

“SparkTrack” Tracking Cleaning Progress

Vyshhnavi a/p Selvarajan¹, Novia Madeline a/p Michael¹, Fareeza Nurzafira Khairul Nizam¹, Noordiana Kassim @ Kassim^{1*}

1 Department of Information Technology, Centre for Diploma Studies

Universiti Tun Hussein Onn Malaysia, Pagoh Higher Education Hub, 84600 Pagoh, Johor, MALAYSIA

*Corresponding Author: noordiana@uthm.edu.my

DOI: <https://doi.org/10.30880/mari.2026.07.01.021>

Article Info

Received: 1 October 2025

Accepted: 30 November 2025

Available online: 15 January 2026

Keywords

Toilet Cleaning Management, Mobile Application, Real-Time Monitoring, Campus Hygiene

Abstract

Maintaining proper restroom cleanliness is crucial for ensuring hygiene and comfort in university environments. Conventional maintenance methods that rely on manual reporting and fixed schedules often result in slow response times, inconsistent cleanliness standards, and limited supervision. This project introduces SparkTrack, a mobile application designed to enhance restroom maintenance at Universiti Tun Hussein Onn Malaysia (UTHM) Pagoh Block A1 by enabling issue reporting, task tracking, and real-time supervisory monitoring. The application was developed using the Multimedia Development Life Cycle (MDLC) and implemented with Android Studio and Firebase Realtime Database for synchronized data handling. User testing showed that SparkTrack improved communication between users, contractors, and supervisors, supported faster task updates, and offered a clearer workflow for monitoring cleaning activities. Feedback indicated that the interface was easy to navigate, the system responded reliably, and the real-time features strengthened accountability in daily operations. Overall, the findings confirm that SparkTrack provides a practical and efficient digital solution for campus restroom hygiene management, demonstrating strong potential for broader adoption across additional campus areas.

1. Introduction

Maintaining cleanliness in public restrooms is crucial for proper hygiene, comfort, and overall health, especially in large capacity environments like university campuses. Traditional toilet management systems usually rely on manual reporting and rigid schedules, are highly likely lead to inefficiencies to cleanliness and poor sanitation systems [1]. These deficiencies not only affect user satisfaction but also disintegrate the overall standard of campus hygiene [2]. To ensure this, this project proposes SparkTrack, a mobile application that introduces contractors, supervisors and general users through real-time issue reporting, cleaning task tracking, and monitoring.

The constant problem of restrooms such as overflowing bins, empty soap dispensers, and unreported malfunction represents how breakdown maintenance erodes hygiene standards and campus reputation [3]. These issues not only minimize the cleanliness of restrooms but also influence the public perception of a facility's care and management [4]. SparkTrack aims to address these issues by allowing users to submit complaints directly through the application and enabling supervisors to assign and verify cleaning tasks based on real-time updates from janitorial staff. The primary objective is to objectively develop a mobile platform capable of enhancing restroom maintenance at Universiti Tun Hussein Onn Malaysia (UTHM) Pagoh block A1. To achieve this, the project establishes three key goals: enabling users to submit cleanliness reports directly via the

application and allowing contractors to update task statuses in real time; and providing supervisors with a Firebase-driven dashboard to monitor operations. The system exploiting Android Studio with Java for frontend development and Firebase Realtime Database to ensure secure and synchronized backend operations [5].

The scope of this project is focused on the implementation of the SparkTrack mobile application specifically at UTHM Pagoh, Block A1. The system will support three user roles: janitors (contractors), supervisors, and general users (students or staff). Features include complaint submission, real-time task status updates, user login authentication, and a monitoring dashboard for supervisors. The app is designed exclusively for Android devices and is initially developed in English, with future versions planned to include Malay language support. The system is also limited to restroom maintenance management only and does not cover other campus facilities such as classrooms or cafeterias.

By reducing conventional paper-based reporting techniques, the application surely increases environmental sustainability in addition to working improvements. SparkTrack addresses these by digitally integrating reporting, task management, and supervision supporting timely interventions, reducing paperwork, and enhancing accountability. This project aims to set a new standard in campus hygiene management to ensure a cleaner, healthier, and more efficiently maintained environment.

1.1 Problem Statement

Maintaining restroom cleanliness in university buildings is very crucial for hygiene and user comfort, with poor conditions often indicate poor management inefficiencies. Restroom hygiene significantly impacts health and satisfaction, as unclean facilities can create risks such as unpleasant odors, bacterial contamination, and the spread of disease. Studies have shown that restroom cleanliness directly influences users' overall satisfaction and their likelihood to reuse or trust a facility, emphasizing the psychological and behavioral impact of hygiene perception [6]. University campuses experience high restroom usage by students, staff, and visitors, making timely maintenance essential. However, traditional methods such as fixed schedules and manual reporting lead to delayed responses and inconsistent cleaning standards. These issues reduce users to entrust and create extra burden for contractors and supervisors. Therefore, this project aims to develop an efficient, user-friendly mobile application to monitor toilet cleaning progress and assist users in maintaining high hygiene standards, including identifying key requirements, developing the system, and evaluating overall effectiveness.

1.2 Objectives and Scope

The research for the UTHM Pagoh Toilet Cleaning Tracking Application SparkTrack had three key objectives. Firstly, it aimed to identify the specific data requirements for tracking cleaning activities by adapting to the needs of UTHM Pagoh, including user roles such as contractors, supervisors, and general users. Secondly, the project focused on developing a mobile application that provides real-time reporting, task updates, and monitoring features to help improve toilet cleanliness and operational efficiency. Subsequently, the project sought to evaluate the effectiveness of the application by testing it sufficiently in a real-world setting with actual users, collecting feedback, and improving the system's use to ensure it meets functional and proven usability expectations.

1.3 Background and Related Studies

Enhancing the overall restroom management and campus hygiene practices has been made more effective through the integration of mobile technology. This Mobile application can create digital experiences that improve cleanliness monitoring, task tracking, and user engagement by combining cloud-based data with real-time interaction features [6]. During this transition to smart campus systems, mobile apps have sufficiently gained recognition as practical tools that enable user reporting, janitorial updates, and supervisor monitoring through smartphones. Their role in digital basic facility management assists mostly in between manual operations and automated monitoring, drawing insights from various existing applications. This mild integration has significantly improved sanitation workflows and cleanliness standards in institutional environments.

Mobile-based apps have been proven useful in addressing several facility management challenges, including delayed maintenance, lack of task accountability, and inefficient communication between users [7]. Despite their advantages, mobile apps still face challenges such as connectivity issues and the need for user training. Mobile apps with real-time dashboards and feedback systems can greatly improve responsiveness, highlighting their value in modern hygiene management efforts.

Several applications have proven to develop to improve restroom cleanliness monitoring and reporting through digital platforms [8]. ginstr's Toilet Cleaning Checklist enables supervisors and staff to share data in real time and log detailed tasks [9]. This encourages staff to note accountability and no problems unsolved. Similarly, users can locate facilities and provide feedback mainly using GPS-based apps through Flush Public Toilets [10]. Additionally, Siesta Admin accelerates automated task scheduling and notification capabilities, which facilitate efficient cleaning operations management [11]. The development of SparkTrack as a complete solution suited to

campus restroom management needs were influenced by these applications, which offer insightful information about how mobile tools can support hygiene maintenance.

1.4 Comparison between Features of Existing Applications

There are several existing applications developed specifically for toilet cleaning, tracking and restroom management, each addressing different operational needs in public or commercial facilities. These applications provide a range of functions such as monitoring cleaning activities, assisting users in locating nearby restrooms, and supporting facility managers in coordinating maintenance tasks. These include ginstr's Toilet Cleaning Checklist [9], Flush Public Toilets/Restrooms [10], and Siestathisin [11]. Each application adopts a different approach based on its target users, whether they are cleaning personnel, the public, or facility administrators. Before proposing a new solution, it is important to compare these systems to understand how their features serve distinct objectives. Table 1 summarizes the differences in purpose and focus for each application.

Table 1: Comparison between features of existing application

Primary Function	Explanation of the system
<i>ginstr's Toilet Cleaning Checklist</i> [9]	Focuses on tracking restroom cleaning activities including working time, completed tasks, missing supplies, and damages. It is more towards designing for professional janitorial services to improve accountability and reporting.
<i>Flush Public Toilets/Restrooms</i> [10]	Allowing users to locate these public restrooms using GPS and contribute data by adding, rating, and reporting restrooms. It particularly aims to make public toilet access more convenient and promote hygiene awareness.
<i>Siesta Admin</i> [11]	Handle restroom and bathroom cleaning tasks and automatically identifies outstanding work. Designed for facility management.

Based on Table 1, each application targets different restroom challenges. ginstr's Toilet Cleaning Checklist is designed to quickly improve janitorial accountability and digital reporting by documenting tasks, missing items, and working time spent [8]. Flush Public Toilets/Restrooms focuses more on user experience and convenience by offering a large database of public restrooms that users can interact with through GPS and reviews [9]. Siesta Admin, on the other hand, is significantly built to assist cleaning management with automated scheduling and progress tracking, to ensure timely task completion and prompt maintenance [10].

1.5 Comparison of Items Used for Features of Existing Applications

A comprehensive review of the existing applications has been carefully conducted to understand the range of tools and components used within each system. This review examined not only the functionality of the applications but also the supporting elements that enable those functions, including the devices required, the type of software involved, and the operational environment in which each application is designed to function. By evaluating these aspects, the analysis provides clearer insight into how different applications implement their features and the level of resources needed for effective operation. A comparison based on the items used in each application is summarized in Table 2. The differences in tools can be observed through the hardware and software components utilized, highlighting distinct approaches and technology choices across the existing solutions.

Table 2: Comparison of items used for existing applications

Primary Function	Hardware Devices	Software
<i>ginstr's Toilet Cleaning Checklist</i> [9]	-Mobile -QR Code -NFC Tags -Scanners	-ginstr Cloud Platform -Mobile App (Android)
<i>Flush Public Toilets/Restrooms</i> [10]	-Smartphones -GPS Sensors -Native - Offline Database Support	Mobile App
<i>Siesta Admin</i> [11]	Tablets Smartphones Server	-Web Dashboard -Mobile App -Push Notification System

Based on Table 2, there are differences mainly in hardware and software used by the three-toilet management feature. *ginstr's Toilet Cleaning Checklist* utilizes mobile devices paired with QR code or NFC scanning to track completion of tasks, and it mainly relies on the *ginstr cloud* for thus data storage and monitoring. *Flush Public Toilets/Restrooms* uses smartphone GPS for locating public toilets and allows offline database access, which is more convenient for travelers without a stable internet connection.

In comparison with existing toilet cleaning tracking applications, *SparkTrack* was specifically developed to address restroom maintenance challenges at Universiti Tun Hussein Onn Malaysia (UTHM), particularly in Block A of the Pagoh campus. The features included were designed to support real-time reporting, cleaning task monitoring, and supervisor oversight, all while enhancing user interaction and feedback. Table 3 below outlines the core features of the *SparkTrack* application and their corresponding descriptions.

Table 3: Key Features of *SparkTrack* Application

Feature	Description
Issue Reporting	Allows users to report problems such as dirty floors, damaged fixtures, or missing supplies.
Real-Time Supervisor Notification	Notifies supervisors instantly upon issue submission, enabling faster response times.
Task Update System	Enables janitorial staff to update the cleaning status, viewable by supervisors in real-time.
Real-Time Monitoring Dashboard	Allow supervisors to monitor progress without manual inspection, improving task tracking.
Settings Page	Let users manage account profiles, notifications, and switch between light/dark themes.
Language Support (English)	Current version supports English; future updates will include Malay for broader accessibility.
Feedback System (Planned)	Future features allowing users to rate and review restroom conditions to improve hygiene quality.
Clean UX Design	User interfaces use simple layout with clearly labelled icons, supporting intuitive navigation.
Age-Inclusive Design	Designed for users aged 18–55, including students, janitors, supervisors, and academic staff.
Firebase Backend Integration	Real-time data handling for tasks, updates, and complaints; improves responsiveness and security.

As shown in Table 3, the *SparkTrack* application integrates multiple functional components that work together to ensure an effective and responsive restroom management system. From real-time reporting to customizable settings, these features not only streamline cleaning contractor's workflows but also promote

accountability, hygiene transparency, and user engagement. The planned additions, such as feedback and multilingual support, further the demonstration of the system's scalability and commitment to inclusive campus cleanliness solutions.

2. Methodology

The Multimedia Development Life Cycle (MDLC) methodology offers a structured framework for developing interactive multimedia systems such as mobile applications. This approach guarantees that every aspect of a project, from initial planning to final implementation, is carefully sorted out and carried out. The SparkTrack toilet cleaning tracking application was developed to enhance overall hygiene management efficiency and accountability at UTHM Pagoh through the implementation of the MDLC model. Fig. 1 illustrates the MDLC approach used in this project, which consists of five critical phases: concept, design, material collecting, assembly, and testing. This model is highly recognized as its sustainability in multimedia application development, by having clear stages that guide project teams from content planning to final deployment [12].

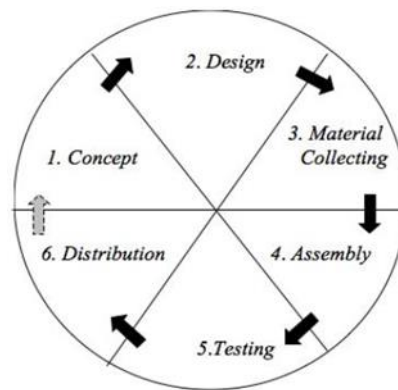


Fig. 1 MDLC Methodology

2.1 Requirements

The precise basic requirements and objectives of the mobile application project were determined, which aims to improve toilet cleanliness management at UTHM Pagoh block A1. This involved identifying the key features needed, such as complaint reporting, cleaning task updates, and supervisor monitoring. We also analyzed the existing manual tracking methods and recognized inefficiencies in response time, communication, and accountability. In utmost addition, we mainly examined similar restroom management systems and mobile technologies that are currently in use to streamline hygiene operations. By collecting and evaluating this information, the functional requirements and objectives of the SparkTrack application were clearly defined.

In the requirements phase, the requirements were carefully divided into hardware and software. For hardware applications, the application operates entirely on Android mobile devices used by contractors, general users (students/staff), and supervisors. There are no external sensors or physical devices required. The application relies mainly on mobile connectivity and Firebase Realtime Database for data storage and updates.

For software, the application was developed using Android Studio with Java programming language. Firebase was carefully selected as the backend because of its real-time database capabilities and easy integration with Android platforms. Mostly the application also includes features such as login, complaint submission, task tracking, and supervisor dashboards.

2.2 Design

The structure and interface layout of the application were carefully planned during the design phase. The primary objective was to create features that would also improve communication between contractors, supervisors and general users while guaranteeing that tasks could be updated and tracked in real-time. Supervisors had access to a dashboard for both task management and verification, meanwhile contractors had a task list screen for various including updating cleaning task statuses, and users could file complaints using the feedback form. Interface mockups and wireframes were created to ensure the design could be previewed by users. The UI components and navigation flow were made to be responsive on Android devices to guarantee overall accessibility for all regarded users, regardless of technical proficiency.

Fig. 2 shows a visual example of the basic implementation that includes (a), which displays the user registration screen; (b), the supervisor task dashboard; (c), the contractor task update interface; and (d), the user feedback

submission form. These components demonstrate the practical integration of SparkTrack's features into a cohesive and user-friendly application suitable for use on campus.

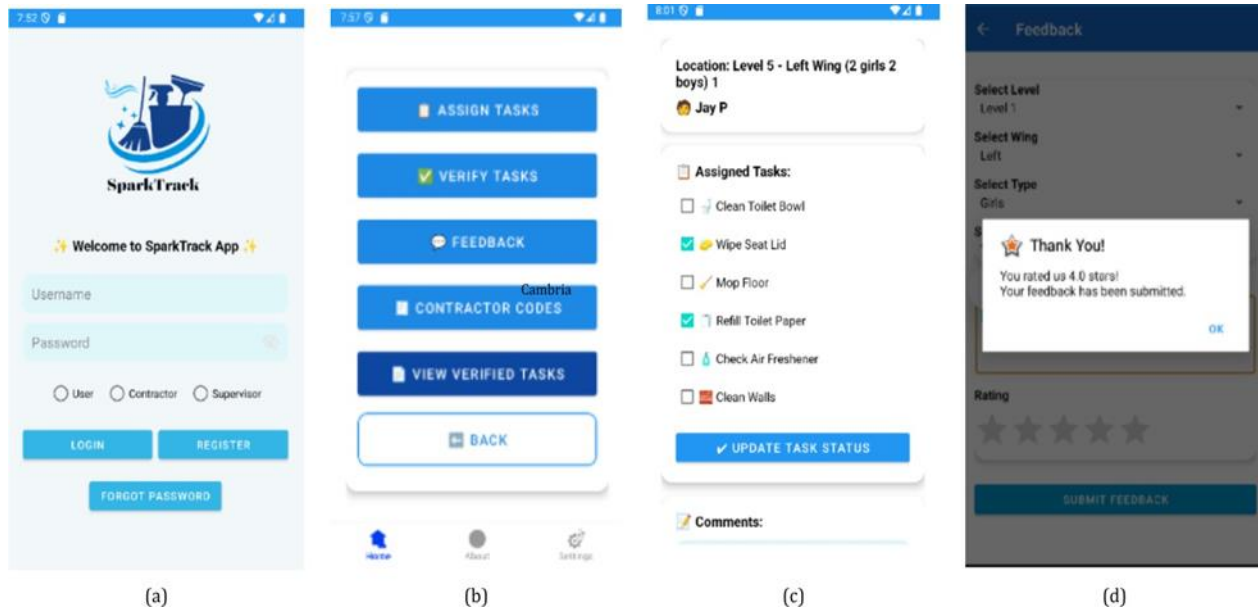


Fig. 2: Basic implementation

2.3 Implementation

The mobile application was developed to bring the planned design to life during the development stage. This included implementing these functionalities using Android Studio and Java and integrating Firebase Realtime Database to mainly handle data storage and updates regularly. The application was organized to allow real-time complaint submissions, task tracking, and monitoring. Multiple testing was conducted to identify and fix inefficiencies such as bugs, to ensure the application performed smoothly across different devices. During these phases, all visual elements were also aligned with the UI design and that data could be sent, stored, and retrieved within the application.

2.4 Testing

The SparkTrack application's usability and functionality were evaluated during the testing phase. This involved collecting feedback from 10 actual users at UTHM Pagoh, including contractors, supervisors, and general users. Respondents tested the complaint system, task update process, and dashboard interface. Through surveys and interviews, insights were gathered on user experience, interface clarity, system responsiveness and overall satisfaction of users. The data collected confirmed that the application met its objectives, and Based on the feedback provided, significant improvements were made to update the interface and enhance performance. These revisions helped improve SparkTrack to serve its functioning role as a cleanliness tracking system on campus.

2.5 Maintenance

The maintenance phase is crucial for ensuring the system remains functional, up-to-date, and aligned with user needs. This includes regular database implement checks, UI/UX improvements, and system optimization based on feedback. One of the core activities during this phase is user interface (UI) testing and weekly data review. Every week, the Firebase database and user interaction logs are examined to make sure that there are no missing or corrupted entries. Before being officially released, any modifications on the interface were made in response to requests for new features are tested in smaller builds. Another critical component of maintenance is the verification of system connections and user role access. This is to confirm that supervisors, contractors, and general users continue to have the appropriate app permissions, user access roles are verified. To ensure app cohesion, access logs and data syncing are being tracked. The application is also periodically updated and optimized. Firebase plugins and Android Studio components are updated. Optimizations such as faster load times and small UI enhancement are implemented based on user feedback.

As a result of these ongoing maintenance efforts, SparkTrack remains stable, user-friendly, and responsive to ongoing needs. Regular checks and improvements to ensure that reliable tracking of restroom cleanliness activities and contribute therefore to long-term cleanliness in campus.

3. Result and Implementation

The mobile application was tested by 10 actual users from UTHM Pagoh. The app's functionality, including issue reporting, status tracking, and user login, was tested to make sure it operated properly in practical situations. To test various important processes like logging in, submitting reports, and updating task statuses, a selective group of supervisors and contractors were invited. Before the final release, their input indicated that performance adjusting and mild minor UI improvements were needed. Through field usability testing with real users, it is essential to identify practical issues and validate mobile app performance in realistic settings [13]. Iterative Testing ensured SparkTrack guaranteed launch with stable and error-free user experience.

3.1 Result

SparkTrack was successfully developed as a mobile application that fulfils all core requirements for monitoring daily toilet cleaning activities carried out by cleaning contractors at UTHM Pagoh. The system is intentionally designed with a straightforward workflow, focusing only on essential functions such as recording which toilet has been cleaned, identifying the janitor responsible, and allowing supervisors to verify the work. Even without advanced features like QR check-ins or automated scanning, the application performs effectively within the practical needs of the cleaning routine.

The application includes several key modules that support daily operations. Janitors can log in, view the list of restrooms under their responsibility, and update the status once a toilet has been cleaned. Each update captures the janitor's identity and the exact time the task was completed. Supervisors are provided with a verification panel where they can review these updates, confirm the cleanliness status, and record verification actions. This structure gives supervisors a simple and reliable way to check whether all assigned restrooms have been attended to for the day.

During testing, supervisors noted that the centralized record helped reduce reliance on physical logbooks, WhatsApp messages, and verbal confirmation, all of which previously caused delays or miscommunication. Comprehensive testing was carried out to evaluate the system's functionality, usability, and performance. Functional testing verified that janitors were able to log activities, supervisors could confirm updates, and the overall data flow operated correctly. Usability testing showed that both janitors and supervisors appreciated the simple interface, clear navigation, and minimal number of steps required to complete each task. The app was found suitable even for staff with limited experience using mobile applications because of its straightforward layout and clearly labelled functions.

3.2 Discussion

To gather feedback from users, a structured Google Form was distributed to 10 respondents. Cleaning contractors, supervisors, and general users were among these included respondents. The form used a 5-point Likert scale, where: 1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly Agree. The questionnaire included statements evaluating app usability, responsiveness, design clarity, and functional performance. According to the feedback, the application's usability received an average score of 4.3 out of 5. Users reported that the app helped them carry out their tasks very effectively, the features were easily accessible, and the layout was clear. Most users thought the role-switching feature was useful and simple to use by users, and the visual layout and interface design received generally positive ratings. Some users, however, complained about their initial confusion with the login process and recommended making role indicators more visible when they first entered. Table 4 below summarizes the Likert-scale responses collected from the questionnaire:

Table 4: User Satisfaction Questionnaire Results

Item	Mean Score (1-5)
Ease of navigation within the app	4.5
Task reporting and submission clarity	4.4
Visual design and layout	4.2
Role-switching feature usability	4.4
Overall satisfaction with the application	4.3

According to various user feedback, the application loaded rapidly on the majority of devices, taking less than three seconds on average. Firebase integration enabled real-time updates, and users confirmed that status changes and complaint submissions were reflected on their dashboards. These findings validated the app's backend and front-end responsiveness overall. Table 5 shows a summary of the testing.

Table 5: A summary of the testing metrics

Feature	Metric	Acceptable Threshold	Result
Task assignment	% accuracy	≥ 95% correct	98% accuracy
Role switching	Ease rating (1-5)	≥ 4 average	4.4 average
App performance	Launch time (seconds)	≤ 3 seconds	2.7 seconds
User satisfaction	Likert score (1-5)	≥ 4 average	4.3 average

Overall, these evaluation outcomes demonstrate that SparkTrack met its design objectives in terms of performance, functionality, and user satisfaction. The app not only improved coordination between contractors and supervisors but also improved complaint user handling and real-time task tracking. While the system is already effective, the feedback received will guide future enhancements, like improving the direct upcoming updates to improve effectiveness and user experience.

4. Conclusion

In summary, SparkTrack, an application created with the Multimedia Development Life Cycle (MDLC), has achieved restroom cleanliness oversight at UTHM Pagoh block A1. The application provides a very structured solution to work together more effectively between contractors, supervisors, and general users with its clear reporting features and real-time task tracking. SparkTrack was created to mainly improve the monitoring and management of cleaning tasks by reducing work dependency on paper records, enabling faster responses and more consistent oversight of hygiene-related concerns. Even with challenges related to network connectivity and user onboarding, the application's launch effectively addressed significant highly maintenance needs. Currently, SparkTrack is implemented for Block A1 at UTHM Pagoh, future updates are expected to expand coverage to additional campus blocks, ensuring broader tracking of restroom cleanliness across the entire institution.

Acknowledgement

Communication of this research is made thoroughly possible through assistance by Universiti Tun Hussein Onn Malaysia and the UTHM Publisher's Office via Publication Fund E15216.

Conflict of Interest

Authors declare that there is no conflict of interest regarding the publication of the paper.

Author Contribution

The authors confirm contribution to the paper as follows: study conception and design: Vyshhnavi, Novia Madeline; data collection: Fareeza Nurzafira; analysis and interpretation of results: Vyshhnavi, Fareeza Nurzafira, Noordiana Kassim@Kassim; draft manuscript preparation: Novia Madeline, Noordiana Kassim@Kassim. All authors reviewed the results and approved the final version of the manuscript.

References

- [1] R. Sujeetha, D. Abhinav, R. Rithik, S. Abishek, "Toilet management system using iot," International Journal of Scientific and Technology Research, vol. 8, 2019.
- [2] S. Shahane, M. Patil, A. Mahajan, B. Gholap, "Smart Toilet Feedback System," International Research Journal of Engineering and Technology, 2020.
- [3] D. Kaushik, S. Yadav, "Multipurpose Street Smart Garbage bin based on Iot," International Journal of Advanced Research in Computer Science, vol. 8, 2017.
- [4] A. R. Maroko, K. Hopper, C. Gruer, M. Jaffe, E. Zhen, M. Sommer, "Public restrooms, periods, and people experiencing homelessness: An assessment of public toilets in high needs areas of Manhattan, New York," PLoS ONE, vol. 16, no. 6, June 2021.
- [5] A. D. M. Africa, C. U. Charleston Franklin, "Development of a cost-efficient waste bin management system with mobile monitoring and tracking," International Journal of Advanced Trends in Computer Science and

- Engineering, vol. 8, 2019.
- [6] H. Kim, J. R. Bachman, "Examining customer perceptions of restaurant restroom cleanliness and their impact on satisfaction and intent to return," *Journal of Foodservice Business Research*, vol. 22, no. 2, pp. 150-164, 2019.
 - [7] I. M. Ali, M. N. M. Nawawi, M. Y. Hamid, F. I. A. Jalil, B. Hussain, "Integration of IoT, Data Analytics and Mobile Application towards Digitisation Facilities Management: A Case Study," *International Journal of Interactive Mobile Technologies*, vol. 15, 2021.
 - [8] O. Maki, M. Alshaiqli, M. Gunduz, K. K. Naji, M. Abdulwahed, "Development of Digitalization Road Map for Healthcare Facility Management," *IEEE Access*, vol. 10, 2022.
 - [9] J. S. Horsburgh, M. E. Leonardo, A. M. Abdallah, D. E. Rosenberg, "Measuring water use, conservation, and differences by gender using an inexpensive, high frequency metering system," *Environmental Modelling and Software*, vol. 96, 2017.
 - [10] A. Lokman, R. K. Ramasamy, C. Y. Ting, "Scheduling and predictive maintenance for smart toilet," *IEEE Access*, vol. 11, pp. 17983-17999, 2023.
 - [11] S. Narain, "The flush toilet is ecologically mindless," *Down to Earth*, vol. 10, no. 19, pp. 1-14, 2002.
 - [12] A. Naska, E. Oikonomou, A. Trichopoulou, T. Psaltopoulou, D. Trichopoulos, "Siesta in healthy adults and coronary mortality in the general population," *Archives of internal medicine*, vol. 167, no. 3, pp. 296-301, 2007.
 - [13] R. Roedavan, B. Pudjoatmodjo, A. P. Sujana, "Multimedia development life cycle (MDLC)," *Teknologi Dan Informasi, Multimedia*, vol. 7, 2022.
 - [14] K. Kekalainen, C. Kallio, Kankainen, "Usability testing of mobile applications: A comparison between laboratory and field testing," *Journal of Usability Studies*, vol. 1, 2005.