NANDHA ENGINEERING COLLEGE

ERODE–638052 (Autonomous)

(Affiliated to Anna University, Chennai)

DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

22AIC14 – INTERNET OF THINGS AND ITS APPLICATION

MINI PROJECT REPORT ON

TOPIC – SMART VACCUM CLEANER ROBOT

Submitted by

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BONAFIDE CERTIFICATE

This is to certify that the project work entitled "SMART VACCUM CLEANER ROBOT" is the Bonafide work of DEEPAKKUMAR M (22AI009), GOKUL RAJ V (22AI016), KAVINKUMAR G (22AI020) who carried out the work under my supervision.

Signature of the Supervisor	**Signature of the HOD**
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SMART VACCUM CLEANER ROBOT

AIM:

The aim of this project is to create an autonomous Smart Vacuum Cleaner that uses sensors, motors, and IoT technology to efficiently navigate and clean home floors, providing a convenient and time-saving solution for users.

SCOPE:

The scope of this project is to develop an autonomous cleaning system that can navigate and clean without manual intervention. It will feature obstacle detection using sensors, IoT integration for remote control and scheduling via a mobile app and optimization of cleaning efficiency to cover maximum floor area with minimal energy consumption. The goal is to create a reliable, efficient, and user-friendly vacuum cleaner for modern homes.

BRIEF HISTORY:

This project began with the goal of creating an autonomous cleaning system that simplifies household chores through advanced technology. Recognizing the increasing demand for smart home devices, the project was conceptualized to integrate autonomous navigation and IoT features into a single vacuum cleaner. The development process started with research on sensor technologies and efficient algorithms for navigation, followed by the integration of remote control capabilities via a mobile app. As the project progressed, a focus was placed on optimizing cleaning efficiency, ensuring the device could cover maximum floor area with minimal energy usage. The outcome of this project aims to provide an innovative, user-friendly solution to home cleaning, enhancing convenience and performance in modern households.

PROPOSED METHODOLOGY:

The methodology for the Smart Vaccum Cleaner Robot is as follows:

1. Analyze user needs and define the system’s functional requirements, including cleaning efficiency, obstacle detection, IoT integration, and ease of use.

2. Design the hardware (sensors, motors, dustbin, suction system) and software (navigation algorithms, AI-based path planning) to meet the defined requirements.

3. Integrate sensors for real-time mapping and obstacle avoidance, ensuring safe and efficient navigation through various environments.

4. Develop a mobile app and voice command features for remote control, scheduling, and monitoring of the vacuum cleaner.
5. Implement algorithms to maximize cleaning coverage, reduce cleaning time, and optimize energy use for longer battery life.
6. Build a prototype and conduct initial tests in different environments to assess performance, navigation, and obstacle detection capabilities.
7. Analyze testing results, refine hardware and software, and improve the system's performance based on feedback and identified issues.
8. Finalize the design, conduct comprehensive testing, and prepare user manuals and technical documentation for deployment and future upgrades.

COMPONENTS REQUIRED:

S.NO	HARDWARE	QUANTITY
1	UltraSonic sensor	1
2	Arduino Nano	1
3	Motor, 6v Motor	4, 1
4	Servo Motor	1
5	Lithium-ion Battery	2
6	Arduino Motor Sheild	1

DESCRIPTION:

The Autonomous Cleaning System project aims to develop an innovative cleaning robot designed to simplify household chores through advanced automation. This cutting-edge device utilizes a combination of sophisticated sensors, artificial intelligence, and IoT technology to navigate and clean various indoor environments autonomously, without the need for manual intervention.

At its core, the system features real-time mapping and path planning capabilities, allowing it to efficiently traverse different floor types while detecting and avoiding obstacles. Equipped with powerful motors and intelligent algorithms, the cleaning robot ensures thorough coverage of maximum floor area, effectively removing dust, dirt, and debris.

One of the standout features of this project is its integration of IoT functionality, enabling users to control and schedule cleaning tasks remotely via a mobile application using smart home devices. This convenience allows users to manage their cleaning schedules seamlessly, making it easier to maintain a clean home even amidst busy lifestyles.

The project also emphasizes energy efficiency, optimizing the robot's operation to extend battery life while maintaining high cleaning performance. User experience is prioritized through an intuitive interface that allows for customizable settings and preferences.

Through rigorous testing and refinement phases, the Autonomous Cleaning System is designed to deliver a reliable, efficient, and user-friendly solution that meets the demands of modern households. Ultimately, this project aims to revolutionize home cleaning by providing a practical and intelligent solution that saves time and enhances the quality of life for users.

CODING:

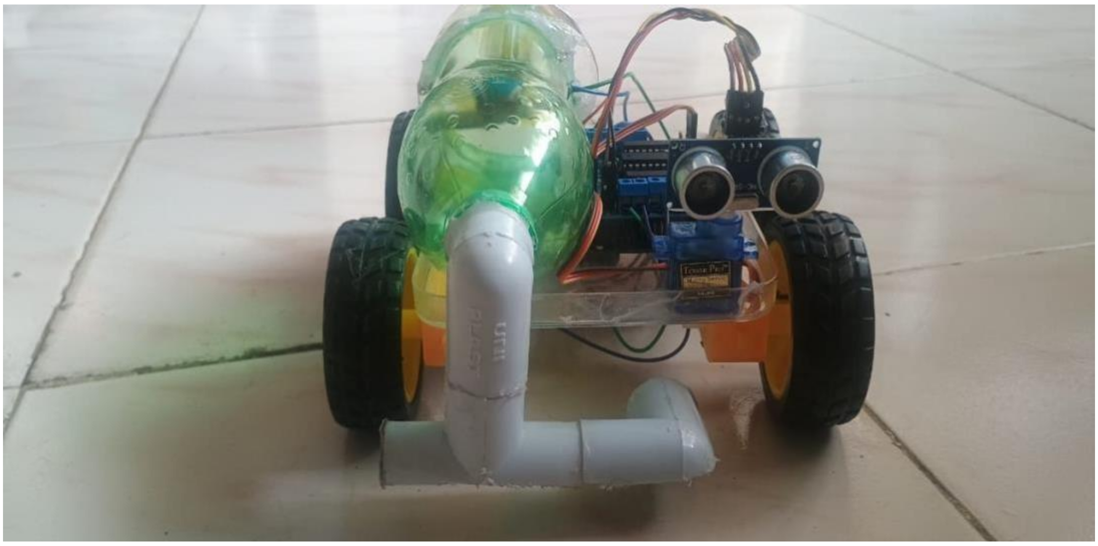
```
#include <AFMotor.h>
#include <NewPing.h>
#include <Servo.h>

#define TRIG_PIN A0
#define ECHO_PIN A1
#define MAX_DISTANCE 200
#define MAX_SPEED 190 // Sets speed of DC motors
#define MAX_SPEED_OFFSET 20

NewPing sonar(TRIG_PIN, ECHO_PIN, MAX_DISTANCE);

AF_DCMotor motor1(1, MOTOR12_1KHZ);
AF_DCMotor motor2(2, MOTOR12_1KHZ);
AF_DCMotor motor3(3, MOTOR34_1KHZ);
AF_DCMotor motor4(4, MOTOR34_1KHZ);
Servo myservo;

boolean goesForward = false;
int distance = 100;
int speedSet = 0;
```

```
void setup() {
  myservo.attach(10);
  myservo.write(115);
  delay(2000);
  distance = readPing();
  delay(100);
}

void loop() {
  // Continuously check the distance
  distance = readPing();

  if (distance > 15) {
    // If no obstacle is detected, keep moving forward
    moveForward();
  } else {
    // If an obstacle is detected, stop and decide the next move
    moveStop();
    delay(100);
    moveBackward();
    delay(300);
    moveStop();
    delay(200);

    int distanceR = lookRight();
    delay(200);
    int distanceL = lookLeft();
    delay(200);

    if (distanceR >= distanceL) {
      turnRight();
    } else {
      turnLeft();
    }
    moveStop(); // Stop before resuming forward movement
  }
}

int lookRight() {
  myservo.write(50);
  delay(500);
  int distance = readPing();
  delay(100);
  myservo.write(115);
```

```
  return distance;
}

int lookLeft() {
  myservo.write(170);
  delay(500);
  int distance = readPing();
  delay(100);
  myservo.write(115);
  return distance;
}

int readPing() {
  delay(70);
  int cm = sonar.ping_cm();
  if (cm == 0) {
    cm = 250; // Return a high value if no object is detected
  }
  return cm;
}

void moveStop() {
  motor1.run(RELEASE);
  motor2.run(RELEASE);
  motor3.run(RELEASE);
  motor4.run(RELEASE);
}

void moveForward() {
  if (!goesForward) {
  goesForward = true;
    motor1.run(FORWARD);
    motor2.run(FORWARD);
    motor3.run(FORWARD);
    motor4.run(FORWARD);
    for (speedSet = 0; speedSet < MAX_SPEED; speedSet += 2) {
      motor1.setSpeed(speedSet);
      motor2.setSpeed(speedSet);
      motor3.setSpeed(speedSet);
      motor4.setSpeed(speedSet);
      delay(5);
    }
  }
}
```

```
void moveBackward() {
  goesForward = false;
  motor1.run(BACKWARD);
  motor2.run(BACKWARD);
  motor3.run(BACKWARD);
  motor4.run(BACKWARD);
  for (speedSet = 0; speedSet < MAX_SPEED; speedSet += 2) {
    motor1.setSpeed(speedSet);
    motor2.setSpeed(speedSet);
    motor3.setSpeed(speedSet);
    motor4.setSpeed(speedSet);
    delay(5);
  }
}

void turnRight() {
  motor1.run(FORWARD);
  motor2.run(FORWARD);
  motor3.run(BACKWARD);
  motor4.run(BACKWARD);
  delay(500);

void turnLeft() {
  motor1.run(BACKWARD);
  motor2.run(BACKWARD);
  motor3.run(FORWARD);
  motor4.run(FORWARD);
  delay(500);
}



  Serial.println("Diabetic Foot Ulcer Monitoring System Initialized.");

}

void loop() {

  Blynk.run();

  timer.run();

}
```

SCREENSHOTS:



OUTPUTS:

The output of the Autonomous Cleaning System project will be a fully functional cleaning robot featuring autonomous navigation, advanced obstacle detection, and IoT integration for remote control via a mobile app. The robot will efficiently clean various indoor environments while optimizing performance and energy use. A user-friendly interface will allow for easy scheduling and customization of cleaning tasks. Comprehensive testing will ensure reliability and effectiveness, supported by detailed documentation and a marketing strategy for product promotion. Ultimately, this project aims to provide a practical and innovative solution that enhances user convenience and quality of life.

PROTOCOLS USED:

1. Design Protocol

Objective: Ensure a robust architecture for hardware and software.

1. Develop a system blueprint showing how sensors, motors, and IoT modules interact.
2. Choose reliable components (e.g., LiDAR for mapping, ESP32 for IoT, efficient motors).
3. Create algorithms for navigation, obstacle detection, and IoT integration.

2.Testing Protocol

Objective: Validate system performance and reliability.

1. Test obstacle detection and navigation algorithms in real environments.
2. Measure cleaning efficiency (coverage, dust removal) and battery life.
3. Stress test by running the robot continuously to identify potential failures.

3.Sensor Protocols

SPI (Serial Peripheral Interface):

Used for high-speed data communication with digital light sensors or real-time clock (RTC) modules for time-based tracking.

LIMITATIONS:

1. Initial Cost: The advanced technology may result in a higher upfront price, which could deter budget-conscious consumers.
2. Maintenance Requirements: Regular upkeep is needed, including emptying dustbins and replacing filters, which can be time-consuming and costly.
3. Risk of Getting Stuck: The robot may become trapped under furniture or caught on cords, necessitating human intervention.
4. Variable Cleaning Performance: Effectiveness can vary by floor type and layout, and it may not match the thoroughness of traditional cleaning methods.
5. Limited Navigation Capabilities: The robot may struggle with stairs or multi-level homes, limiting its functionality to single-level spaces.

FUTURE ENHANCEMENTS:

1. Advanced AI and Machine Learning: Enable the robot to learn from experiences and optimize cleaning patterns based on floor types and dirt conditions.
2. Enhanced Sensor Technology: Upgrade sensors for better mapping and navigation, allowing seamless transitions between different surface types and multi-level homes.
3. Smart Home Integration: Connect with other smart home devices to optimize energy usage and enhance automation.
4. Self-Emptying Capability: Introduce a feature for automatic debris disposal into a base station, reducing user maintenance tasks.

CONCLUSION:

This project successfully creates an autonomous cleaning system that combines advanced navigation, obstacle detection, and IoT integration to provide an efficient, user-friendly solution for home cleaning. The system offers remote control, optimized cleaning patterns, and energy-efficient operation, meeting the demand for smart home technology. It simplifies household chores and sets the stage for future innovations in home automation and robotics.