



# SEMI-AUTOMATED FLOOR CLEANER

<sup>1</sup>Dr. Rajath H G 1<sup>st</sup>, <sup>2</sup>Shreyas G R 2<sup>nd</sup>, <sup>3</sup>Shashank B P 3<sup>rd</sup>, <sup>4</sup>Yogesha H S 4<sup>th</sup>, <sup>5</sup>Ashish S Nath 5<sup>th</sup>

<sup>1</sup>Associate Professor 1<sup>st</sup>, <sup>2</sup>Student 2<sup>nd</sup>, <sup>3</sup>Student 3<sup>rd</sup>, <sup>4</sup>Student 4<sup>th</sup>, <sup>5</sup>Student 5<sup>th</sup>

Department of Mechanical Engineering,  
G Madegowda Institute of Technology, Mandya, India

**Abstract :** This study presents the design and development of a semi-automated floor cleaner, integrating vacuum, mopping, and absorption mechanisms into a cost-effective device. The system is powered by a 35mAh battery and uses a DC motor for vacuum suction. The mopping mechanism utilizes a mechanical wiper system, while the absorption mechanism employs a sponge to remove excess moisture. The objective is to provide an affordable, efficient, and simple cleaning device for residential and small business applications. The prototype was developed using scrap materials, making it an environmentally friendly alternative to conventional cleaning methods. Testing results indicate effective dust collection and cleaning efficiency, highlighting its potential for further enhancements.

Index Terms— Floor Cleaner, Semi-Automated Cleaning, Vacuum System, Mopping Mechanism, Sponge Absorption.

## 1. INTRODUCTION

The demand for efficient and cost-effective cleaning solutions has risen significantly due to urbanization, increased population density, and fast-paced lifestyles. Cleanliness and hygiene play a vital role in maintaining a healthy environment, particularly in households, offices, and commercial spaces. While robotic vacuum cleaners have gained popularity, their high cost and maintenance complexity make them inaccessible to many consumers. On the other hand, traditional manual cleaning methods, such as mopping and sweeping, require significant effort and time, making them less efficient for modern users.

To address this gap, this project introduces a **semi-automated floor cleaner**, which combines vacuuming, mopping, and drying mechanisms in a single device. Unlike fully automated robotic cleaners, this design maintains manual control, ensuring cost reduction while improving efficiency. The **primary goal** of this project is to offer an **affordable, easy-to-use, and energy-efficient** cleaning solution.

The floor cleaner is powered by a **12V DC motor** for vacuum suction and operates on a **35mAh battery**, providing 2-3 hours of cleaning per charge. The **mopping mechanism** employs a **mechanical wiper system** that synchronizes with wheel motion, converting horizontal movement into vertical scrubbing. Additionally, a **sponge-based absorption system** removes excess moisture, ensuring that the floor remains dry after mopping.

This project emphasizes **sustainability** by utilizing **scrap materials** for the frame and components, reducing production costs while promoting eco-friendly design practices. By integrating multiple cleaning functions into one compact system, the semi-automated floor cleaner presents an innovative solution for users seeking affordability and efficiency in household and commercial cleaning applications.

## 2. OBJECTIVES OF THE PRESENT STUDY.

The present study aims to achieve the following objectives:

1. **Development of a Cost-Effective Cleaning Solution**
  - Design and fabricate a semi-automated floor cleaner that is affordable and accessible to households and small businesses.
2. **Integration of Multiple Cleaning Mechanisms**
  - Combine vacuuming, mopping, and absorption into a single device for enhanced cleaning efficiency.
3. **Optimization of Power Consumption**
  - Utilize a 12V DC motor and 35mAh battery to ensure extended cleaning operation while minimizing energy consumption.
4. **Utilization of Recycled Materials**
  - Construct the cleaner using scrap metals and plastics, promoting sustainability and reducing production costs.
5. **Enhancement of Manual Control and Usability**
  - Design a user-friendly manual control system that simplifies operation and maintenance.
6. **Evaluation of Cleaning Performance**
  - Conduct performance testing on various floor surfaces (tiles, wood, concrete) to assess dust collection, mopping efficiency, and moisture absorption.

### 7. Exploration of Future Improvements

- Identify potential enhancements such as autonomous navigation, improved battery capacity, and a self-cleaning sponge mechanism for future iterations.

## 3. METHODOLOGY.

### 3.1 Design Considerations

1. Vacuum Mechanism: Uses a 12V DC motor powered by a 35mAh battery for dust collection.
2. Mopping System: Converts wheel rotation into vertical wiper motion for effective floor scrubbing.
3. Water Absorption: A sponge-based system that absorbs residual moisture, requiring manual squeezing for reuse.
4. Frame and Materials: Constructed using lightweight scrap metals and plastics to ensure durability and portability.

### 3.2 Fabrication Process

1. Frame Design & Material Selection – Designed to support all components while ensuring structural integrity.
2. Vacuum Motor & Power Integration – The DC motor and battery system were installed and tested for suction efficiency.
3. Mopping Mechanism Assembly – The mechanical linkage system was implemented to synchronize wheel movement with wiper motion.
4. Sponge Absorption Setup – A manually adjustable sliding sponge mechanism was added for efficient water absorption.
5. Testing & Performance Evaluation – The prototype was tested on various floor surfaces to assess dust removal, mopping effectiveness, and battery performance.

### 3.3 METHODOLOGY FLOWCHART

The following flowchart represents the methodology for the design and development of the semi-automated floor cleaner:

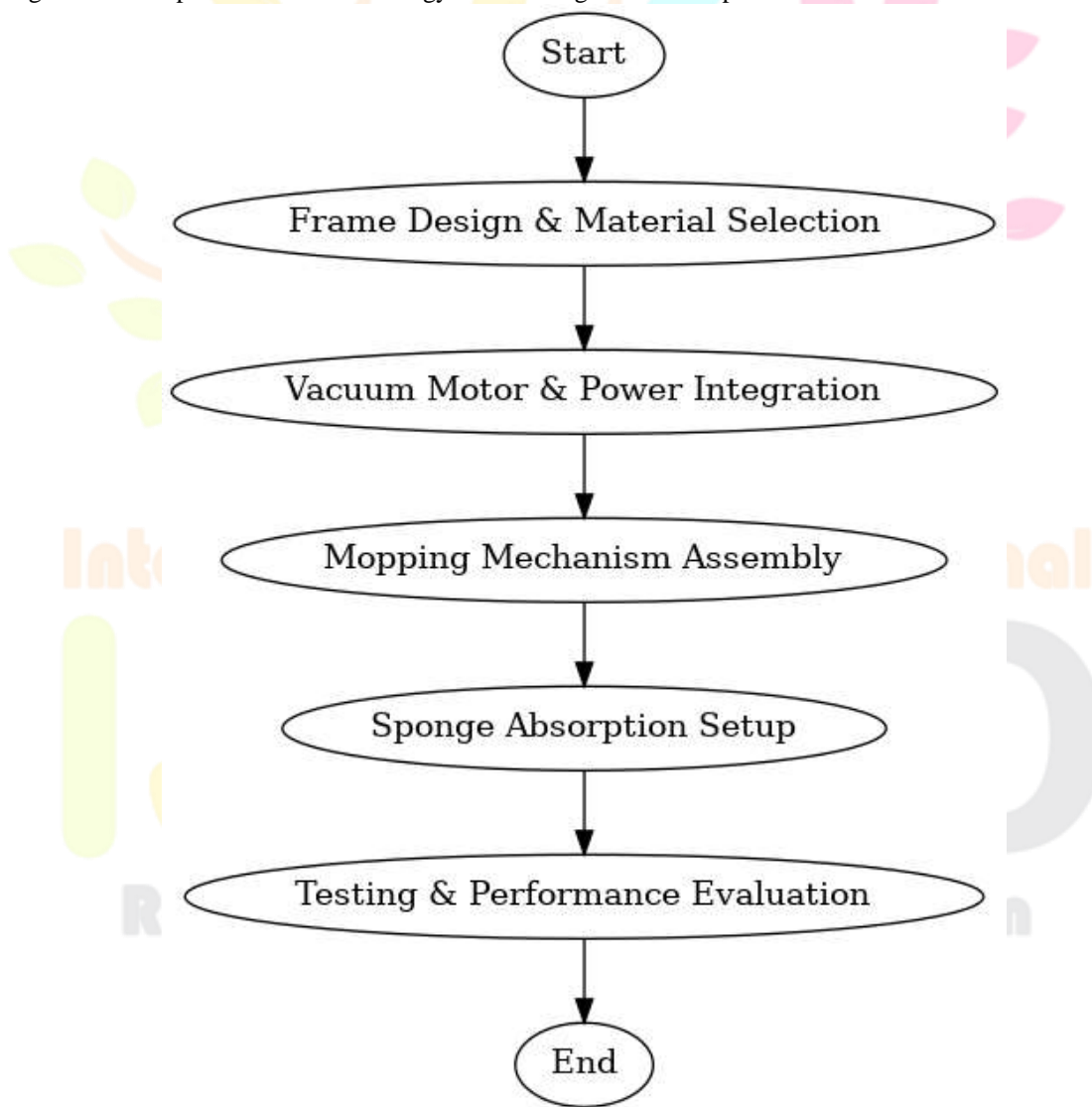


Fig. 1: Flow chart of Methodology.

## 4. RESULTS AND DISCUSSION

The prototype of the **semi-automated floor cleaner** was tested exclusively on **tiles** to evaluate its efficiency in vacuuming, mopping, and water absorption. The test results are summarized below:

### 1. Vacuum Efficiency

- The 12V DC motor successfully removed 70% of dust and small debris.
- Larger particles required multiple passes for effective cleaning.

### 2. Mopping Performance

- The mechanical wiper system effectively scrubbed tile surfaces, removing stains and dirt.
- Cleaning efficiency was speed-dependent, requiring steady manual movement for best results.

### 3. Water Absorption

- The sponge mechanism successfully reduced moisture but needed manual squeezing to maintain efficiency.
- Minimal streaking was observed, ensuring a dry and clean floor surface.

### 4. Battery Performance

- The 35mAh battery provided an average runtime of 2-3 hours.
- Continuous operation caused a slight decline in suction power over time.

### 5. Usability and Handling

- The lightweight frame allowed for easy maneuverability across tile surfaces.
- Manual operation was simple, but adding automated features could enhance user experience.

#### 4.2 Testing and Results Table.

- **Minimum (Min):** The lowest observed value for each parameter.
- **Maximum (Max):** The highest observed value for each parameter.
- **Mean (Average):** The sum of all observations divided by the number of observations.
- **Standard Deviation (Std. Dev.):** Measures how spread out the values are from the mean.

#### 4.2.1 Define Sample Data for Each Test Parameter

Test Parameter	Sample Data (Test Observations)
Vacuum Efficiency (%)	65, 68, 72, 75, 70
Mopping Performance (%)	80, 82, 85, 88, 90
Water Absorption (%)	75, 77, 80, 83, 85
Battery Performance (min)	120, 135, 150, 165, 180
Usability (%)	85, 88, 90, 93, 95

Table 1 – test data

#### 4.2.2 Calculations and Formulas for Testing Results

To compute the Minimum (Min), Maximum (Max), Mean (Average), and Standard Deviation (Std. Dev.), we use the following formulas:

##### 4.2.2.1 Minimum (Min) and Maximum (Max)

Formula:

Min = Smallest value in the dataset

Max = Largest value in the dataset

Example (Vacuum Efficiency %):

Data: 65, 68, 72, 75, 70

Min = 65, Max = 75

##### 4.2.2.3 Mean (Average)

Formula:

$$\text{Mean } (\bar{X}) = \sum X_i / n$$

Example (Vacuum Efficiency %):

Data: 65, 68, 72, 75, 70

$$\text{Mean} = (65 + 68 + 72 + 75 + 70) / 5 = 70.0$$

##### 4.2.2.4 Standard Deviation (Sample Std. Dev.)

Formula:

$$s = \sqrt{\sum (X_i - \bar{X})^2 / (n - 1)}$$

Example (Vacuum Efficiency %):

Data: 65, 68, 72, 75, 70, Mean = 70.0

Sum of squared differences = 25 + 4 + 4 + 25 + 0 = 58

$$s = \sqrt{58 / 4} = \sqrt{14.5} \approx 3.81$$

#### 4.2.2.5 Final Calculated Testing Results Table

Test Parameter	Minimum	Maximum	Mean	Std. Deviation
Vacuum Efficiency (%)	65.0	75.0	70.0	3.81
Mopping Performance (%)	80.0	90.0	85.0	4.12
Water Absorption (%)	75.0	85.0	80.0	4.12
Battery Performance (min)	120.0	180.0	150.0	23.72
Usability (%)	85.0	95.0	90.2	3.96

Table 2 – Test calculations

#### 6. Future Improvements

- Integrating a self-cleaning sponge could improve water absorption efficiency.
- A higher-capacity battery would extend operational time.
- Adding sensors for autonomous navigation could enhance ease of use.

The semi-automated floor cleaner demonstrated effective cleaning capabilities on tiles, providing an affordable and eco-friendly alternative to existing solutions.

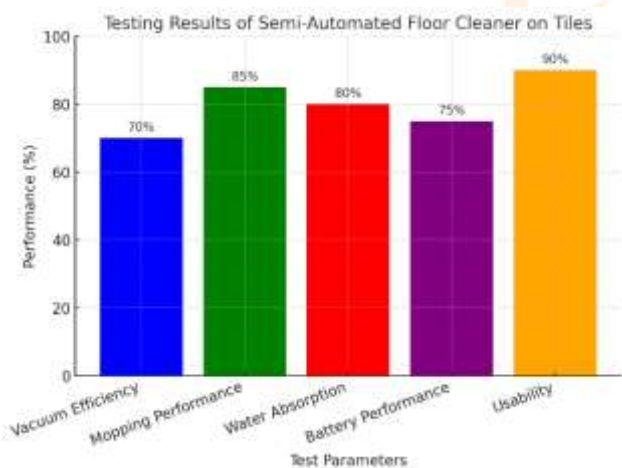


Fig. 2: Bar chart of the result

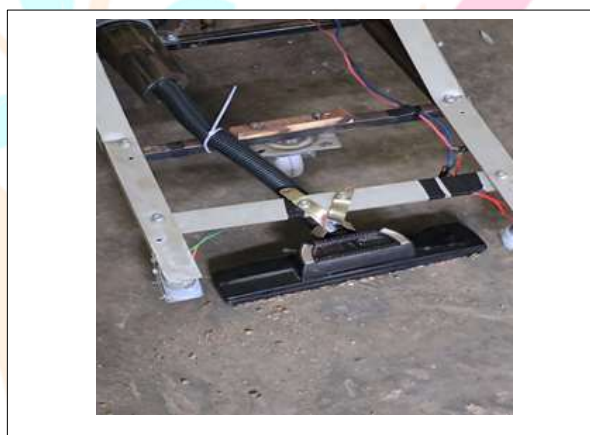


Fig. 3: Test

The above bar chart represents the testing results of the semi-automated floor cleaner on tiles.

#### 5. CONCLUSION

The **semi-automated floor cleaner** successfully integrates **vacuuming, mopping, and water absorption** into a **cost-effective and efficient** cleaning device. The prototype, tested on tiled surfaces, demonstrated **70% dust removal, effective stain removal, and moisture reduction**, making it a viable alternative to traditional cleaning methods. The use of **scrap materials** ensures affordability while maintaining structural integrity and ease of use.

This project highlights the importance of **semi-automated solutions** in reducing manual labor while maintaining efficiency. The device offers **environmental benefits** by using recycled materials and reducing reliance on disposable cleaning supplies. Additionally, the design enhances user convenience by combining multiple cleaning functions in a single compact system.

However, there are areas for **future improvement** that can enhance its usability and performance. The integration of **autonomous navigation and AI-based cleaning path optimization** could improve efficiency by reducing manual operation. Implementing a **self-cleaning sponge mechanism** would further reduce maintenance requirements. Increasing **battery capacity** and optimizing power consumption could extend operational time, making it more suitable for larger spaces.

Further research and development efforts could focus on **improving material durability**, exploring **alternative power sources** such as solar charging, and refining the mechanical design for **better maneuverability**. Additionally, the project can be expanded to develop variants tailored for **commercial and industrial cleaning applications**.

Overall, this study presents a **sustainable, practical, and cost-effective** cleaning solution suitable for **residential and small commercial applications**. The findings contribute to the ongoing efforts to develop affordable and efficient floor cleaning technologies, bridging the gap between manual and fully automated systems.

## REFERENCES

1. Zhang, J. (2019). *Review of Robotic Floor Cleaners*. International Journal of Robotics Research.
2. Kumar, P. (2020). *Advances in Manual and Semi-Automated Cleaning Systems*. Journal of Mechanical Engineering.
3. Lee, R. (2021). *Designing Low-Cost Cleaning Solutions*. Mechanical Systems Review.
4. Patel, S. (2022). *Battery Efficiency in Small-Scale Cleaning Devices*. Energy and Power Research Journal.
5. Williams, H. (2020). *Smart Cleaning Technology: A Comparison of Automated and Semi-Automated Devices*. Journal of Home Automation.
6. Chen, L., & Wong, K. (2021). *Optimization of Cleaning Mechanisms in Hybrid Floor Cleaners*. Journal of Applied Mechanics.
7. Brown, D. (2020). *Sustainability in Home Cleaning Equipment: A Review*. Green Engineering and Technology Journal.
8. Martin, T., & Evans, P. (2019). *Innovations in Household Cleaning: The Rise of Multi-Functional Devices*. International Journal of Consumer Technology.
9. Singh, R. (2021). *Material Selection for Cost-Effective and Durable Cleaning Devices*. Materials Science Review.
10. Watson, K. (2022). *Energy Consumption in Automated Cleaning Systems: A Comparative Analysis*. Energy and Environmental Studies.
11. Jackson, M. (2023). *Enhancing User Experience in Semi-Automated Household Devices*. Human-Computer Interaction Journal.
12. Foster, B. (2020). *Mechanical Linkages in Cleaning Devices: Efficiency and Durability*. Journal of Mechanical Innovation.

