

# Waste Management System

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**Abstract**—Waste management is the methodical process of collecting, conveying, processing, recycling, and disposing of wastes in a manner that keeps them from causing significant effects on human health and the environment. Within construction sites, improper waste disposal and safety training deficiency are serious challenges that always result in critical occupational hazards. This study solves these problems by suggesting a mobile app prototype that seeks to improve safety training for construction personnel. The app integrates features such as interactive modules, tracking of progress, voice-navigation, multilingual capabilities, quizzes with personalized suggestions, and certificate generation. Built on React with TypeScript and backed by backend technologies such as Firebase or Node.js, the app also adds offline capability to make it more accessible in low-connectivity environments. This research highlights the ability of online tools in driving sustainable waste management practices and enhancing on-site awareness of labourers regarding safety.

**Keywords:** Waste Management, Construction Safety, Mobile App Prototype, Safety Training, Occupational Hazards, React with TypeScript, Firebase, Node.js, Multilingual Support, Voice Navigation, Offline Accessibility, Progress Tracking, Quiz-based Learning, Certificate Generation, Sustainable Practices

## I. INTRODUCTION

Waste management is an important part of environmental sustainability and public health that involves collecting, treating, and disposing of waste materials in a cost-effective and environmentally sound way. In the construction sector, where huge amounts of waste are produced every day, proper waste management is not only important for environmental conservation but also for the protection of workers' safety and health. In spite of the enforcement of different safety regulations, there are high levels of accidents and injuries reported at construction sites, mostly as a result of insufficient training and knowledge. This research fills the urgent call for better safety education by suggesting a mobile app prototype for construction site workers. The application is a software-based platform for rendering interactive safety training, having aspects of tracking, voice assist, support of various

languages, personal feedback-driven quizzes, and the provision of certificates. Designed by React with TypeScript and sustained through backend structures like Firebase or Node.js, the application aims to be usable, intuitive, and functional even offline. Through the incorporation of contemporary technology in conventional safety training procedures, this study hopes to help build safer, better-informed, and more environmentally sound construction sites

## II. LITERATURE REVIEW

Among the most exciting and rapidly developing spheres, which can be observed in the process of implementing innovative changes, one can distinguish the sphere of waste management. Newer performance indicator proposed by EWU, as underlined by Schmidt & Laner (2023) can be used to evaluate waste management systems in terms of its capability to reduce negative impact of waste on environment. It reveals some issues on the assessment of learning achievements and underscores the requirement of having better strategies of evaluating prospective learning achievements in order to coincide with the dramatic fluctuation of EWU scores [1].

Campitelli et al. (2023) discussed waste management in Marrakech Morocco using WMS-DSC, with an aim of enhancing circular economy. The study highlighted a number of measures to enhance waste management, but stressed the need for a feasibility study for success full implementation of the recommendations [2].

Likewise, Derdera & Ogato (2023) also implemented the Integrated Sustainable Solid Waste Management (ISWM) model in Ethiopia in Shashemane city and discovered challenges including limited collection capacity and ill-bot governance. Like in the case with previous recommendations, they stressed the need of making people more aware and to include private participants in the process [3]. Vega and Bautista-Rodriguez (2024) have suggested a conceptual system dynamics model to enhance the utilization of

organic waste, glass, and plastics within an urban solid waste management program [4]. The model provided a modified waste elimination plan: instead of the linear system of waste management, which would require excessive efforts, more effective, resource-saving methods of operating were proposed.

Public willingness to contribute to better waste management in Gedeo Zone, Ethiopia: A survey was conducted by Kaso et al., (2022) with the result that more than 91 percent of the participants expressed their willingness to contribute to the improved project, especially those with large families and those with more information on waste management [5]. Another work focused on the incorporation of IoT and AI into the platforms that are aimed at managing waste. Possible platforms for data analysis mentioned in the work included SSD MobileNetV2 for waste classification together with real-time data for better decision-making [6]. Monzambe et al., 2019 made observations similar to the above whereby they pointed out that, Industry 4.0 adoption which encompassed technologies such as AI and IoT could improve the MSWMS. Their work also pointed out considerable gaps regarding the absence of comprehensive approaches embracing these technologies in the developing world [7].

Finally, Ceraso and Cesaro (2024) have highlighted the state-of-the-art of Life Cycle Sustainability Assessment (LCSA) in municipalities solid waste management systems. Some shortcomings that were pointed out by their work include dual coding and the case of double counting issues that require, better and superior methods to perform proper evaluations of the sustainability in the management of wastes [8].

### III. METHODOLOGY

The Waste Management System is a web-based program that integrates the front and back ends dynamically to focus on effective trash management. The methodology is as follows:

Architecture of the System: Frontend: HTML, CSS, and JavaScript are used to create the user interface, which offers an interactive platform for tracking trash statuses, requesting garbage collection services, and viewing reports. Backend: PHP is used to create the server-side logic that manages user login, data processing, and database interaction. MySQL is

utilized for database management, where waste data, collection schedules, and user information are stored. Front-end Programming: The user interface is organized and styled using HTML and CSS, which makes it responsive and easy to use. JavaScript: enables dynamic interactions, including the update of collection schedules, the display of bin statuses, and alert notifications without needing to reload the page. Developing Backend: PHP is used to schedule waste collections, handle user inputs, and update and get data from the database, including collection records and bin statuses. It also manages the main business logic. User profiles, collection records, timetables, and other system data are all stored in the MySQL database. Fast querying and access are prioritized in the database.

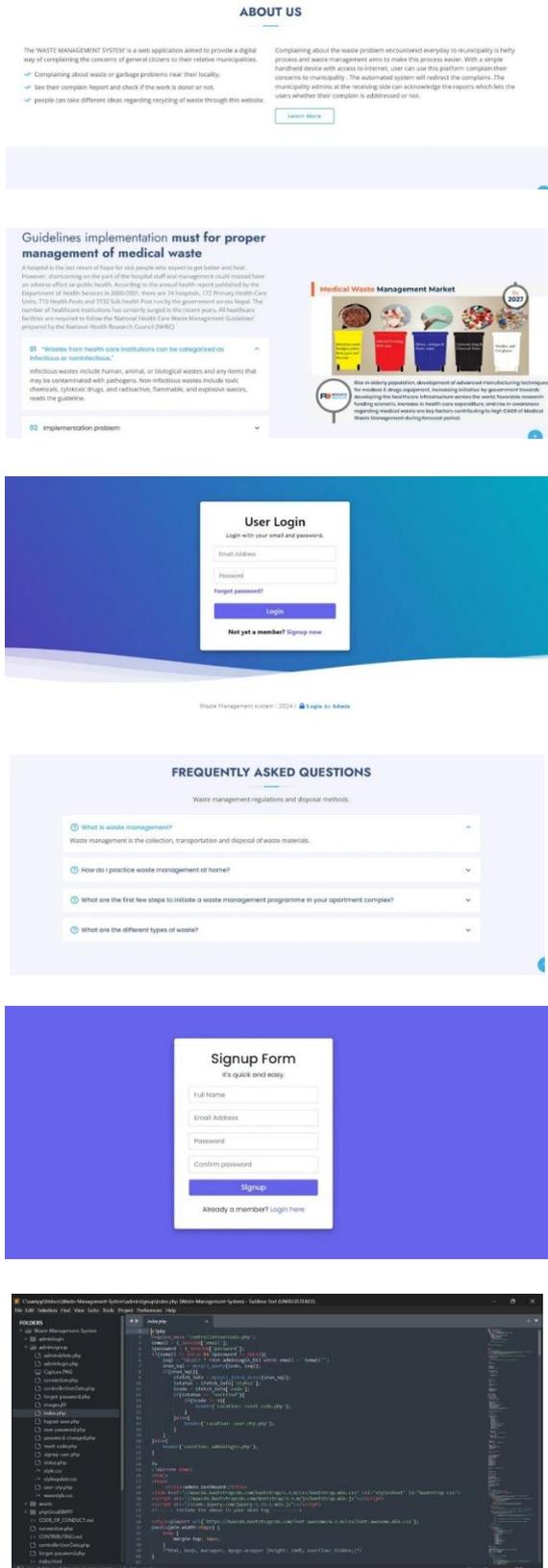
Reporting and Scheduling: Utilizing pre-established routes or user input, PHP implements waste collection scheduling algorithms. Reports about collection efficiency and trash generation trends are also generated by it using data that is kept in MySQL. Safety: User authentication: To safeguard user data, secure login methods are developed with PHP sessions and password encryption techniques. Database Security: Prepared statements and parameterized queries are used to enforce SQL injection protection and guarantee data integrity.

Testing: Unit testing: To guarantee correct functionality, each front-end and back-end component is tested separately. End-to-end testing: To verify the scheduling, reporting, and interaction processes of the system, the entire system is tested.

Implementation: The system is housed on a suitable PHP and MySQL-capable server that receives routine maintenance to guarantee stability, security upgrades, and improved performance.

### IV. RESULT





Figures

V. DISCUSSION

This paper proposes a new approach to trash management, which involves users' engagement and

token incentive system. It is expected that the system offers potentials for a lot of benefits. Originally, was developed to reach out to the communities and improve on the ways of reporting wastes. Since the tokens can be redeemed for some valuable items, the strategy is effective to ensure people champion trash management causes. The above approach leverages on technology to facilitate participation and fast tracking of trash reporting. In any case, this seems to be a perfect way to advance waste management procedures, involve the community and enhance environmental developments.

VI. CONCLUSION

In conclusion, with the intention of encouraging the awareness and participation of the community in trash management this work introduces a new innovative smart trash management system with token-based incentive mechanism. The approach fosters enhanced trash management methodologies and enhanced users participation through the offer of incentives for reporting waste through a one-stop-shop online platform. Being an innovative technology, IoT's choice for waste tracking and a token-based reward solution addresses multiple issues with handling garbage. This way, the strategy empowers people to get involved in tracking garrages and their disposal and also contribute to keeping their environment clean. The possibility of the proposed technique to be implemented and the readiness of users inspires the optimistic results, which may bring improved collaboration and optimization of the waste management. Future studies need to focus on improving the global efficiency and studying various application of the presented system in different geographical and demographic environment..

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