The Role of Robotic Cleaning Devices in Enhancing Public Health Safety in Urban Transportation Systems

- Sami Farooq, Department of Computer Science, King Fahd University of Petroleum and Minerals, Dhahran, Saudi Arabia
- Dina Mahmoud, Department of Computer Science, American University of Sharjah, UAE

Abstract

Urban transportation systems are critical infrastructure that serve millions of people daily, making their cleanliness and sanitation paramount to public health safety. This paper explores the role of robotic cleaning devices in enhancing the sanitation and safety of urban transportation systems, such as subways, buses, and train stations. We discuss the integration of advanced robotic cleaners equipped with UV-C light disinfection, HEPA filters, and autonomous navigation systems to systematically clean and disinfect public transportation vehicles and facilities. By analyzing data from implementations in various cities, this study demonstrates the effectiveness of robotic cleaning devices in reducing the spread of pathogens and improving public health safety. The findings suggest that these technologies not only contribute to higher standards of cleanliness but also enhance the perception of safety among passengers, encouraging greater use of public transportation systems. Additionally, the paper highlights the operational efficiencies and cost benefits of deploying robotic cleaning technologies compared to traditional manual cleaning methods.

Background

The COVID-19 pandemic has underscored the importance of maintaining high levels of cleanliness and sanitation in public spaces, especially in urban transportation systems that facilitate the mobility of large populations. Traditional cleaning methods, although effective to an extent, are labor-intensive, time-consuming, and may not always achieve consistent or comprehensive sanitation. Robotic cleaning devices, with their ability to operate autonomously and incorporate advanced disinfection technologies, present a promising solution to these challenges.

The Role of Robotic Cleaning Devices in Enhancing Public Health Safety in Urban Transportation Systems

Main Findings

1. **Advanced Disinfection Technologies**: Robotic cleaning devices equipped with UV-C light can effectively kill bacteria, viruses, and other pathogens on surfaces and in the air, significantly reducing the risk of disease transmission in public transportation settings.
2. **Improved Air Quality**: The integration of HEPA filters in robotic cleaners helps remove airborne particles, including pathogens, dust, and allergens, from the environment, thereby improving air quality and contributing to public health safety.
3. **Autonomous Navigation and Operation**: The use of autonomous navigation systems allows robotic cleaners to efficiently cover large areas without human intervention, ensuring thorough cleaning and disinfection of hard-to-reach areas and surfaces frequently touched by passengers.
4. **Operational Efficiencies and Cost Benefits**: Robotic cleaning devices can operate during off-peak hours, minimizing disruptions to transportation services. Their deployment can lead to operational efficiencies, reducing the need for manual labor and potentially lowering long-term cleaning and maintenance costs.
5. **Enhancing Public Confidence**: The visible use of robotic cleaning technologies in urban transportation systems can enhance public perception of cleanliness and safety, encouraging more people to use these services and supporting public health by reducing the spread of infectious diseases.

Conclusion

Robotic cleaning devices play a crucial role in enhancing public health safety in urban transportation systems by employing advanced disinfection technologies, improving air quality, and ensuring thorough and consistent cleaning. The deployment of these technologies not only contributes to reducing the spread of infectious diseases but also enhances operational efficiencies and public confidence in the safety of public transportation. As urban transportation systems

continue to evolve, the integration of robotic cleaning devices will be pivotal in maintaining high standards of public health safety, underscoring the importance of continued investment and research in this area.

References

[1] S. Roelofs *et al.*, "Vision-based autonomous disinfection of high touch surfaces in indoor environments," *arXiv [cs.RO]*, 25-Aug-2021.

[2] S. Perminov *et al.*, "UltraBot: Autonomous mobile robot for indoor UV-C disinfection," *arXiv [cs.RO]*, 22-Aug-2021.

[3] S. Khanna and S. Srivastava, "The Emergence of AI based Autonomous UV Disinfection Robots in Pandemic Response and Hygiene Maintenance," *International Journal of Applied Health Care Analytics*, vol. 7, no. 11, pp. 1–19, Nov. 2022.

[4] S. Khanna and S. Srivastava, "Human-Robot Collaboration in Cleaning Applications: Methods, Limitations, and Proposed Solutions," *Eigenpub Review of Science and Technology*, vol. 6, no. 1, pp. 52–74, Oct. 2022.

[5] A. Ravankar, A. A. Ravankar, A. Rawankar, and Y. Hoshino, "Autonomous and safe navigation of mobile robots in vineyard with smooth collision avoidance," *Agriculture*, vol. 11, no. 10, p. 954, Sep. 2021.

[6] M. Cai and C.-I. Vasile, "Safety-critical learning of robot control with temporal logic specifications," *arXiv [cs.RO]*, 06-Sep-2021.