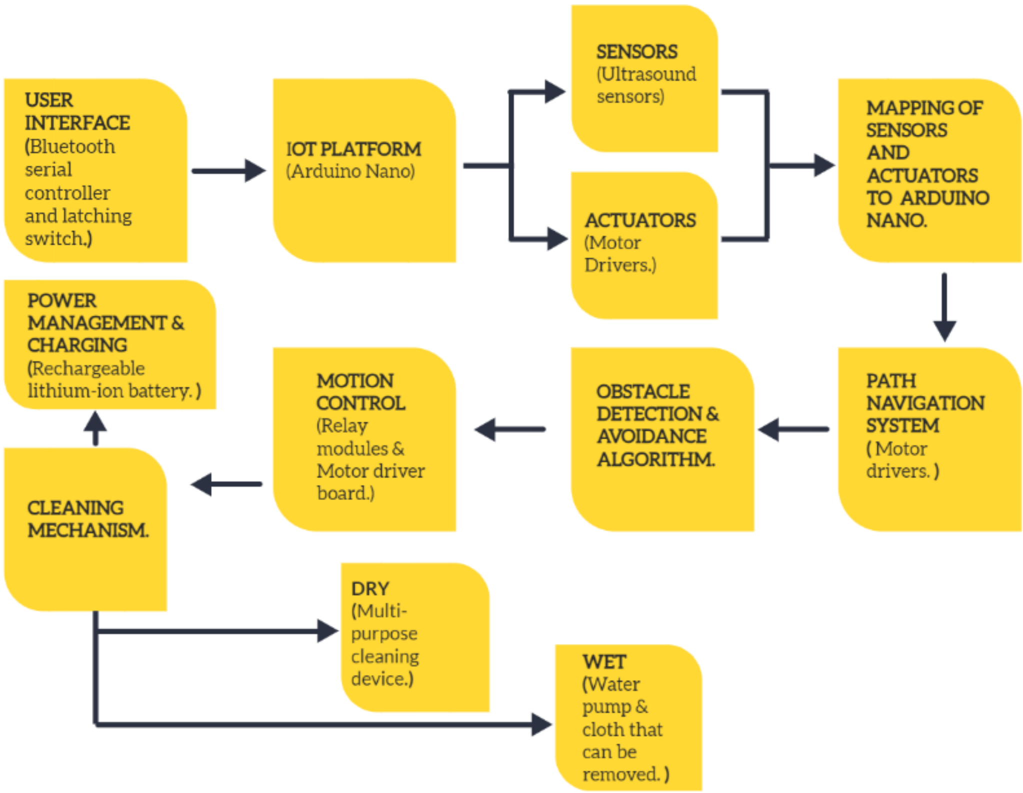
[4] The project uses Bluetooth communication via an HC-05 Bluetooth module to send the commands to the microcontroller- Arduino Nano. The robot is powered on 18650 lithium-ion rechargeable battery pack . The driver motor pair are 100rpm ones.

[5] The Robot has two modes: Manual mode and Automated Mode.

[6] In Manual mode the user can explicitly command the robot to carry out its operations of cleaning and mopping through the Bluetooth serial controller

[7] In Automated mode, a combination of the Obstacle-detection and avoidance algorithm with 3 HC-SR04 ultrasound sensors help the robot avoid any sort of obstacles which may come on its way.

4.3SYSTEM ARCHITECTURE



The system architecture for an IoT-based floor cleaning robot typically consists of several components that work together to enable communication, control, and coordination. Here's a high-level overview of the key components:

Sensors: The robot is equipped with sensors to perceive the environment.Three Ultrasonic sensors (HC-SR04) are deployed for obstacle detection and avoidance.

Actuators: The robot utilizes actuators to perform physical tasks such as movement and cleaning. Actuators include:

Wheels or tracks for mobility.

Cloth attached with Velcro for wet cleaning

VPLLEX multipurpose device for floor cleaning and vacuuming process.

Microcontroller: The brain of the robot, usually a microcontroller or a more powerful processor, controls the overall system operations. It receives input from sensors, processes data, and sends commands to actuators. The microcontroller may also handle wireless communication with the IoT infrastructure. Arduino Nano is used as the microcontroller in this case.

Connectivity: The robot needs to connect to the internet or a local network for IoT capabilities. This can be achieved through the Bluetooth Serial Controller that allows communication with smartphone.

Remote control: Allowing users to monitor and control the robot remotely through a web or mobile application, through the Bluetooth serial controller

User Interface: The user interface can be a web or mobile application that allows users to interact with the robot, monitor its status, set cleaning schedules, or define cleaning areas. The Bluetooth serial controller is the User Interface.

Power Management: The robot requires a power supply to operate. It may include a rechargeable battery or be connected to a power source for continuous operation. Power management systems ensure efficient use of power and may include features like automatic docking for recharging. We used 18650 Lithium-ion rechargeable battery pack as the robot's power source.

It's important to note that the specific architecture may vary depending on the complexity and requirements of the floor cleaning robot. This overview provides a general framework for designing an IoT-based system for such a robot.

PSEUDO CODE :

```
#include <NewPing.h>    //import libraries
#include <Wire.h>
#include <LiquidCrystal_I2C.h>

const int echo_L = A2;   //initialize pin numbers
const int trig_L = A3;
```

```
const int echo_M = 4;

const int trig_M = 5;

const int echo_R = A0;

const int trig_R = A1;

const int L1 = 6;

const int L2 = 9;

const int R1 = 10;

const int R2 = 11;

const int button = 2;

const int pump = 3;

int motor_speed = 255;      //speed of the motor can be set between 125 (minimum) and 255 (maximum)

int max_distance = 200;   //max distance of ultrasonic sensors is set to 200cm

int distance_L = 0;

int distance_M = 0;

int distance_R = 0;

char incomingByte;


NewPing sonar_L(trig_L, echo_L, max_distance);    //initialize all the 3 sensors

NewPing sonar_M(trig_M, echo_M, max_distance);

NewPing sonar_R(trig_R, echo_R, max_distance);

LiquidCrystal_I2C lcd(0x27,16,4);    //initialize LCD


void setup()

{

  pinMode(L1, OUTPUT);    //intitialize pins as output or input

  pinMode(L2, OUTPUT);

  pinMode(R1, OUTPUT);

  pinMode(R2, OUTPUT);

  pinMode(button, INPUT);

  pinMode(pump, OUTPUT);

  digitalWrite(L1, LOW);

  digitalWrite(L2, LOW);
```

```
  digitalWrite(R1, LOW);
  digitalWrite(R2, LOW);
  digitalWrite(pump, HIGH);
  lcd.init();
  lcd.backlight();
  lcd.clear();
  lcd.print("Hello");
  Serial.begin(9600);   //begin serial communication via bluetooth at 9600 baud rate
  delay(2000);
}


void loop()
{
  if(digitalRead(button) == LOW)    //if button is not pressed
  {
    lcd.clear();                    //manual mode
    lcd.print("Manual Mode");
    while(true)
    {
      manualMode();
      if(digitalRead(button) == HIGH)
      {
        moveStop();
        break;
      }
    }
    delay(100);
  }

  else                              //else automatic mode
  {
```

```
    lcd.clear();
    lcd.print("Automatic Mode");
    while(true)
    {
      automaticMode();
      if(digitalRead(button) == LOW)
      {
        moveStop();
        break;
      }
    }
    delay(100);
  }
}

void manualMode()
{
  if (Serial.available() > 0)   //check if any data is available
  {
    incomingByte = Serial.read();   //read incoming data
  }

  switch(incomingByte)    //based on received character execute respective commands
  {
    case 'F':
    moveForward();
    lcd.clear();
    lcd.print("Forward");
    incomingByte='*';
    break;

    case 'B':
```

```
moveBackward();
lcd.clear();
lcd.print("Backward");
incomingByte='*';
break;

case 'L':
moveLeft();
lcd.clear();
lcd.print("Left");
incomingByte='*';
break;

case 'R':
moveRight();
lcd.clear();
lcd.print("Right");
incomingByte='*';
break;

case 'S':
moveStop();
lcd.clear();
lcd.print("Stop");
incomingByte='*';
break;

case 'P':
digitalWrite(pump, LOW);
lcd.clear();
lcd.print("Pump ON");
incomingByte='*';
```

```
    break;

    case 'p':
    digitalWrite(pump, HIGH);
    incomingByte='*';
    break;

    case '1':
    motor_speed = 155;
    lcd.clear();
    lcd.print("Speed=LOW");
    incomingByte='*';
    break;

    case '2':
    motor_speed = 205;
    lcd.clear();
    lcd.print("Speed=MED");
    incomingByte='*';
    break;

    case '3':
    motor_speed = 255;
    lcd.clear();
    lcd.print("Speed=HIGH");
    incomingByte='*';
    break;

    delay(100);
  }
}
```

```
void automaticMode()
{
  distance_L = readSensor_L();    //read distance from all the 3 sensors
  distance_M = readSensor_M();
  distance_R = readSensor_R();
  lcd.clear();    //print distance on LCD
  lcd.print("L=");
  lcd.print(distance_L);
  lcd.print("cm ");
  lcd.print("M=");
  lcd.print(distance_M);
  lcd.print("cm");
  lcd.setCursor(0, 1);
  lcd.print("R=");
  lcd.print(distance_R);
  lcd.print("cm");

  digitalWrite(pump, HIGH);

  if(((millis()/1000)%420) <= 5) // pump water every 7 minutes (420 seconds)
  {
    digitalWrite(pump, LOW);
    delay(1000);
    digitalWrite(pump, HIGH);
  }

  if(distance_M <= 25)    //if middle sensor distance is less than 20cm
  {
    if(distance_R > distance_L)   //check if there is place at right or left
    {
      if((distance_R <= 25) && (distance_L <= 25))    //if there is no place on both sides
      {
```

```
      moveStop();
      delay(200);
      moveBackward();   //move back
      delay(4000);
    }
    else
    {
      moveBackward();  //move back then turn right
      delay(500);
      moveRight();
      delay(4000);
    }
  }
  else
  if(distance_R < distance_L)
  {
    if((distance_R <= 25) && (distance_L <= 25))
    {
      moveStop();   //move back
      delay(200);
      moveBackward();
      delay(4000);
    }
    else
    {
      moveBackward();   //move back then turn left
      delay(500);
      moveLeft();
      delay(4000);
    }
  }
}
```

```
  else
  if(distance_R <= 25)    //if right sensor distance is less than 20cm
  {
    moveLeft();   //turn left
    delay(2000);
  }
  else
  if(distance_L <= 25)    //if left sensor distance is less than 20cm
  {
    moveRight();    //turn right
    delay(2000);
  }
  else
  {
    moveForward();    //in all other cases keep on moving forward
  }
}

int readSensor_L()    //read distance in centimeters from left sensor
{
  delay(70);
  int cm_L = sonar_L.ping_cm();
  if(cm_L==0)
  {
    cm_L = 250;
  }
  return cm_L;
}

int readSensor_M()    //read distance in centimeters from left sensor
{
```

```
  delay(70);
  int cm_M = sonar_M.ping_cm();
  if(cm_M==0)
  {
    cm_M = 250;
  }
  return cm_M;
}

int readSensor_R()    //read distance in centimeters from left sensor
{
  delay(70);
  int cm_R = sonar_R.ping_cm();
  if(cm_R==0)
  {
    cm_R = 250;
  }
  return cm_R;
}

void moveForward()
{
  digitalWrite(L1, LOW);
  analogWrite(L2, motor_speed);
  analogWrite(R1, motor_speed);
  digitalWrite(R2, LOW);
}

void moveBackward()
{
  analogWrite(L1, motor_speed);
  digitalWrite(L2, LOW);
```

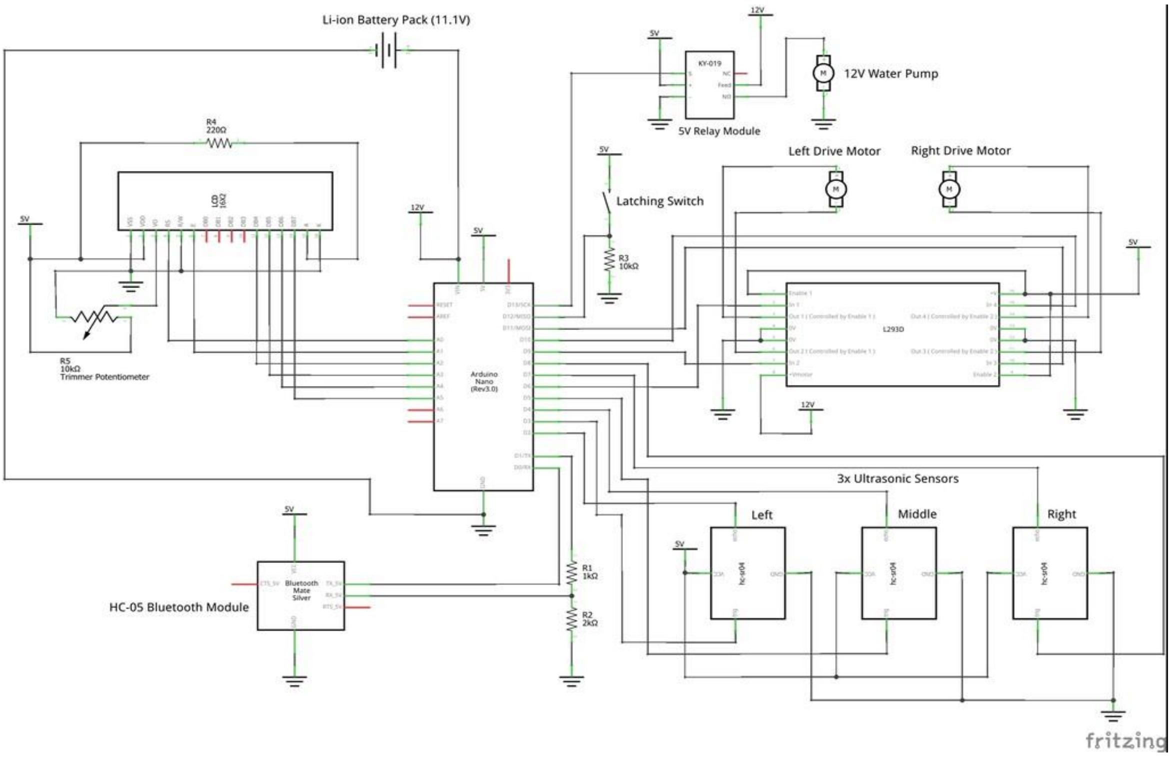
```
  digitalWrite(R1, LOW);
  analogWrite(R2, motor_speed);
}

void moveLeft()
{
  analogWrite(L1, motor_speed);
  digitalWrite(L2, LOW);
  analogWrite(R1, motor_speed);
  digitalWrite(R2, LOW);
}

void moveRight()
{
  digitalWrite(L1, LOW);
  analogWrite(L2, motor_speed);
  digitalWrite(R1, LOW);
  analogWrite(R2, motor_speed);
}

void moveStop()
{
  digitalWrite(L1, LOW);
  digitalWrite(L2, LOW);
  digitalWrite(R1, LOW);
  digitalWrite(R2, LOW);
}
```

CIRCUIT DIAGRAM :



Chapter 5

CONCLUSION

In conclusion, IoT-based floor cleaning robots bring a new level of convenience, efficiency, and effectiveness to the task of maintaining clean floors. With advanced sensors and mapping technology, these robots can autonomously navigate and clean floors, providing thorough and consistent cleaning results.

IoT connectivity allows users to remotely monitor and control the robots, scheduling cleaning tasks and adjusting settings from anywhere. Real-time data and analytics capabilities optimize cleaning operations by analyzing factors such as cleaning time and energy usage.

The integration of these robots with other smart home systems further enhances automation and convenience. Overall, IoT-based floor cleaning robots revolutionize the cleaning process, saving users time and effort while delivering superior cleaning performance. They offer a seamless and intelligent solution for maintaining clean floors, making them a valuable asset in modern households and commercial spaces.

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