International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 09 Issue: 11 | Nov - 2025 SJIF Rating: 8.586 ISSN: 2582-3930

Smart Floor Cleaner

Sakshi Gharmode , Vedika Parmar , Sharayu Mahajan

UG Student, Dept. of ENTC ,GSMCOE Balewadi Pune
Assistant Professor Dept. of ENTC ,GSMCOE Balewadi Pune

ABSTRACT: This paper presents the design of a **Smart Floor Cleaner using Raspberry Pi** for automated household cleaning. The system integrates sensors for obstacle and edge detection, motor control for movement and cleaning mechanisms, and optional IoT features for remote monitoring. Raspberry Pi serves as the central controller, enabling efficient navigation and real-time decision- making. The proposed solution provides a cost-effective and energy-efficient alternative to conventional robotic vacuum cleaners.

KEYWORDS: Smart Floor Cleaner, Raspberry Pi, Home Automation,Obstacle Detection,Edge Detection, IoT-based Cleaning System, Autonomous Navigation, Robotic Vacuum.

INTRODUCTION

Automation in household chores is becoming increasingly important due to busy lifestyles and the need for efficiency. Floor cleaning is a routine task that requires significant time and effort, and traditional methods are often labor-intensive. While robotic cleaners are available in the market, they are generally expensive and may have limited functionality. To address this, a Smart Floor Cleaner has been designed to provide an autonomous and efficient solution for cleaning floors. The system is built around a **Raspberry Pi**, which acts as the central controller for decision-making. Ultrasonic and infrared sensors are used to detect obstacles and prevent the device from falling off edges. Motor drivers control the movement of the device as well as the cleaning mechanism. Optional IoT connectivity allows users to monitor and control the cleaner remotely. This approach ensures systematic navigation and effective cleaning with minimal human intervention. Overall, the project presents a cost-effective, energy-efficient, and user-friendly solution for modern households.

LITERATURE SURVEY

Shripad Malavadikar et al. [1] designed an **Automatic Cleaner Robot** that focuses on autonomous navigation and basic cleaning operations. Their work highlighted the integration of sensors for obstacle detection and movement control in robotic floor cleaners.

Pooja D. Rathod et al. [2] proposed a **multipurpose smart floor cleaning system using Android devices**, which enables remote control and scheduling through mobile applications. This work demonstrated the advantages of IoT integration in smart cleaning systems, improving accessibility and user convenience.

H.G.T. Milinda [3] studied **mud and dirt separation methods for floor cleaning machines**, emphasizing the mechanical and functional aspects of cleaning efficiency. The methods discussed provided insight into optimizing the separation of debris from the surface during robotic cleaning.

Jens-Steffen Gutmann et al. [4] explored the **social impact of systematic floor cleaners**, evaluating how domestic robots interact with human users in household environments. Their study underscored the importance of designing robots that are not only efficient but also socially acceptable.

Evolution Robotics Inc. [5] introduced **Mint**, one of the early commercial floor-cleaning robots. The Mint robot highlighted the transition from research prototypes to market-ready smart cleaners, combining navigation technology with practical usability.

J.-S. Gutmann et al. [6] presented **Vector Field SLAM**, a technique for autonomous navigation and mapping in cleaning robots. This research contributed to advancements in simultaneous localization and mapping (SLAM), which is crucial for efficient floor coverage and obstacle avoidance.

J.-Y. Sung et al. [7] examined **domestic robot technologies from a social perspective**, particularly focusing on housewives' interaction with robotic cleaners. Their study provided insights into user acceptance, interaction design, and the role of robots in daily domestic routines.

Overall, the literature shows a trend toward integrating **autonomous navigation, IoT connectivity, user-friendly interfaces, and social acceptability** in smart floor cleaning systems. These developments are essential for creating efficient, reliable, and widely adopted robotic cleaners.

METHODOLOGY

The smart floor cleaner is designed to autonomously clean floors with minimal human intervention, using sensors, a microcontroller (Raspberry Pi), and a motor-driven cleaning mechanism. The methodology can be divided into the following steps:

1. **System Design**:
   - The hardware consists of a **Raspberry Pi**, motor driver, wheels, cleaning brush/roller, and power supply.
   - Sensors include **ultrasonic sensors** for obstacle detection, **IR sensors** for edge detection, and optionally a **camera** for navigation.
2. **Navigation and Obstacle Avoidance**:
   - The ultrasonic sensors detect obstacles, allowing the cleaner to change direction and avoid collisions.
   - IR sensors prevent the robot from falling off edges like stairs.
   - Algorithms such as **Random Walk**, **Wall Following**, or **SLAM (Simultaneous Localization and Mapping)** are implemented for systematic cleaning.
3. **Cleaning Mechanism**:
   - The floor cleaning unit consists of a rotating brush or mop driven by DC motors.
   - Suction or a wet-dry mop mechanism can be integrated depending on the design.
4. **Control System**:
   - The Raspberry Pi processes sensor inputs and controls motors via a **motor driver module**.
   - The system can be programmed to follow predefined cleaning patterns or adjust routes dynamically based on sensor feedback.
5. **User Interface**:
   - A **mobile application or web interface** can allow the user to start, stop, or schedule cleaning.
   - Optional features include voice control or integration with smart home assistants.
6. **Power Management**:
   - The robot uses a rechargeable **Li-ion battery**, and the system monitors battery levels to return to the charging dock automatically.
7. **Testing and Optimization**:
   - The robot is tested on different floor types (tiles, wood, carpet) to optimize speed, cleaning efficiency, and obstacle handling.

SOFTWARE AND TECHNOLOGIES USED

1. **Microcontroller / Processor**

- Raspberry Pi / Arduino / ESP32 for control and processing.

2. **Programming Languages**

- Python – for image processing, control logic, and AI.
- C/C++ – for embedded system programming.

3. **Sensor Technologies**

- Ultrasonic Sensors – for obstacle detection.
- IR Sensors – for edge/cliff detection.
- LiDAR / Camera – for mapping and navigation.

4. **Navigation & Mapping Algorithms**

- SLAM (Simultaneous Localization and Mapping) – for smart navigation.
- Path Planning Algorithms – to ensure complete floor coverage.

5. **Wireless Communication**

- Wi-Fi / Bluetooth – for app-based control.
- IoT Platforms (MQTT, Blynk, Firebase, etc.) – for remote monitoring.

6. **Mobile Application / User Interface**

- Android/iOS Apps – for scheduling, control, and monitoring.

7. **Motor Control Technology**

- Motor Driver Modules (L293D, L298N, etc.) – to control wheels and brushes.

8. **Power Management**

- Rechargeable Li-ion Battery & Charging Dock – for autonomous recharging.

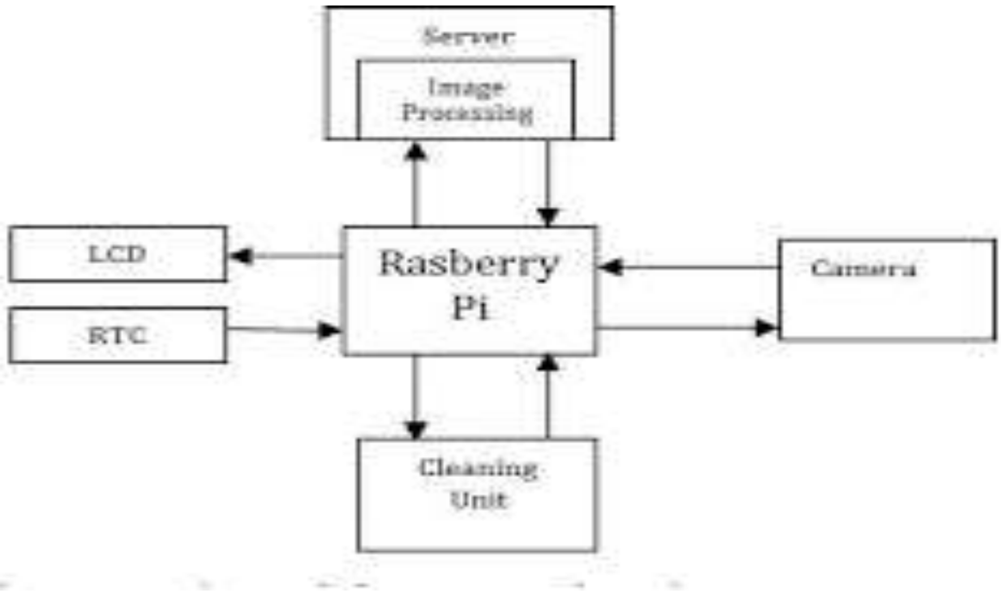
HARDWARE AND TECHNOLOGIES USED

1. **Processing Unit**
   - Raspberry Pi / Arduino / ESP32 for controlling the system.
2. **Sensors**
   - Ultrasonic Sensors – obstacle detection.
   - IR Sensors – edge/cliff detection.
   - LiDAR / Camera – mapping and navigation.
   - Dust/Surface Sensors – for dirt detection.
3. **Actuators & Motors**
   - DC Motors – for wheel movement.
   - Servo Motors – for brush/mop mechanism.
   - Suction Motor / Vacuum Pump – for dust collection.
4. **Cleaning Mechanism**
   - Rotating Brushes / Rollers.
   - Mop Pads / Wet Cleaning Unit.
   - Suction Chamber with Dustbin.
5. **Power Supply**
   - Rechargeable Li-ion Battery.
   - Charging Dock with Auto-Return Feature..

FEATURES

1. **Autonomous Navigation**:Uses sensors and mapping algorithms to move around without human guidance.
2. **Obstacle Detection and Avoidance**:Equipped with ultrasonic, infrared, or LiDAR sensorsto detect and avoid furniture, walls, and other obstacles.
3. **Edge and Cliff Detection**:Prevents the robot from falling off stairs or edges using IR or ultrasonic sensors.
4. **Multiple Cleaning Modes**:Supports vacuuming, sweeping, and mopping depending on floor type and user preference.
5. **Smart Scheduling**:Allows users to set cleaning times through a mobile app or web interface.

BLOCLK DIAGRAM



ADVANTAGES

1. **Time-Saving**:Cleans floors autonomously, reducing the need for manual cleaning.
2. **Efficient Cleaning**:Covers large areas systematically, ensuring thorough cleaning without missing spots.
3. **Convenience**:Can be scheduled to clean automatically at specific times.
4. **Energy Efficient**:Uses optimized battery and cleaning patterns to save energy.
5. **Easy to Use**:Simple controls via smartphone apps, remote, or voice assistants.
6. **Accessibility**:Reaches under furniture, corners, and tight spaces that are difficult to clean manually.
7. **Reduces Physical Effort**:Ideal for elderly or physically challenged individuals, eliminating strenuous work.
8. **Adaptive to Different Floor Types**:Can clean tiles, hardwood, carpets, or laminate without damaging surfaces.
9. **Smart Obstacle Handling**:Avoids collisions, stairs, and fragile objects, protecting furniture and itself.
10. **Continuous Improvement**:Advanced models can learn the layout of the home for optimized cleaning routes.

CONCLUSION

Smart floor cleaners represent a significant advancement in home and commercial cleaning technology. By integrating sensors, autonomous navigation, and smart control systems, these devices reduce human effort, save time, and ensure efficient cleaning across different floor types. They offer convenience through scheduling, remote control, and automatic charging while adapting to obstacles and home layouts. However, limitations such as high initial cost, maintenance requirements, and reduced effectiveness on heavily soiled areas highlight that they complement rather than fully replace manual cleaning. Overall, smart floor cleaners are a practical, time-saving solution that enhances cleanliness and convenience, reflecting the growing role of robotics and IoT in daily life.

ACKNOWLEDGEMENT

It is great pleasure for me to acknowledge the assistance and contribution of number of individuals who helped me in developing, Smart glasses for blind people and foremost, I wish to record my gratitude and thanks to (……..) (Lecture)for his enthusiastic guidance and help in successful completion of Project work. I express my thanks to Mrs. Shushma Patwardhan (Head of Electronics and Telecommunication Department) for their valuable guidance. I am also thankful to other teachers and non-teaching staff of Electronics and Telecommunication Department and Library for their co- operation and help.

REFERENCES

1 Kavitha, S., Mahesh, J., Manohar, G.D., Arun Kumar, P., & Mallikarjuna Rao, L. (2023). *Design and Implementation of IoT based Floor Cleaning Robot for Healthy Environment*. International Journal of Engineering Research & Technology (IJERT), 12(04). IJERT

2 Shah, Y., Rindhe, B., Salunkhe, P., Shinde, O., & Shaikh, S. (2022). *IoT Based Floor Cleaning Robot*. IJRASET. IJRASET

3 Nirosha, K., Sai Harshini, K., Divya, K., Nikitha Reddy, K., & Snigdha Reddy, P. (2024). *Solar Based Floor Cleaning Robot Using IoT*. Journal of Image Processing & Intelligent Remote Sensing (JIPIRS), 4(03), 14–25. HM Journals

4 Pookkuttath, S., Elara, M.R., Mohan Rayguru, M., Saldi, Z.S., Sivanantham, V., & Ramalingam, B. (2023). *Snail: An Eco-Friendly Autonomous Steam Mopping Robot for Cleaning and Disinfection of Floors*. Mathematics, 11(5), 1086. MDPI

5 Butaney, S., Gaurav, K., Ranjan, P., & Shrivas, N.V. (2024). *Recent developments in autonomous floor-cleaning robots: a review*. Industrial Robot: the international journal of robotics research and application, 3, 362–380. Ouci

6 Nair, V.G. (2024, Feb). *Efficient Path Planning Algorithm for Mobile Robots Performing Floor Cleaning Like Operations*. Journal of Robotics and Control (JRC), 5(1), 287–300. Journal UMY

7 Patil, A.S., Mali, A.S., Desai, P.S., & Kadam, A.S. (2024, Apr 19). *Smart Floor Cleaner*. Journal of Microprocessor and Microcontroller Research. MAT Journals

8 Guruprasad, A.M., Anusha, Meghana B.M., Sanjana K.T., & Vaishnavi Kumar. (2025, May). *Autonomous Floor Cleaning Robot*. International Journal of Innovative Science and Research Technology (IJISRT), Vol 10 Issue 5.