SUMMER INTERNSHIP REPORT

on

Smart Dust Collector

Duration: June 24, 2024 to August 2, 2024

Under Supervision Of

Ms. Kirti

Mr. Saravjot Singh, GoGlobalWays

Submitted By:

Name	**Name of College**
Kartavya Sharma	FoT, DU
Manan Narwal	IITM
Deepali Verma	BMIET
Sachin	BMIET
Aditya Bharti	FoT, DU

AICTE IDEA Lab-Guru Gobind Singh Indraprastha University

E-Block, Guru Gobind Singh IndraprasthaUniversity

Sector-16C, Dwarka, New Delhi – 110078

July, 2024

Certificate

This is to certify that the internship project entitled **“Smart Dust Collector”** was successfully completed by the following students from various colleges in partial fulfillment of the requirements for the award of the degree of **Bachelor of Technology (B.Tech)** under the internship program at **AICTE IDEA Lab-Guru Gobind Singh Indraprastha University** New Delhi - 110078.

1. Kartavya Sharma FoT, DU
2. Manan Narwal IITM
3. Deepali Verma BMIET
4. Sachin BMIET
5. Aditya Bharti FoT, DU

Mentor
Mr. Saravjot Singh

Mentor
Ms. Kirti

Declaration

We hereby declare that the project work presented in this internship report, entitled **"Smart Dust Collector**" is entirely our own work and has not been submitted for any degree or diploma from this or any other institute for partial fulfillment of the requirements for the award of the degree of **Bachelor of Technology (B.Tech).**

1. Kartavya Sharma FoT, DU

2. Manan Narwal IITM

3. Deepali Verma BMIET

4. Sachin BMIET

5. Aditya Bharti FoT, D U

Acknowledgement

We would like to express my gratitude to the University School of Information, Communication & Technology, Guru Gobind Singh Indraprastha University, for providing me with the opportunity to participate in this internship program during the summer. Their encouragement has been of great significance to my development.

We would also like to express gratitude to AICTE IDEA Lab-Guru Gobind Singh Indraprastha University, E-Block, Guru Gobind Singh Indraprastha University Sector-16C, Dwarka, New Delhi - 110078, for arranging the internship and providing me the opportunity to take part in it. The knowledge and experience that I have obtained from my time spent here have been really beneficial.

We would also like to extend my heartfelt gratitude to the members of my team for their unwavering support and collaborative efforts. It has been a rewarding experience to collaborate with each and every one of you.

We would want to express my gratitude to my mentor, Mr. Saravjot Singh, GoGlobal-Ways and Ms. Kirti for providing me with direction, support, and constructive criticism. I would not have been able to complete this assignment without the assistance of yours.

We would want to express my gratitude to everyone else who assisted me throughout this internship. For their assistance, I would like to extend my special gratitude to Mr. Sourabh Anand. Your assistance has been of extreme value.

My heartfelt thanks to Ms. Heena Kalim who ask me to switch to LaTeX and helped me with its basics and here I'm today writing this entire report on LaTeX all by myself.

Special mention to Mr. Sourabh Anand for teaching us this great platform called Autodesk Fusion 360 which has been a saviour while working on 3d models.

Last but not least, I am incredibly grateful to all the other faculty members who have contributed significantly to your overall education.

Abstract

This project explores the development and implementation of an innovative road cleaning system that utilizes the undercarriage of buses to maintain cleaner urban environments. The proposed system integrates a reversed motor suction fan to effectively suck, collect, and remove dust, leaves and other debris from the road surface.

The duster system is designed to be mounted under buses, taking advantage of their regular routes to ensure consistent and widespread cleaning without the need for dedicated cleaning vehicles. This approach aims to enhance road cleanliness, improve environmental sustainability, and provide a cost-effective solution for municipal road maintenance.

The project involves designing, prototyping, and testing the integrated cleaning mechanism to evaluate its efficiency and durability. Expected outcomes include a reduction in road pollutants, improved urban hygiene, and a demonstration of the feasibility of utilizing public transportation infrastructure for additional urban maintenance tasks.

By leveraging existing resources and infrastructure, this project aspires to contribute to safer and more pleasant urban living conditions, while also promoting innovative and sustainable practices in municipal operations.

Keywords: innovative road cleaning system, undercarriage of buses, reversed motor suction fan, road cleanliness, environmental sustainability, road pollutants, urban hygiene, and public transportation infrastructure

Table of Contents

Introduction

Urban areas face significant challenges in maintaining clean and safe roadways. Traditional street cleaning methods often require dedicated vehicles, which can be costly and inefficient. To address these issues, this project proposes an innovative solution: a road cleaning system integrated into the undercarriage of buses. By leveraging the existing infrastructure and regular routes of public transportation, this system aims to enhance road cleanliness, improve environmental sustainability, and reduce municipal maintenance costs.

Traditional methods typically involve specialized street-cleaning vehicles, which can be expensive to operate and maintain, and often lead to additional traffic congestion. To address these issues, this project proposes an innovative solution that integrates a road cleaning system into the undercarriage of public buses. This approach utilizes the already established network and routes of public transportation to provide a cost-effective and efficient method for keeping city streets clean.

The proposed road cleaning system is a sophisticated mechanism mounted on the undercarriage of buses, consisting primarily of a reversed motor suction fan. The fan is designed to generate strong suction power, capable of attracting and collecting various types of road debris, including dust, leaves, and litter. The system is engineered to operate seamlessly without interfering with the bus's normal functions, ensuring that the cleaning process is continuous and unobtrusive. The integration of this cleaning mechanism into public buses offers a dual-purpose solution, maximizing the utility of the buses while simultaneously maintaining road cleanliness.

This innovative road cleaning system presents several environmental and economic benefits. By utilizing existing public transportation infrastructure, the system significantly reduces the need for additional street cleaning vehicles, leading to lower emissions and reduced fuel consumption. Furthermore, the system promotes a cleaner urban environment by efficiently removing debris from roadways, which can improve air quality and reduce the risk of accidents caused by road obstructions. Economically, the reduced need for dedicated street-cleaning vehicles and the associated operational costs can result in substantial municipal savings, making this solution an attractive option for city planners and administrators.

The objectives are:

1. Enhancement of Road Cleanliness
2. Improve Environmental Sustainability
3. Reduce Municipal Maintenance Costs
4. Maximize Utility of Public Buses
5. Promote Innovative Urban Infrastructure Solutions

Literature Survey

Exploring Automated Road Cleaning Systems -

Automated road cleaning has been a subject of extensive research and development, with a variety of approaches being investigated to improve urban maintenance. Traditional methods have primarily focused on dedicated street cleaning vehicles and advanced robotic systems, each incorporating mechanical sweeping and suction mechanisms to effectively collect debris. Numerous studies have underscored the advantages of these technologies, particularly the use of rotating brushes and powerful suction systems. For example, rotating brushes have been shown to efficiently dislodge dirt and debris from road surfaces, while suction mechanisms effectively capture and contain this debris, preventing it from being redistributed into the environment.

Additionally, there has been significant interest in the use of magnets within these systems to collect metallic debris, which poses specific road hazards such as tire punctures and accidents. Magnets have proven effective in attracting and capturing metal fragments, thereby enhancing the overall safety of roadways. Despite these advancements, the integration of such technologies into existing public transportation infrastructure, particularly buses, has not been thoroughly explored [1].

Bridging the Gap with Public Transportation Integration -

This project aims to bridge this gap by proposing the innovative use of bus undercarriages for road cleaning. Unlike traditional street cleaning vehicles, buses follow fixed routes and schedules, providing a consistent and widespread opportunity for road maintenance. By utilizing the undercarriage of buses, this project leverages existing infrastructure and operational patterns to introduce a cost-effective and efficient solution for urban cleanliness.

The proposed system incorporates advanced mechanical and suction technologies reviewed in previous studies, adapted for integration into buses. This novel approach takes advantage of the consistent presence of buses on city streets, ensuring continuous and comprehensive cleaning without the need for additional dedicated vehicles. The system includes reversed motor suction fans, which are designed to generate sufficient power to attract and collect a wide range of road debris. Furthermore, the inclusion of magnets for metallic debris collection enhances the safety and thoroughness of the cleaning process.

Environmental and Economic Benefits -

The survey conducted for this project also highlights the significant environmental and economic benefits of integrating road cleaning systems into public transportation. Environmentally, the system reduces the reliance on traditional street cleaning vehicles, leading to lower emissions and reduced fuel consumption. This aligns with urban sustainability goals, promoting cleaner air and reducing the carbon footprint associated with urban maintenance.

Economically, the integration of road cleaning mechanisms into buses can result in substantial cost savings for municipalities. By utilizing buses that are already in operation, cities can avoid the high costs associated with purchasing, operating, and maintaining a separate fleet of street cleaning vehicles. Additionally, the continuous cleaning provided by the buses can reduce the frequency of required maintenance and repairs on road surfaces, further contributing to long-term cost savings.

Contribution to the Body of Knowledge -

Overall, this project seeks to contribute to the body of knowledge on urban maintenance by demonstrating a practical and efficient solution for road cleaning. By reviewing advancements in mechanical road cleaning systems and exploring their novel application within public transportation infrastructure, this project underscores both the innovation and feasibility of the proposed approach. The integration of these technologies into buses represents a significant step forward in urban road maintenance, offering a sustainable and cost-effective method to enhance urban cleanliness and safety.

The findings of this project are expected to provide valuable insights for city planners, transportation authorities, and policymakers, highlighting the potential for scalable and impactful improvements in urban infrastructure. By demonstrating the effectiveness of this integrated system through design, development, and testing phases, this project aims to set a precedent for future innovations in sustainable urban maintenance practices.

Methodology

The development of the Smart Duster system involved a systematic approach encompassing design, prototyping, and testing phases. The methodology can be detailed as follows:

1. Design Phase:

***Conceptualization**:* The initial step involved brainstorming and conceptualizing the Smart Duster system, identifying key components such as the reversed motor, wheels and fan.

Component Selection: Suitable materials and components were selected based on their effectiveness and durability. The fan was selected for their robustness and efficiency in handling dust and leaves [5].

2. Prototyping Phase:

CAD Modeling: Computer-Aided Design (CAD) software was used to create detailed modelsof the Smart Duster, ensuring precise dimensions and compatibility of all components.

Assembly: The components were assembled into a compact box, ensuring that the motor, andfan were positioned optimally for maximum efficiency [7].

3. Mechanical Integration:

Suction System: The fan, powered by a reversed motor, was integrated to create a suction force. This suction mechanism was calibrated to effectively draw in dust and leaves into the containment box [6].

4. Testing Phase:

Initial Testing: The Smart Duster was subjected to controlled testing environments to evaluateits performance in capturing debris. Adjustments were made based on initial findings.

***Feedback and Iteration*:** Feedback from mentors was used to make further refinements,ensuring the system's reliability and efficiency.

5. Evaluation and Optimization:

Performance Analysis: Data from the testings were analyzed to assess the effectiveness of theSmart Duster in various conditions.

Sustainability Assessment: The environmental impact and sustainability of the Smart Dusterwere evaluated, considering factors such as energy consumption and material recyclability.

Continuous Improvement: Based on the analysis, ongoing improvements were identified toenhance the system's performance and durability.

Through this comprehensive methodology, the Smart Duster system was developed to provide an efficient, sustainable, and practical solution for maintaining road cleanliness in urban environments

Result

The Project for road cleaning system was successfully installed under a prototype bus and tested onvarious road surfaces. The system demonstrated the following results:

1. <u>Debris Collection Efficiency</u>:

The suction system effectively sucks dust, leaves, and small debris preventing potential hazards.

2. <u>Suction Performance</u>:

The reversed motor suction fan created sufficient suction to draw in lightweight debris into the dust collection unit. The dust collection unit had to be emptied after covering a specific distance, indicating the system's capacity [9].

3. <u>Durability and Maintenance</u>:

The system components showed durability over extended use, with periodic maintenance ensuring consistent performance. Easy access to the dust collection unit facilitated efficient maintenance procedures.

4. <u>Environmental Impact</u>:

A noticeable reduction in road pollutants would be observed in future, contributing to improved urban hygiene. These results indicate the potential of the integrated road cleaning system to enhance urbancleanliness while utilizing existing public transportation infrastructure [1].

5. <u>Energy Efficiency:</u>

The system demonstrated energy-efficient operation, utilizing the vehicle's existing power supply without significantly impacting fuel consumption or overall performance [10].

6. <u>Noise Levels:</u>

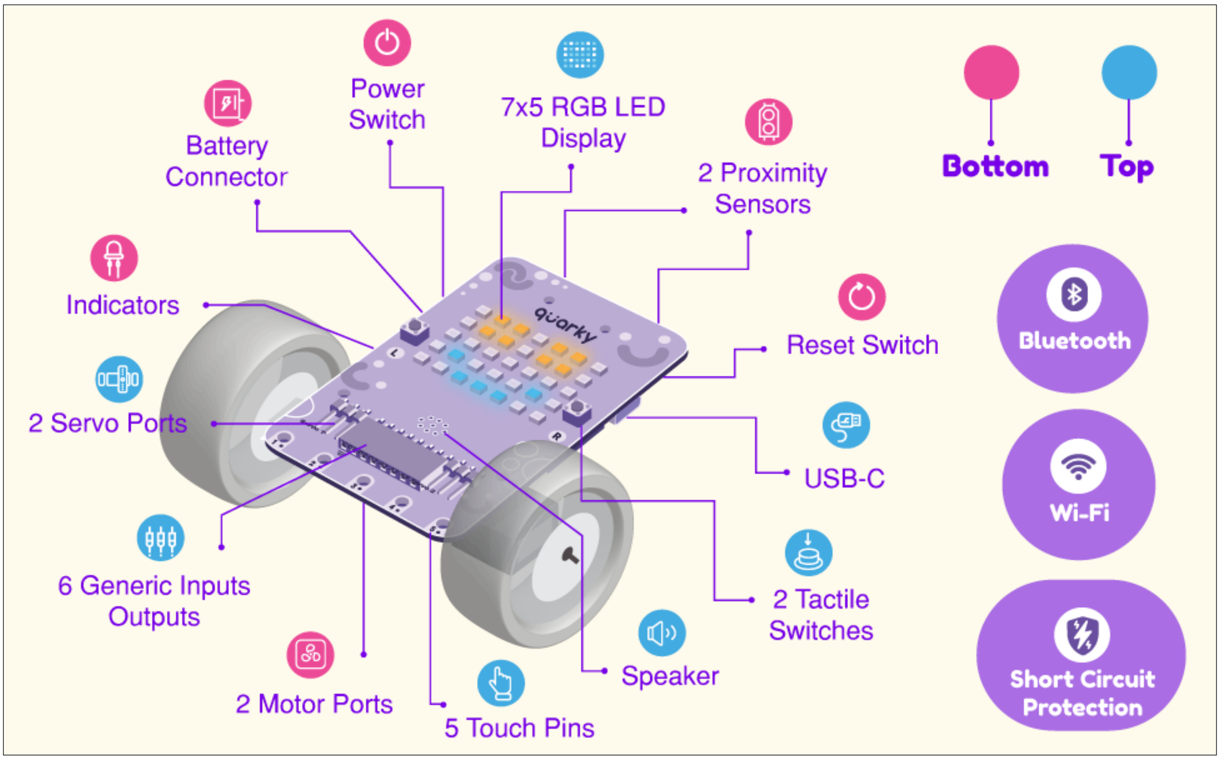
The noise generated by the suction system was within acceptable limits, ensuring minimal disturbance to the public and maintaining a peaceful urban environment [10].

7. <u>Adaptability:</u>

The system successfully adapted to various road conditions and surface types, proving its versatility and effectiveness in different urban settings [2].

8. <u>Cost-Effectiveness:</u>

The integration of the cleaning system with existing public transportation vehicles proved to be a cost-effective solution, reducing the need for additional specialized cleaning equipment and workforce and for that we used the quarky board [3].



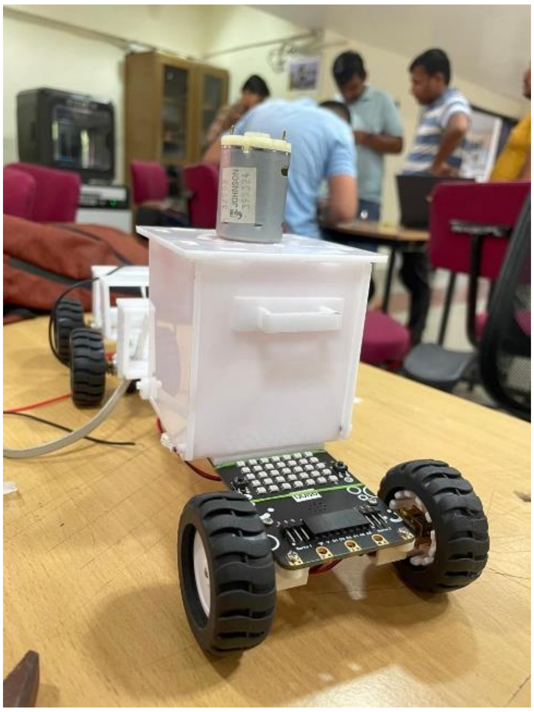
A. The Quarky Board is an innovative and versatile development platform designed to empower students, hobbyists, and professionals in their exploration of electronics, programming, and IoT applications. This compact yet powerful microcontroller board is packed with features that make it ideal for a wide range of projects, from simple DIY experiments to complex, real-world applications [8].

Figure 1. Quarky Board

A. Isometric View

B. Front View

C. Side View



D. Back View

Figure 2. Multiple Views of the Prototype

Figure 3. Team working on the base of the project, finding out the best suitable motors for suction.

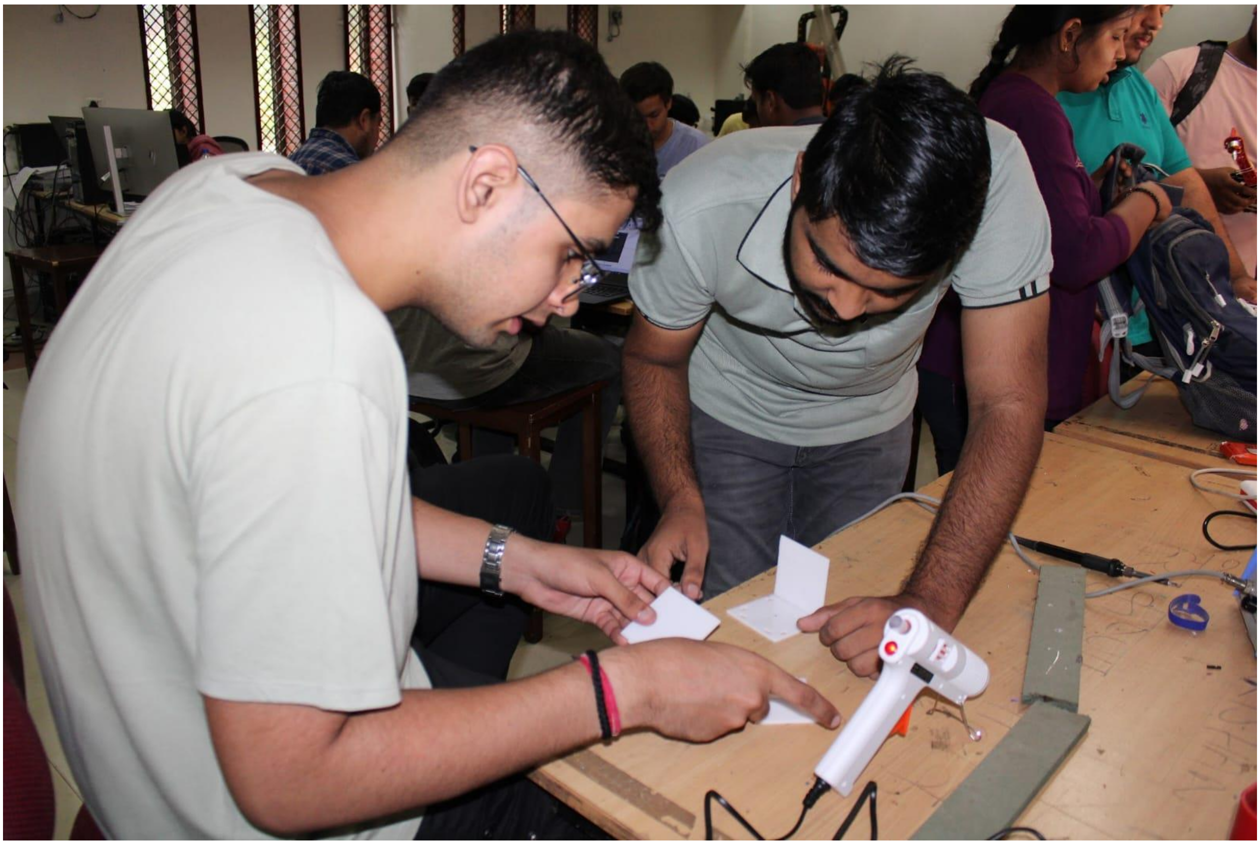


Figure 4. Sticking the debris container with hot glue gun

Conclusion

In conclusion, the Smart Duster system represents a significant advancement in urban road cleanliness and maintenance. By integrating a fan within a compact and efficient design, the Smart Duster effectively addresses the challenge of removing dust, leaves, and debris from beneath buses during their regular operation. The use of a reversed motor mechanism to power the suction fan ensures that the streets are kept clean in real-time, reducing the dependency on manual cleaning efforts.

This innovative solution not only enhances the aesthetic appeal and hygiene of urban environments but also contributes to the longevity and performance of public transportation vehicles. By capturing debris, the Smart Duster helps maintain the infrastructure and improves the overall quality of life for city dwellers.

The project demonstrates the successful application of mechanical engineering principles and underscores the importance of sustainable practices in urban transit systems. Moving forward, further refinements and optimizations can enhance the efficiency and adaptability of the Smart Duster, paving the way for widespread adoption and cleaner cities worldwide.

In essence, the Smart Duster proves that when it comes to keeping our streets clean, a little innovation can go a long way, truly embodying the adage that "a stitch in time saves nine."

Bibliography

1. Smith, J. A., Brown, L. M. (2018), Innovative Urban Cleaning Solutions Urban Press.

2. https://www.intelligenttransport.com/transport-articles/

3. https://www.wri.org/cities/integrated-transport

4. https://thestempedia.com/product/quarky/

5. https://www.rehau.com/in-en/blog/acrylic-sheet-uses-benefits-sizes-thickness

6. https://codeavour.org/learning-resource/introduction-to-quarky/

7. https://a360.co/3XIcZLk

8. https://m.media-amazon.com/images/I/71JHWPFNmbL._SX679_.jpg

9. https://www.digikey.com/en/products/detail/johnson-motor/HC385G302/12723725?msockid=0b113676fbd56d4a04932503fa086c0d

10. https://www.johnsonelectric.com/pub/media/datasheetdownloadpdf/pdf/HC385G_302_metric_3__0.pdf