

E-BOOK OF EXTENDED ABSTRACT

THE 14TH INTERNATIONAL INVENTION, INNOVATION & DESIGN COMPETITION 2025



14TH **INDES** 2025

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INVENTION, INNOVATION &
DESIGN COMPETITION 2025

Organized by:

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TrashTrack

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ABSTRACT

TrashTrack is an IoT-enabled waste management solution designed to improve the efficiency, hygiene, and sustainability of waste disposal systems in urban communities. The system addresses key challenges in traditional waste management, such as bin overflow and delayed collection, through the integration of smart technologies. By utilizing infrared sensors to detect human presence and ultrasonic sensors to monitor waste levels, TrashTrack automates the waste detection process and ensures touchless operation to promote public hygiene. When the bin reaches 80% capacity, the system automatically halts operation to prevent overflow. An RFID sensor logs collection details and verifies the identity of cleaning personnel through staff card scans, maintaining secure access and operational integrity. The Arduino Uno R3 microcontroller serves as the primary hardware platform, interfacing with sensors and transmitting real-time data to a web-based monitoring dashboard. The software component processes and visualizes the collected data using tables and charts for easy interpretation. Developed using the Agile methodology, TrashTrack supports iterative enhancements and responsiveness to user needs. This smart system aligns with Sustainable Development Goal (SDG) 11: Sustainable Cities and Communities by enabling data-driven, real-time decision-making and supporting scalable, eco-friendly waste management practices in modern urban environments.

Keyword: TrashTrack, IoT, waste management, Agile methodology, Sustainable Development Goal (SDG) 11

1. INTRODUCTION

Effective waste management has become a growing concern in rapidly urbanizing communities, where inefficient collection processes, overflowing bins, and hygiene issues pose significant environmental and public health challenges. Traditional waste disposal systems often lack the necessary automation and real-time data needed for timely interventions, leading to delays in collection, increased operational costs, and poor sanitation. In response to these issues, TrashTrack was developed as an IoT-enabled smart waste management solution aimed at enhancing efficiency, automation, and monitoring of waste disposal activities in real-time.

TrashTrack integrates infrared, ultrasonic, and RFID sensors into a single system that promotes cleanliness and sustainability through touchless and intelligent waste handling. The infrared sensor detects the presence of a user, triggering the automatic opening of the bin to maintain hygienic disposal. Once the user leaves, the ultrasonic sensor measures the waste level and transmits this data to a web-based platform where administrators can monitor the status of bins through visualizations such as tables and charts. This allows for optimized waste collection scheduling and prevents overflow by halting bin operation once the fill level reaches 80%.

To further support operational efficiency and secure access, the system integrates an RFID sensor that records the date and time of garbage collection and identifies the personnel involved. When bins are locked due to high fill levels, cleaners must scan their staff cards to unlock them, ensuring only authorized personnel can perform the collection.

2. METHODOLOGY

2.1 Development Methodology

Agile methodology, a flexible and iterative software development approach, has been applied throughout the entire development process. This approach enables developers to efficiently implement changes, minimize waste, and reduce the risk of project failure, unlike the traditional Waterfall model. Given that TrashTrack is designed for public use, the development process must be adaptable to user feedback and capable of making immediate changes to enhance usability and functionality. Moreover, the system integrates both hardware and software components, making iterative development crucial. The Agile methodology utilizes prototypes to gather valuable customer feedback, allowing for continuous improvements. The development of prototypes not only enhances user understanding of the product but also provides a quick and comprehensive overview, facilitating better engagement and usability testing.

3. CONCLUSION

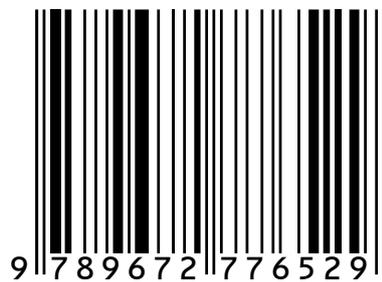
In conclusion, TrashTrack emerges as a pioneering solution in the modernization of waste management through the integration of IoT technologies. The system's successful implementation of real-time monitoring, automated waste tracking, and touchless operation has significantly enhanced the efficiency, hygiene, and responsiveness of waste disposal processes. These advancements have led to improved collection efficiency, a reduction in waste overflow incidents, and overall enhancement of public sanitation. Looking ahead, future improvements will focus on the integration of wireless technology to facilitate scalability and enable mass production. Additionally, the incorporation of artificial intelligence into the waste segregation process will further enhance environmental sustainability by promoting more efficient and eco-friendly waste disposal practices. By supporting cleaner and smarter urban living, TrashTrack will ultimately contribute to the realization of Sustainable Development Goal 11, which aims to make cities inclusive, safe, resilient, and sustainable.

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