JOURNAL OF DIGITAL SYSTEM DEVELOPMENT

https://e-journal.uum.edu.my/index.php/jdsd

How to cite this article:
Yusof, N., Matzin, A., Vijayakumaran, R. & Marimuthu, N. V. R. (2026). Improving the Community System with RFID Technology. *Journal of Digital System Development, 4* (1), 62-74. https://doi.org/10.32890/jdsd2026.4.1.5

IMPROVING THE COMMUNITY SYSTEM WITH RADIO FREQUENCY IDENTIFICATION (RFID) TECHNOLOGY

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Received: 18/8/2025 Revised: 9/10/2025 Accepted: 25/2/2026 Published: 30/4/2026

ABSTRACT

Many gated communities still rely on outdated manual methods for security and facility management, leading to inefficiencies and security risks. Security challenges in gated communities stem from poor visitor tracking, inefficient facility management, and manual record-keeping errors. Traditional logbooks often lead to missing or inaccurate data, making it difficult to monitor visitor movements and prevent unauthorised access. Furthermore, the lack of an anonymous complaint system leads to unaddressed concerns and resident dissatisfaction. These issues underscore the need for an integrated, technology-driven solution to enhance security and improve management efficiency. MyCommunity ResolvePoint is a digital solution designed with RFID technology to enhance security, track visitors, and streamline facility access. It replaces physical logbooks with real-time digital records, ensuring accurate monitoring and preventing unauthorised access. Additionally, an anonymous complaint platform allows residents to communicate securely with management, fostering a more transparent and responsive community. The product's development follows an Agile methodology, comprising planning, design, development, testing, release, and feedback. By implementing the MyCommunity ResolvePoint system, management can enhance security oversight, maintain accurate records of facility usage, and facilitate seamless communication with residents. The system's digital tracking and alert mechanisms provide real-time updates, reducing vulnerabilities and improving operational efficiency. As a scalable and adaptable solution, MyCommunity ResolvePoint helps create safer, better-managed residential communities, setting a new standard for security and resident engagement. Therefore, this study contributes to the residential community in Balik Pulau, Penang, with a secure RFID architecture tailored for low-density residential environments.

Keywords: Community, RFID, Residential System, Real-Time Record, Tracking Technology

INTRODUCTION

The MyCommunity ResolvePoint system is designed to address inefficiencies in communication and technology use within gated communities. It serves as a resident-friendly platform that enhances interactions between residents and management. The system leverages Radio Frequency Identification (RFID) and web-based technologies to streamline visitor monitoring, facility access, and record-keeping. It also introduces features such as time-limited visitor entry, facility usage tracking, and an anonymous complaint platform. By improving security measures and operational efficiency, the system aims to create a safer, more organised environment for residents of gated communities.

Gated communities often face significant security and management challenges due to inadequate security controls, making it difficult to monitor visitors' movements. The reliance on manual logbooks by security personnel results in inconsistent, incomplete, and inaccurate record-keeping, further compromising security. Additionally, inefficiencies in tracking visitors' stay durations and facility usage increase the risk of unauthorised access and misuse of community facilities due to inadequate oversight. The absence of a centralised system for managing and storing visitor and facility usage records complicates the generation of accurate reports, making it harder to track activities effectively. Furthermore, the limited ability to identify suspicious activities and maintain up-to-date records reduces the overall effectiveness of security measures. A major gap is the lack of an anonymous platform for residents to raise concerns or complaints, which creates a disconnect between residents and management. These issues contribute to overall inefficiencies in communication, record-keeping, and security, making it essential for gated communities to adopt a more structured, technology-driven approach to management. To address these issues, a digital solution integrating RFID and web technologies is needed to enhance security, streamline processes, and improve overall community management. The MyCommunity ResolvePoint system aims to enhance security through RFID-based visitor monitoring, automate tracking of facility access to prevent unauthorised use, improve record-keeping with a centralised digital database, facilitate better communication between residents and management, and introduce an anonymous complaint system to encourage feedback.

By implementing this system, gated communities can benefit from improved security, reduced risks through automated visitor and facility tracking, elimination of manual paperwork for more accurate record-keeping, a transparent complaint mechanism that encourages resident participation, and enhanced communication between residents and management. Additionally, real-time facility tracking will optimise resource utilisation, ensuring fair and efficient use of community facilities. Ultimately, the MyCommunity ResolvePoint system contributes to a more secure, efficient, and well-managed gated community environment and could improve the community's user experience (Sundar et al., 2023; Yusof et al., 2022a).

LITERATURE REVIEW

Many gated communities continue to rely on manual logbooks and paper-based visitor tracking despite the availability of advanced security technologies. Studies highlight that traditional methods are prone to inaccuracies, inefficiencies, and security risks (Twum-Bobie et al., 2025). Handwritten records can lead to missing or incorrect data, unauthorised access, data integrity issues, and difficulty retrieving past entries (Gokulakrishnan & Venkataraman, 2024). Additionally, the absence of “real-time monitoring” means security personnel often rely on reactive rather than proactive measures, limiting their ability to prevent incidents effectively. To address these challenges, digital visitor management systems have emerged as a more efficient alternative. Research indicates that these systems “enhance security by replacing physical logbooks with real-time tracking and automated alerts (Rajan et al., 2024). Smart security solutions, such

as biometric access, AI-driven monitoring, and cloud-based record-keeping, could reduce unauthorised access while improving overall operational efficiency. These systems can improve response times to security incidents and provide better oversight of community management, making them a vital component of modern security strategies.

Another critical aspect of security management is anonymous communication between residents and management. A significant challenge in traditional systems is the lack of an anonymous complaint platform, which discourages residents from reporting security concerns. Research highlights that anonymous feedback systems empower residents to communicate security risks and management issues without fear of retaliation (Jones & Taylor, 2019). Digital complaint platforms have been shown to enhance community engagement, trust, and transparency, contributing to a more responsive and accountable management system (Wong, 2021). The adoption of MyCommunity ResolvePoint aligns with recent studies advocating for technology-driven security solutions in residential communities.

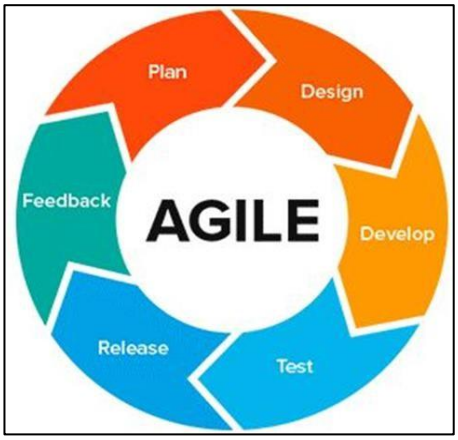
Therefore, traditional methods, such as manually recording guest cars entering and leaving residents' homes, can lead to records being easily lost, integrity issues, information misuse, and difficulty retrieving information about previous visitors. In addition, one of the main factors driving the development of the system was the lack of a platform for residents to make complaints about their residential area in a transparent (anonymous) manner for the improvement of residential management and visitor parking. Thus, the development of MyCommunity ResolvePoint with RFID technology is needed. The RFID technology supports integrating real-time visitor tracking, digital facility management, and reporting platforms to address security inefficiencies. These systems reduce manual errors, provide actionable insights through analytics, and enable seamless communication between residents and management (Kumar et al., 2023). By implementing MyCommunity ResolvePoint, communities can enhance security oversight, maintain accurate facility usage records, and facilitate transparent communication, ultimately contributing to a safer, more efficiently managed residential environment.

METHODOLOGY

This study used the Agile method for system development, which comprises six phases (refer to Figure 1): Planning, Design, Development, Testing, Release, and Feedback. The planning phase defines objectives and scope and develops a project timeline with milestones. The design phase involves creating a system architecture that integrates RFID technology with a web-based platform, including the development of flowcharts, data flow diagrams, and use case diagrams to model the system's functionality. The development phase involves implementing the system: developing RFID-based visitor tracking and access control, building the web-based platform for complaint management and facility tracking, integrating all components, and implementing security features. The testing phase involves unit, integration, and user acceptance testing (UAT) to ensure system reliability. Moreover, the testing also addresses the specific needs of gated communities while delivering a reliable, user-friendly, and efficient solution. The release phase is to deploy the system within the gated community in a controlled environment. Lastly, the feedback phase was conducted to gather user input. Refer to Figure 1 for the Agile method in system development.

Figure 1

Agile Method for System Development



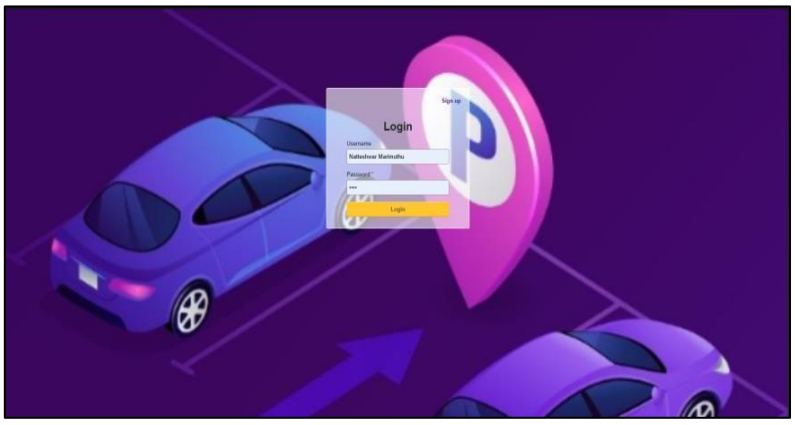
RESULTS AND DISCUSSIONS

Once the system has been designed and development completed according to user needs, the system is tested with real users. The system developed was tested with the community in Penang. The MyCommunity ResolvePoint comprises residents' registration, visitors' information, visitors' parking information with RFID technology, and complaint information. The login screen is the initial access point for users of the MyCommunity ResolvePoint. It features a modern, intuitive user interface (UI) with a vibrant isometric illustration of a parking lot that indicates the system's core functionality, such as vehicle tracking and parking slot monitoring, as shown in Figure 2. The interface includes:

i. Username and Password Fields: Secure user authentication via credentials.
ii. Login Button: Triggers the backend validation process.
iii. Sign Up Option: Allows new users to create accounts.

Figure 2

Login Interface for System



The MyCommunity ResolvePoint system is a centralised digital platform designed to manage residential communities efficiently and securely. Figure 3 illustrates the system's homepage. The key functionalities of the system are:

i. Security Oversight and Alerts: The system enables real-time monitoring and digital tracking, which helps in reducing vulnerabilities by alerting the management team of any unusual activities or emergencies within the community.
ii. Facility Usage Records: It maintains accurate logs of facility usage, such as visitor entries, parking, and other common areas. This is essential for operational audits and resource planning.
iii. Resident Communication: The system allows seamless two-way communication between residents and management, which helps in addressing complaints, sharing announcements, or reporting issues.
iv. Digital Visitor Management: Modules like Visitors and Visitors Logs track entry and exit times of non-residents. This ensures better control and documentation for security purposes.
v. Parking Management: The Parking module helps manage vehicle entries, parking space allocation, and overall traffic within the community's premises.
vi. Resident Information System: With features like Resident Record and Resident Info, the system stores personal and demographic information of residents, ensuring all data is centralised and easily accessible for administrative purposes.
vii. Complaint Management: The Resident Complaint section offers a structured platform for residents to file complaints, which can then be addressed systematically by the management

Figure 3

Homepage for System

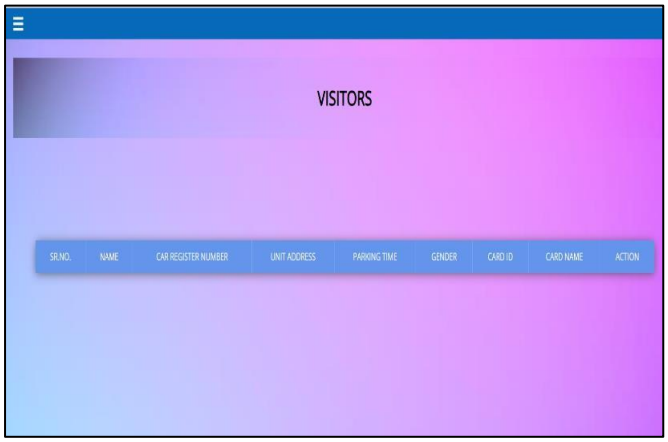
Moreover, the Visitors module in the MyCommunity ResolvePoint system is designed to record and manage information about individuals who temporarily enter the residential community. Refer to Figure 4. Thus, an interface for visitors comprises:

i. SR.NO.: A unique serial number automatically assigned to each visitor entry for easy reference.
ii. Name: The full name of the visitor for identification purposes.
iii. Car Register Number: Records the vehicle registration number of the visitor for tracking parking and vehicle access.
iv. Unit Address: Indicates the unit or resident the visitor is associated with or visiting.
v. Parking Time: Captures the entry or allocated parking time of the visitor's vehicle.
vi. Gender: Basic demographic detail for identification and record-keeping.

vii. Card ID: A unique identifier linked to an access card or temporary entry pass issued to the visitor.
viii. Card Name: The designation or type of card used (e.g., temporary visitor card).
ix. Action: Typically includes functions like edit, view, or delete, allowing administrators to manage each record effectively.

Figure 4

Visitors Interface for System



Refer to Figure 5, the Visitors Logs module is an advanced tracking system that provides detailed records of every visitor's entry and exit within the residential area. For example, the records captured by the system include name, card ID, car registration number, residents' and visitors' in-and-out times, parking time status, and the parking lot for the cars. Moreover, the time visitors spend using the gym in the residents' area is also recorded. Table 1 describes the visitors' log based on RFID tracking.

Figure 5

Homepage for System

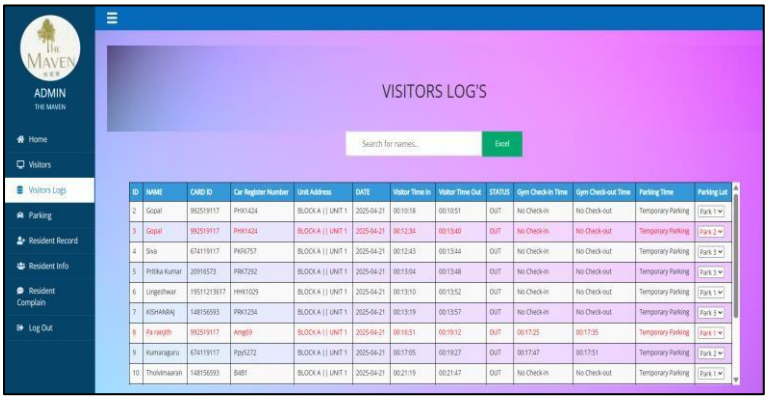


Table 1

Visitors' Logs Based on RFID Tracking

Column	Description
ID	Unique identifier for each visitor log entry.
Name	Name of the visitor—entries in red overtime parking and alerts.
Card ID	ID of the access card used by the visitor.
Car Register Number	Vehicle plate number associated with the visitor.
Unit Address	Unit or block number the visitor is associated with.
Date	The date of the visit.
Visitor Time In / Out	Records the time the visitor entered and exited the premises.
Status	Indicates whether the visitor is currently "IN" or has exited ("OUT").
Gym Check-in / Check-out Time	If the visitor accessed the gym, this records their entry and exit times. "No Check-in" or "No Check-out" indicates gym access was not used.
Parking Time	Type of parking used (e.g., "Temporary Parking").
Parking Lot	The specific lot the visitor parked in (e.g., "Parking Lot 1", "Park Lot 2", etc.).

Based on Figure 6, the Parking Slots consist of three green circular indicators labelled "Lot 1", "Lot 2", and "Lot 3". The green colour indicates that all three lots are available or vacant. The UI design suggests that the status may change dynamically (e.g., red for occupied, green for vacant). The colour of the parking lot in the system will change depending on the record of visitors entering and leaving the residence. This change will occur automatically when the visitor has left the residence. The administrator of this system can also monitor the movement of visitors' cars as they enter and leave, especially during weekends or school holidays.

Figure 6

Parking Lot Captured from RFID Technology

Figure 7 is an interface for registered residents' records. The category of residents, such as "Resident or Non-Resident," is used to categorise the residents. Figures 7 and 8 are the residents' information interfaces that record details such as name, resident type, car registration number, phone number, and address. Figure 8 is the resident complaint interface of the developed system. Residents submit their complaints by scanning a QR code in the residential area, and the details are then displayed in the system. The names of the complainants are kept confidential to ensure their safety and the integrity of the information in the residential management system.

Figure 7

Resident Database Interface for System

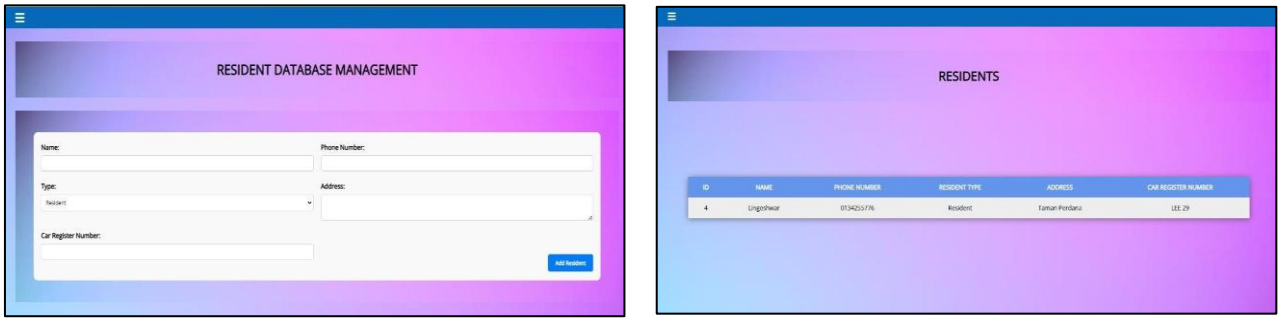


Figure 8

Resident Complaint Interface for System

Findings of System Testing

This section outlines the testing process for the MyCommunity ResolvePoint system, covering unit testing, integration testing, and user acceptance testing. Each testing phase aims to ensure that the system components function correctly, integrate seamlessly, and meet user requirements. Based on Table 2, unit testing involves isolating units to verify functionality before they are connected to other program components. Unit tests enable automated testing, which speeds up the development process in the short term. Therefore, the developer of this system has selected the tools and test cases that will be used during testing. The developer used the Arduino IDE, a web browser for the front end, and MySQL for backend testing. Among the test cases are those involving an RFID scanner that detects a card and logs time, and the

complaint form, which is submitted via anonymous entries to the system. Moreover, the test case also relates to the facility booking logs and tracks user access.

Table 2

Unit Testing Plan

Unit Testing	Description
Purpose	To ensure individual components (RFID module, complaint system, facility tracking) function correctly.
Tools Used	Arduino IDE, web browser for front-end, MySQL for backend testing.
Test Cases	• RFID scanner detects the card and logs time. • The complaint form submits anonymous entries to the database/website. • Facility booking logs and tracks user access.

Based on Table 3, integration testing was conducted to ensure that the hardware and software worked together without errors. Integration testing assesses system reliability by testing different units. RFID cards facilitate access to residents' homes' infrastructure by recording parking times in real time. The results of this test show that all integrated flows are completed without errors. Table 4 presents the findings of User Acceptance Testing (UAT) involving three residents, two security staff members, and an administrator from management. Users log in to the system and scan the RFID to enter the residential area. Thus, the testing shows that the system automatically records the visitor's car being parked. The UAT also tests the process of the complaint form that is submitted by the users. The testing shows that the system is easy to use. However, a minor delay is observed when updating the database (1–5 seconds), which is acceptable for use.

Table 3

Integration Testing Plan

Integration Testing	Description
Purpose	To ensure modules (hardware + software) work together seamlessly.
Scenario Tested	RFID card triggers a facility access event → data is logged → real-time alert generated.
Result	All integrated flows completed without error.

Table 4

User Acceptance Test

User Acceptance Test	Description
Participants	3 residents, 2 security staff, 1 management user.
Objective	Evaluate usability and functionality in real-world usage.
Method	Users performed login, scanned RFID, submitted a complaint, and viewed logs.
Feedback	100% found the system easy to use. Minor delay noticed in database update (1–5 sec), acceptable in use.

Table 5 summarises the test results for the MyCommunity ResolvePoint system. The system was tested through unit, integration, and user acceptance testing. The finding shows that parking information is stored in a database when visitors scan an RFID-enabled card. The complaint record is saved anonymously and without errors after users submit it. Integration testing shows that RFID scans trigger an alert when a user scans them, and that the data log is recorded without errors. User acceptance testing (UAT) was also conducted, whereby management quickly accepted complaints through the system after users submitted them. Additionally, tests show that the RFID log time is 5 seconds for this system. Therefore, the tests carried out show that the MyCommunity ResolvePoint system meets the needs and requirements of users such as residents and visitors to the residence.

Table 5

Summary of Test Results

Test Type	Test Case	Expected Result	Actual Result	Status
Unit Testing	RFID scan logs entry	Entry saved in the database	Entry saved in the database without error	✅ Positive
Unit Testing	Complaint submission	Record of complaint saved anonymously	Record of complaint saved anonymously without error	✅ Positive
Integration Testing	RFID scan triggers an alert and logs data	RFID scans trigger alerts, and then the data logs are recorded	RFID scans trigger alerts, and then the data logs are recorded without error	✅ Positive
UAT	The resident submits a complaint	Complaints are received by management	Complaints are received by management quickly	✅ Positive
Performance Testing	RFID log time	< 5 seconds	5 seconds	✅ Positive

Release the System

The system is used in a gated community in a controlled environment in Balik Pulau, Penang. The administrator can manage resident information, visitor records, and visitor parking time for vehicles through this system. During this release phase, training sessions were conducted for management and security staff to familiarise them with the system.

Feedback of the System

The feedback phase evaluates the system's performance against predefined success criteria, such as visitor tracking accuracy. In addition, user feedback on usability, efficiency, and security is collected to identify improvements for the future. Among the improvements that need to be made is the status of complaints sent by residents via the system. Apart from that, the system interface also needs improvement in terms of colour choices.

The MyCommunity ResolvePoint system is a significant innovation that enhances security, efficiency, and communication within gated communities. By integrating RFID-based technology, it replaces traditional manual visitor logbooks with a digital tracking system, ensuring real-time monitoring and preventing unauthorised access. This enhances security by providing a more reliable method of visitor verification. Additionally, the system optimises facility management by automating the tracking of facility usage, ensuring fair access to community amenities such as gyms and event halls. With a centralised digital database, record-keeping becomes more accurate and efficient, eliminating errors associated with manual documentation and enabling easy report generation. The inclusion of an anonymous complaint platform further strengthens community engagement, allowing residents to voice concerns freely and fostering transparency between residents and management. By automating various administrative tasks, the system also improves operational efficiency, reducing paperwork and saving time for security personnel and community administrators. Designed to be scalable, MyCommunity ResolvePoint has the potential to be adopted by other gated communities, providing a sustainable solution for improving security and operational management and enhancing the system's user experience (Yusof et al., 2022b). Ultimately, this system creates a safer, more organised, and well-managed environment that enhances residents' overall quality of life.

Benefits of Improving the Community System

The study has identified several strengths that can improve the effectiveness and user experience through RDIF technology, including:

i. Enhanced Security: The system is RFID-based, which ensures only authorised visitors and residents can enter facilities**.** The real-time alerts in the system are to improve responsiveness to suspicious activities.

ii. Accurate Record-Keeping: The developed system eliminates errors from manual logbooks with automated, time-stamped logs. The database simplifies data management and report generation.

iii. Improved Communication: The system developed a built-in anonymous complaint platform that encourages open feedback from residents. Thus, it strengthens trust and transparency between residents and management.

iv. Operational Efficiency: The system can reduce workload for security and management by automating logging and tracking. In addition, this system can save time through quick access to resident and visitor data and streamlined facility monitoring.

v. User-Friendly Interface: Intuitive design for all user roles (residents, management, security), thus minimising the need for technical skills or lengthy training.

vi. Scalability: The system can be easily expanded to other communities or upgraded with new features. Moreover, modular design supports future integration, such as using biometric access and predictive analysis of facility usage.

vii. Cost-Effective: This system uses affordable hardware (RFID, ESP32) with open-source tools. Therefore, development costs are low, and long-term maintenance is more economical.

viii. Environmentally Friendly: Reduces paper usage by replacing physical logbooks and complaint forms. This system also indirectly promotes digital transformation in community management.

Recommendation

By incorporating these recommendations, the MyCommunity ResolvePoint system could evolve into a more comprehensive and robust solution for gated community management, enhancing security, user experience, and operational efficiency.

i. User Experience: Enhance the web interface and introduce a mobile app with multi-language support for residents and management.
ii. Integration: Connect with community management systems or resident databases for automatic updates and record syncing.
iii. Customizable Features: Allow management to set facility access rules, visitor time limits, and customise complaint categories.
iv. Analytics & Reporting: Provide real-time dashboards and data insights on visitor trends, facility usage, and complaint statistics to support better decision-making.

CONCLUSION

The MyCommunity ResolvePoint system provides a creative answer to the problems gated communities encounter in overseeing facility operations and security. It guarantees accurate visitor tracking, efficient facility use management, and smooth communication between residents and management by replacing manual processes with technology-driven procedures. In addition to improving community safety and functionality, this system addresses inefficiencies and enables management to operate more efficiently. MyCommunity ResolvePoint's automated record-keeping, real-time alerts, and anonymous complaint platform, among other features, create a safe, orderly, and resident-friendly environment that, over time, raises the standard of living in the neighbourhood. The MyCommunity ResolvePoint system significantly enhances the security, efficiency, and communication within a gated community. With the integration of RFID technology and a centralised web platform, the system should enable real-time tracking of visitor entries and facility usage, reduce the risk of unauthorised access, and improve accountability. Manual record-keeping was replaced by automated digital logging, ensuring accurate and tamper-proof data storage. Residents benefit from a user-friendly interface to submit anonymous complaints, encouraging more open and honest communication without fear of backlash. Management gains access to detailed reports and alerts, allowing faster response to issues and better oversight of community activities. The system is designed to minimise human errors, improve resource utilisation (such as fair use of shared facilities), and strengthen trust between residents and management. Therefore, the development of this system led to a safer, more organised, and digitally empowered gated community. The contribution of research is offering a safe RFID architecture designed for low-density residential settings to the residential community in Balik Pulau, Penang. Future studies could consider the full flow process for resident complaints. In addition, it is also suggested that future systems could integrate biometrics, use machine learning for predictive analysis of facility usage, or explore blockchain to improve data security.

ACKNOWLEDGMENT

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors. The authors would also like to thank the Department of Polytechnic and Community Colleges Education (JPPKK) and Politeknik Balik Pulau, Penang, Malaysia, for their support.

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