International Journal of Research on Multidisciplinary Studies
Online ISSN: 3116-4137 | Print ISSN: 3116-4145
Volume 1, Issue 5, pp. 412-425, June 2026
https://ijroms.com

Original Article

GeoCycleSJDM: A GPS-Enabled Intelligent Group Cycling Safety and Route Analytics System for Bikers in San Jose del Monte, Bulacan

John Gabriel C. Sambajon[1] Eduardo R. Yu II[2] Nicole T. Llorin[3]

Author Information:
[1-2]AMA University, Quezon City, Philippines

[3]AMA Computer College Caloocan, Caloocan City, Philippines

Correspondence:
jgcsambajon@amaes.edu.ph

Article History:

Date Received: June 2, 2026
Date Revised: June 15, 2026
Date Accepted: June 19, 2026
Date Published: July 3, 2026

DOI:
https://doi.org/10.5281/zenodo.21130415

Document ID: *2026IJROMS0161*

Recommended Citation:
Sambajon, J. G. C., Yu II, E. R., & Llorin, N. T. (2026). GeoCycleSJDM: A GPS-Enabled Intelligent Group Cycling Safety and Route Analytics System for Bikers in San Jose del Monte, Bulacan. International Journal of Research on Multidisciplinary Studies, 1(5), 412–425.
https://doi.org/10.5281/zenodo.21130415

Abstract. Cycling has emerged as a sustainable and environmentally friendly mode of transportation; however, cyclists remain vulnerable to road hazards, inadequate infrastructure, and limited access to localized navigation and safety systems. This study developed GeoCycleSJDM, a GPS-enabled intelligent group cycling safety and route analytics system designed for cyclists in San Jose del Monte, Bulacan. The system integrates real-time GPS route tracking, group ride coordination, SOS emergency alerts, and route analytics to enhance cyclist safety, navigation efficiency, and community engagement. A developmental research design utilizing the Design Science Research (DSR) approach and Agile Software Development Methodology was employed in the design, development, testing, and evaluation of the system. The application was evaluated by 43 cyclists and 7 IT professionals using the ISO/IEC 25010 Software Quality Model. Results showed that all core functionalities were successfully implemented. Performance testing revealed response times ranging from 0.28 to 0.61 seconds across major system operations. Evaluation using the ISO/IEC 25010 Software Quality Model yielded excellent ratings from cyclists (overall mean = 4.65) and IT experts (overall mean = 4.58), indicating high functional suitability, usability, performance efficiency, and security. These findings confirm the system's effectiveness, reliability, and readiness for real-world deployment. The study concludes that GeoCycleSJDM provides a localized and intelligent solution that promotes safer cycling experiences, improves group ride coordination, and supports data-driven urban mobility planning within San Jose del Monte, Bulacan.

Keywords: Cycling Safety; Geospatial Analytics; GPS Tracking; Intelligent Transportation Systems; Route Analytics

Introduction

The global landscape of urban mobility is undergoing a significant digital transformation driven by rapid technological advancements. Cities worldwide are increasingly adopting Intelligent Transportation Systems (ITS) to address traffic congestion and mitigate environmental impacts. Central to this transition is the concept of smart mobility, which promotes sustainable transportation alternatives such as cycling. As governments continue to invest in green infrastructure, cycling has emerged as a viable solution for low-cost, health-oriented, and carbon-neutral mobility. Consequently, the utilization of real-time data, collected through Global Positioning Systems (GPS) and mobile and web-based applications, has become fundamental to modern navigation systems and urban planning strategies (Nourbakhshrezaei et al., 2023).

Despite the growing emphasis on sustainable transport, cyclists remain classified as Vulnerable Road Users (VRUs) due to their limited physical protection compared to motor vehicle users. This vulnerability increases their exposure to road accidents, particularly in environments characterized by poor visibility and shared traffic lanes (Ameen, 2025). In developing areas such as San Jose del Monte (SJDM), Bulacan, these risks are further intensified by several contextual challenges, including inadequate infrastructure, limited availability of dedicated bicycle lanes, and poorly maintained road conditions. Moreover, existing global navigation applications often fail to account for localized road behaviors and the unique topographical features of the area. The absence of effective group coordination tools in standard applications also limits cyclists' ability to maintain synchronized navigation and receive real-time safety alerts during group rides. Additionally, the so-called "data graveyard" phenomenon persists, wherein large volumes of GPS data are collected but remain underutilized due to the lack of optimized database structures and advanced geospatial analytics capable of transforming raw data into meaningful safety insights (Nourbakhshrezaei et al., 2023).

To address these limitations, this study proposes the development of GeoCycleSJDM, a GPS-enabled intelligent mobile and web-based application specifically designed for the cycling community in San Jose del Monte. Unlike conventional tracking applications, the proposed system integrates real-time safety features, including emergency SOS alerts and hazard-prone area detection, alongside group ride coordination functionalities that ensure synchronized navigation among users. Furthermore, the system incorporates advanced data analytics through an optimized database framework to support spatial and temporal analysis for route optimization and risk assessment.

Existing cycling applications such as Strava, Komoot, and Google Maps offer functionalities related to route navigation and activity tracking; however, these platforms primarily emphasize fitness monitoring and general navigation rather than localized cycling safety. While Strava provides performance analytics, it lacks integrated emergency response features and localized hazard detection. Komoot supports route planning but does not offer real-time group synchronization or coordinated safety mechanisms. Similarly, Google Maps delivers general navigation services but does not incorporate cyclist-specific safety intelligence or community-driven route analytics. These platforms are designed for broad geographic applicability and do not adequately address the distinct road conditions, infrastructure limitations, and cycling patterns present in San Jose del Monte, Bulacan. Consequently, a significant gap exists in the availability of a localized system that integrates GPS tracking, group coordination, emergency response, and route analytics within a single platform. GeoCycleSJDM seeks to fill this gap by consolidating these functionalities into a unified system tailored to the needs of the local cycling community.

This study contributes to the fields of advanced systems analysis and database management by demonstrating the integration of dynamic geospatial data within a unified application platform. Beyond its technical contributions, the proposed system offers practical value to local urban planners by providing a data-driven tool for identifying high-risk areas and improving cycling infrastructure. By combining user-centered design principles with proactive safety features, GeoCycleSJDM aims to promote a safer, more connected, and sustainable urban mobility ecosystem.

Literature Review

Recent studies highlight the growing importance of intelligent transportation systems (ITS) in improving urban mobility, particularly through the integration of GPS technology and data-driven analytics. GPS-based systems have been widely used to analyze cycling behavior and route patterns. Chen et al. (2019) emphasized that GPS data enhances the understanding of trip purpose and route choice, allowing for improved navigation systems. Supporting this, Menghini et al. (2010) and Hood et al. (2011) demonstrated that GPS-based tracking can effectively model cyclist route preferences and decision-making behavior. In addition to route analysis, GPS data plays a critical role in transportation planning and infrastructure development. Studies such as Romanillos et al. (2016) and Sun et al. (2017) showed that large-scale cycling data can be used to evaluate environmental factors and improve urban mobility systems. Furthermore, Larsen et al. (2013) highlighted the use of geographic information systems (GIS) in planning bicycle infrastructure, while Zare et al. (2022) emphasized the importance of data-driven approaches in designing safer cycling environments. These findings suggest that integrating GPS data into mobile applications can support both individual navigation and large-scale planning. Cyclist safety has also been a major focus of recent research. Heesch and Langdon (2016) found that GPS tracking is effective in assessing the impact of infrastructure on cycling safety. Similarly, Kapousizis et al. (2022) reviewed modern bicycle technologies and concluded that real-time monitoring systems significantly improve cyclist awareness and safety. Supporting this, Nourbakhshrezaei et al. (2023) developed an intelligent situational awareness system that identifies high-risk areas and provides safety alerts, demonstrating the potential of integrating real-time data with safety mechanisms. In addition, Winters et al. (2015) introduced the concept of bikeability metrics, which link environmental conditions with cycling safety and user behavior. Mobile and intelligent systems have further enhanced the functionality of transportation technologies. Recent developments in smart city technologies emphasize the importance of information and communication technologies (ICT), real-time data processing, and citizen-centered digital services in improving urban mobility and user engagement. These intelligent systems support more efficient transportation services and facilitate data-driven decision-making within smart urban environments (Alderete, 2021). Similarly, Gu et al. (2018) explored intelligent advisory systems for cyclists, while Dabiri and Heaslip (2018) applied machine learning techniques to analyze GPS trajectories and predict transportation modes. These studies indicate that combining real-time data with intelligent algorithms enhances system responsiveness and decision-making capabilities.

The increasing adoption of cycling as a mode of transportation has also led to the development of shared mobility and cycling systems. Fishman (2016) reviewed bike-sharing systems and highlighted their role in promoting sustainable transportation. Likewise, Wang et al. (2018) analyzed user behavior across

INTERNATIONAL JOURNAL OF RESEARCH ON MULTIDISCIPLINARY STUDIES
International Journal of Research on Multidisciplinary Studies
Online ISSN: 3116-4137 | Print ISSN: 3116-4145
Volume 1, Issue 5, pp. 412-425, June 2026
https://ijroms.com
Original Article

different demographic groups. Earlier studies by Jensen et al. (2010) and Krizek et al. (2007) further demonstrated how cycling patterns and infrastructure influence user decisions and mobility behavior. Despite these advancements, many existing systems remain limited in terms of integration and localization. Most applications focus primarily on navigation or data analysis, without incorporating real-time safety features, group ride coordination, or localized analytics. Additionally, existing systems often lack the ability to transform raw GPS data into actionable insights for both users and urban planners. To address these gaps, this study proposes GeoCycleSJDM, a GPS-enabled intelligent group cycling safety and route analytics system. Unlike existing solutions, the proposed system integrates real-time GPS tracking, geospatial analytics, group coordination, and emergency response features into a single platform. This approach not only enhances individual safety and navigation but also contributes to data-driven decision-making and localized urban mobility planning in San Jose del Monte, Bulacan. The reviewed studies collectively demonstrate that GPS technology, geospatial analytics, and intelligent transportation systems significantly improve route planning, mobility analysis, and cyclist safety. However, existing research tends to focus on these components independently. Studies on GPS tracking primarily emphasize route behavior analysis, while safety-oriented research focuses on hazard detection and situational awareness. Similarly, intelligent navigation systems concentrate on route optimization without integrating emergency response and group ride coordination. Consequently, there remains a lack of integrated and localized solutions that combine real-time GPS tracking, geospatial analytics, emergency response mechanisms, and synchronized group ride management within a single platform. This gap forms the basis for the development of GeoCycleSJDM.

Methodology

Research Design

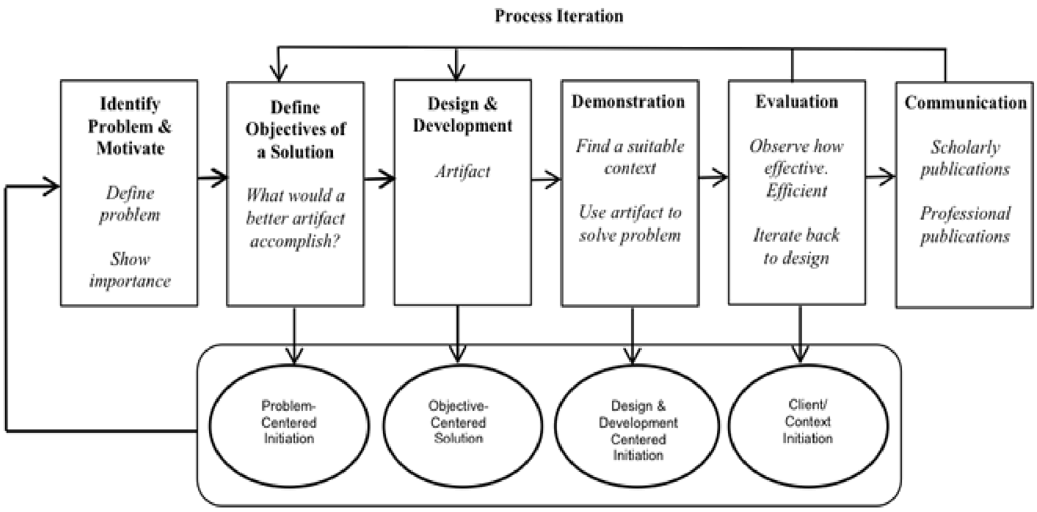

Figure 1: *Design Science Research Approach*

This study employed a developmental research design using the Design Science Research (DSR) approach to design, develop, and evaluate GeoCycleSJDM, a GPS-enabled intelligent group cycling safety and route analytics system. The approach is appropriate as the study focuses on creating a functional mobile and web application that addresses real-world problems in cycling safety, group coordination, and route optimization. The system integrates real-time GPS tracking, geospatial data processing, and intelligent analytics to support safer and more efficient cycling activities within San Jose del Monte, Bulacan.

Mobile Application Development Framework

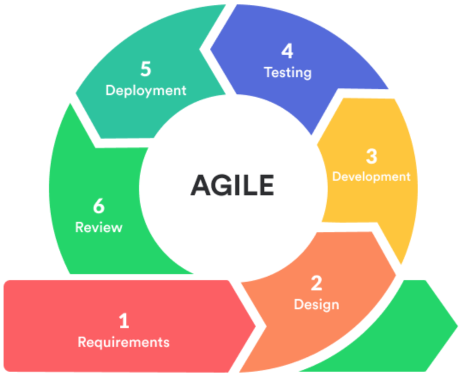

Figure 2: *Agile Development Cycle*

The mobile application was developed using the Agile Software Development Methodology, specifically the Scrum framework, to support iterative development and continuous enhancement. Agile methods are widely recognized for improving adaptability, collaboration, and incremental delivery of functional modules (Schwaber & Sutherland, 2020).

The development process was divided into the following phases:

1. Requirements Analysis

   This phase identified both functional and non-functional requirements through stakeholder interviews, literature review, and analysis of existing cycling applications. Special emphasis was placed on GPS-based tracking, group synchronization, and safety mechanisms.

2. System Design

   Preparation of system models including:

   - Use Case Diagram Defines the functional interactions between cyclists and administrators, such as triggering SOS alerts and managing group ride coordination.
   - Data Flow Diagram (DFD) Maps the transformation of raw GPS coordinates into real-time safety alerts and route analytics as they move through the system.
   - Entity Relationship Diagram (ERD) Illustrates the optimized database schema used to store and relate user profiles, group ride logs, and geospatial hazard data.
   - Class Diagram Outlines the internal software structure and object-oriented logic, detailing how code modules like RouteTracker and EmergencyHandler operate.
   - Deployment Architecture Displays the physical hardware and cloud environment that connects the mobile app to the backend servers and spatial databases.

3. Development Sprint Cycles

   The system is built using Development Sprint Cycles, an iterative approach that breaks the project into manageable blocks to ensure each feature is functional, tested, and integrated seamlessly.

   - User Account Management: The first sprint focuses on the security layer, establishing the database schema for user profiles and implementing authentication protocols to ensure data privacy for every cyclist.
   - GPS Route Tracking: The second sprint develops the core spatial engine, focusing on the high-frequency polling of coordinates and the logic required to map raw GPS pings into smooth, visual route paths.
   - Group Ride Coordination: This sprint introduces real-time synchronization, utilizing a centralized backend to broadcast location data across multiple devices simultaneously so group members can monitor each other's positions.
   - SOS Emergency Alerts: During this cycle, the safety trigger logic is implemented, ensuring that when a cyclist activates the SOS feature, their precise coordinates are instantly pushed to the group and emergency contacts.

INTERNATIONAL JOURNAL OF RESEARCH ON MULTIDISCIPLINARY STUDIES
International Journal of Research on Multidisciplinary Studies
Online ISSN: 3116-4137 | Print ISSN: 3116-4145
Volume 1, Issue 5, pp. 412-425, June 2026
https://ijroms.com
IJROMS INTERNATIONAL JOURNAL OF RESEARCH ON MULTIDISCIPLINARY STUDIES "Bridging Disciplines, Advancing Knowledge"
Original Article

- Route Analytics Dashboard: The final sprint focuses on the "Intelligence" aspect, building the data processing layer that aggregates historical trip data into visual heatmaps and identifies hazard-prone "black spots" within San Jose del Monte.

4. Testing and Refinement

Following the development phase, the Testing and Refinement stage focuses on a rigorous cycle of continuous debugging and system validation to ensure that real-time GPS coordinates and safety triggers are both precise and reliable. This iterative process integrates Black Box testing to refine the user interface, ensuring the app is intuitive and accessible for cyclists under active road conditions. By identifying and resolving technical bottlenecks early, this phase ensures the system achieves the high standards of performance and reliability required for a life-safety application.

5. Deployment and Evaluation

The project culminates in the Deployment and Evaluation phase, where the system undergoes a pilot implementation among the cycling community in San Jose del Monte, Bulacan. This real-world transition serves as a critical "stress test" to measure how the application performs under actual local road conditions and group dynamics. Following the pilot, the system is formally assessed against the ISO/IEC 25010 software quality standards and user acceptability metrics to ensure that the integrated safety and analytics features effectively address the specific needs of local bikers.

Population of the Study and Data Collection Procedure

The target population consists of active cyclists in San Jose del Monte, Bulacan who participate in both individual and group cycling activities during the system testing and evaluation period. Eligible participants must be active cyclists residing in the area, regularly engage in cycling activities including group rides, own and use a GPS-enabled smartphone, and be willing to use the GeoCycleSJDM mobile application. Based on coordination with local cycling communities, approximately 30 to 50 cyclists are expected to participate in the study. Purposive sampling was used to select participants who meet these criteria to ensure relevance to the study objectives, with the final sample size determined by the number of valid responses and documented response rate. Data collection was conducted through stakeholder interviews, system requirements surveys, route usage observation, and pilot testing feedback to ensure comprehensive and relevant input for system development and evaluation.

Rationale for Respondent Selection

Cyclists were selected because they represent the primary end-users of the GeoCycleSJDM system and possess practical experience in route navigation and group riding activities. IT professionals were included because of their expertise in software evaluation and quality assessment. Their combined perspectives provided both user-centered and technical evaluations, ensuring a comprehensive assessment of the system's effectiveness and software quality.

Mobile Application Testing Procedures

The mobile application was tested using the Black Box Testing approach, which focuses on evaluating the system’s functionality based on user inputs and expected outputs without examining the internal code structure. This method is appropriate for validating whether the system meets the specified functional requirements from the user’s perspective.

Black Box Testing was conducted on the core features of GeoCycleSJDM, including authentication, GPS route tracking, group ride coordination, SOS emergency alerts, and route analytics.

The testing process involved the following steps:

1. Test Case Design - Test cases were created based on the system’s functional requirements. Each test case defined specific inputs, expected outputs, and actual results.
2. Execution of Test Cases - The application was tested by entering valid and invalid inputs to observe system behavior and verify whether outputs matched the expected results.
3. Validation of Results -The system responses were compared with expected outcomes to determine whether each function passed or failed.
4. Error Identification and Correction - Any inconsistencies or errors encountered during testing were recorded and resolved through system refinement.

Software Quality Evaluation Procedures

The system was evaluated using the ISO/IEC 25010 Software Quality Model, which assesses software based on key quality characteristics such as functional suitability, usability, reliability, performance efficiency, security, maintainability, and portability. The evaluation involved 43 cyclists, who assessed the system based on usability and actual usage experience, and 7 IT professionals, who evaluated its technical quality standards. A structured questionnaire using a 5-point Likert scale was administered after system deployment, allowing respondents to use the application before completing the evaluation. The collected responses were then encoded and analyzed to determine the system's overall quality and acceptability.

Data Analysis

The weighted mean was used to analyze the evaluation results by computing the average score based on the frequency and corresponding scale values of responses. The analysis considered the distribution of ratings across the Likert scale relative to the total number of respondents, and the resulting mean scores were interpreted using a predefined descriptive scale. Mean scores ranging from 4.50 to 5.00 were interpreted as Excellent, 3.50 to 4.49 as Very Satisfactory, 2.50 to 3.49 as Satisfactory, 1.50 to 2.49 as Needs Improvement, and 1.00 to 1.49 as Poor, to determine the overall system evaluation.

System Validation Environment

System validation was conducted using Android smartphones with GPS functionality enabled and stable internet connectivity. Testing was performed along selected cycling routes within San Jose del Monte, Bulacan, including urban roads, residential areas, and major cycling corridors. The testing environment was chosen to simulate actual riding conditions and evaluate the system's responsiveness, location accuracy, synchronization capability, and emergency alert functionality under real-world scenarios.

Results and Discussions

Architectural Design of GeoCycleSJDM

The system design results are presented through functional specifications and modeling artifacts that define the application's structure and behavior. Figure 3 shows the system context diagram illustrating interactions among users, administrators, and external components. Figure 4 presents the use case diagram detailing key system processes such as authentication, route tracking, group coordination, SOS alerts, and analytics. Figure 5 shows the entity-relationship diagram representing the system's data structure and relationships for efficient storage and retrieval. These models are supported by detailed use case specifications covering core functionalities such as authentication, route tracking, group rides, SOS alerts, analytics, feedback, and administration, including normal and exception flows. Overall, the results confirm that the system is well-structured, functionally complete, and aligned with real-time operational and data integrity requirements.

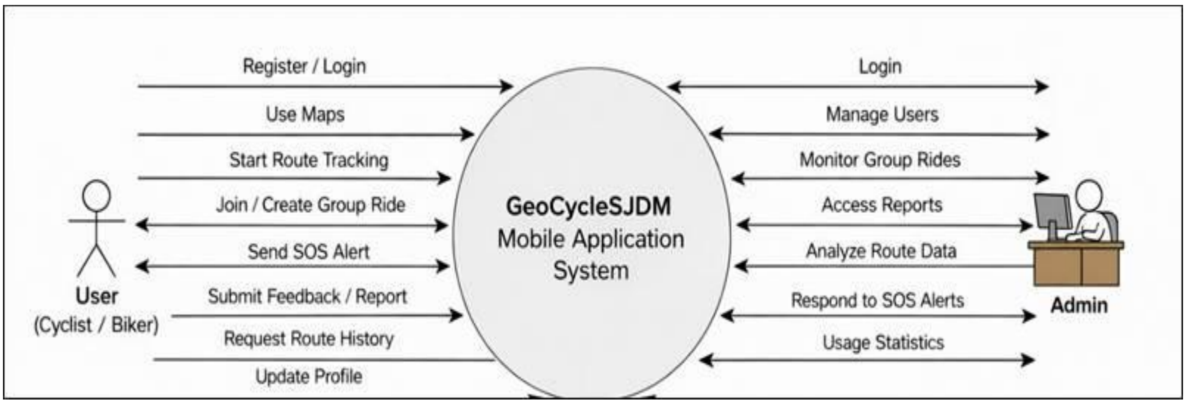

Figure 3: *Context Diagram*

Original Article

International Journal of Research on Multidisciplinary Studies
Online ISSN: 3116-4137 | Print ISSN: 3116-4145
Volume 1, Issue 5, pp. 412-425, June 2026
https://ijroms.com

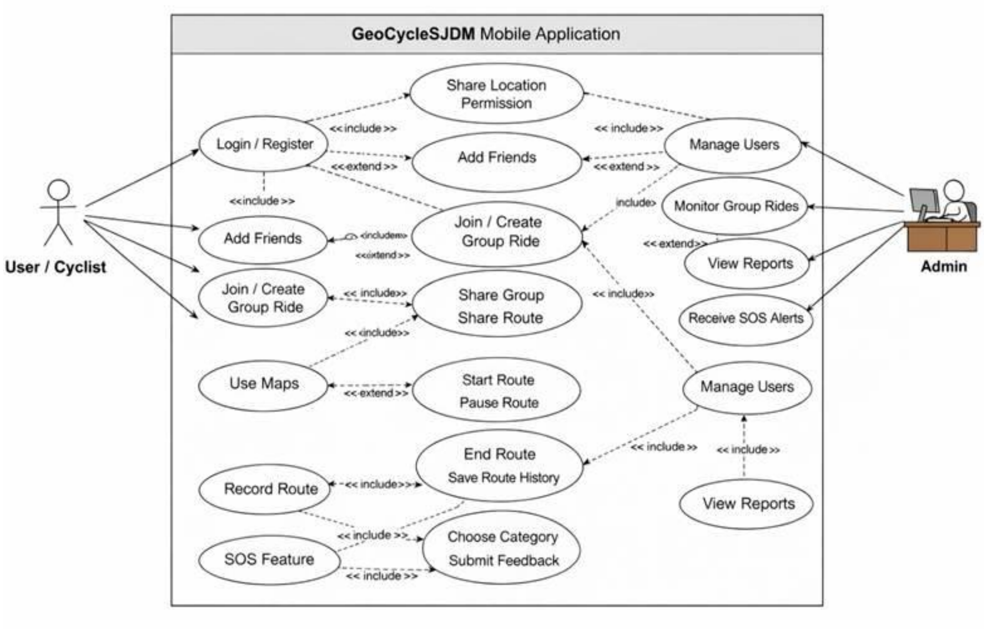

Figure 4: *Use Case Diagram*

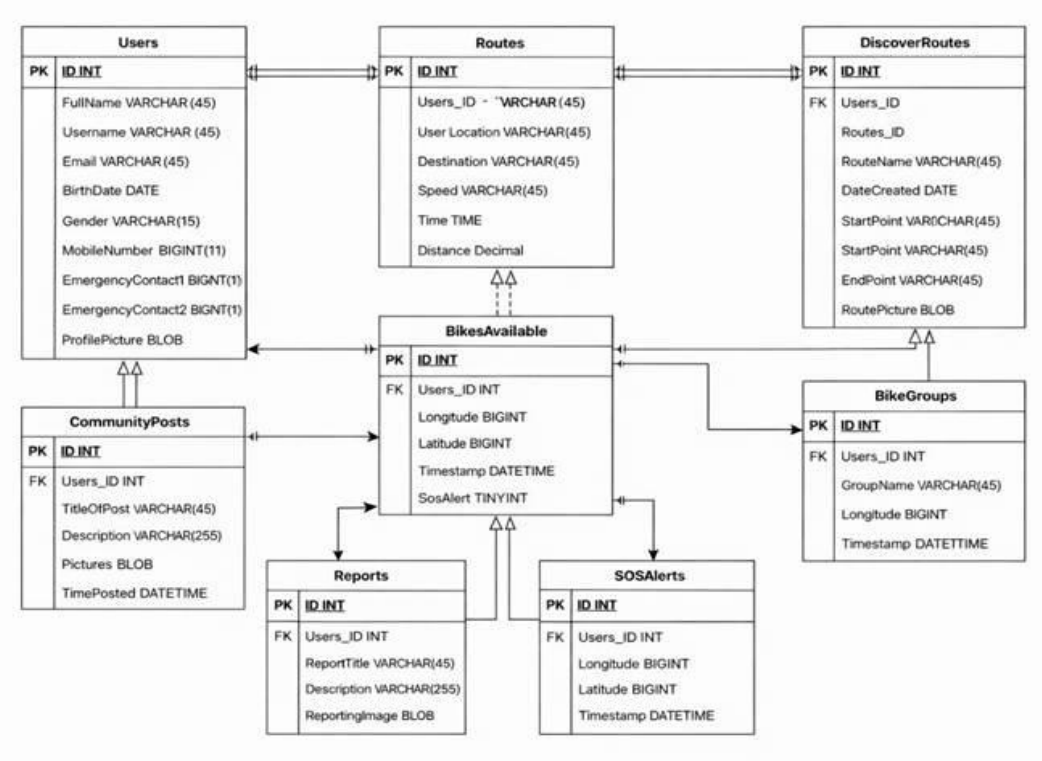

Figure 5: *Entity Relationship Diagram*

Key Features of GeoCycleSJDM

The system's main entry point for both users and administrators is the authentication interface, which includes login, registration, and password recovery functionalities to ensure secure and user-friendly access. It also provides quick navigation options to core modules such as Home, Routes, Groups, and Profile, enabling seamless movement across the application. The login interface is designed to authenticate users securely, while the registration interface allows new users to create accounts by providing personal information and emergency contact details, ensuring proper onboarding and secure storage of essential cyclist data for authentication and safety purposes. The map navigation interface enables users to view their

International Journal of Research on Multidisciplinary Studies
Online ISSN: 3116-4137 | Print ISSN: 3116-4145
Volume 1, Issue 5, pp. 412-425, June 2026
https://ijroms.com
Original Article

real-time location and cycling route within San Jose del Monte, Bulacan, supporting GPS-based navigation, route monitoring, and distance tracking for improved safety and efficiency. Meanwhile, the group ride interface allows users to search, view, and join cycling groups, displaying ride schedules, meeting points, and participant counts to facilitate coordinated and safe group cycling activities.

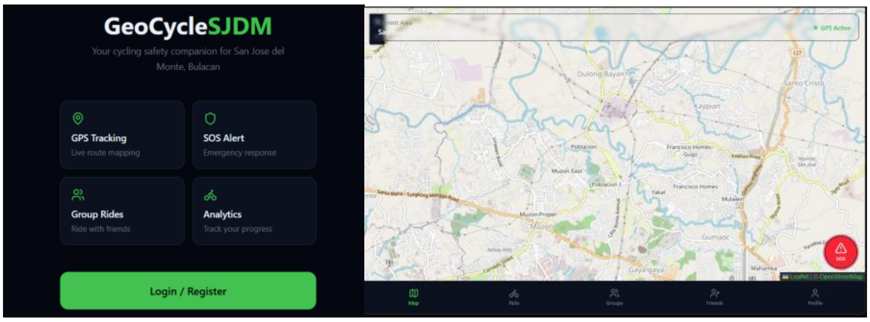

Figure 6: *Login and GPS Map Interfaces of GeoCycleSJDM*

The group ride interface enables users to search, view, and join available cycling groups within San Jose del Monte, Bulacan. It displays ride schedules, meeting points, and participant counts to support coordinated and safe group cycling activities. The contacts screen allows users to view their cycling connections and send ride invitations, enhancing social connectivity and improving coordination for group rides and community-based cycling activities. The SOS alert feature is designed to provide immediate emergency assistance during active rides by enabling users to contact emergency services, notify guardians, and share their live location, thereby ensuring timely response and improved rider safety in San Jose del Monte, Bulacan.

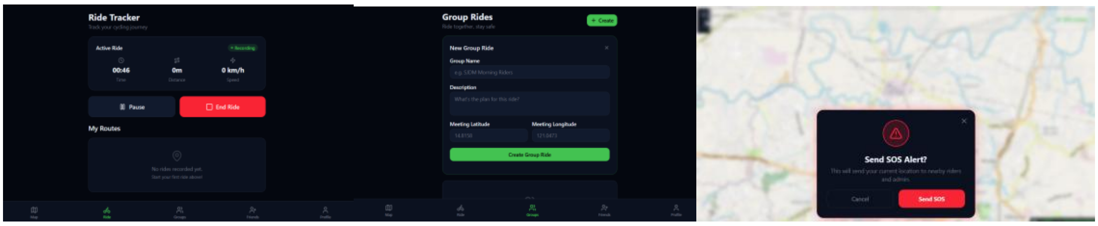

Figure 7: *Group Ride, Contacts, and SOS Alert Interfaces of GeoCycleSJDM*

The system results indicate that all core features were successfully implemented and are fully operational. The application supports essential functions such as real-time route tracking, group ride coordination, and emergency response, demonstrating compliance with the functional requirements defined during the design phase. The integration of these features shows that the system effectively addresses limitations of existing cycling applications, particularly in safety, coordination, and real-time monitoring, and aligns with related studies emphasizing the value of GPS-based systems for user safety and situational awareness. However, system performance remains dependent on stable internet connectivity, which may affect real-time synchronization in areas with weak or inconsistent signal coverage. In addition, performance evaluation results show consistently low response times across key operations, indicating efficient processing and system responsiveness. Overall, the findings confirm that the system is functionally complete, performance-efficient, and capable of supporting reliable real-time operation under typical usage conditions.

Table 3. System Functionality Implementation

Feature	Status	Description
Route Tracking	Implemented	Real-time GPS tracking with route history
Group Ride Coordination	Implemented	Group creation and live synchronization
SOS Emergency Alert	Implemented	Real-time distress signal with location
Route Analytics	Implemented	Visualization of cycling patterns

International Journal of Research on Multidisciplinary Studies
Online ISSN: 3116-4137 | Print ISSN: 3116-4145
Volume 1, Issue 5, pp. 412-425, June 2026
https://ijroms.com
Original Article

Table 4. System Performance Results

Operation	Average Response Time
User Login	0.42 sec
GPS Data Insert	0.35 sec
Route Retrieval	0.57 sec
Group Synchronization	0.61 sec
SOS Alert	0.28 sec

Route Analytics and Visualization Functionality of GeoCycleSJDM

The analytics module successfully generated meaningful insights from collected GPS data. The identified patterns help cyclists plan safer and more efficient routes. The system also provides useful data for local stakeholders in improving cycling infrastructure. The findings support studies on geospatial analytics and data-driven transportation systems. The limitation lies in the sample size, which affects the scope of the generated insights. Table 5 presents the route analytics output, highlighting key indicators derived from the system. The most frequently used route was identified between Muzon and Tungkong Mangga, while peak cycling activity was observed between 5:00 AM and 7:00 AM. Additionally, high-risk areas were associated with low visibility zones and steep route segments, indicating potential safety concerns that may require targeted

Table 5. Route Analytics Output

Indicator	Result
Most Used Route	Muzon to Tungkong Mangga
Peak Hours	5:00 AM – 7:00 AM
High-Risk Areas	Low visibility, steep routes

Evaluation Results the GeoCycleSJDM using ISO/IEC 25010 Software Quality Model

The evaluation results show consistently high system acceptability among both cyclists and IT professionals. As shown in Table 6, cyclists (n = 43) rated all criteria highly, with usability scoring the highest (4.75), followed by functional suitability (4.70), while other aspects such as performance efficiency and security were rated excellent and reliability as very satisfactory, indicating strong user satisfaction in terms of functionality and ease of use. Similarly, Table 7 shows that IT experts (n = 7) rated functional suitability, usability, and security as excellent, while other criteria such as reliability, performance efficiency, maintainability, and portability were rated very satisfactory, reflecting strong technical acceptability with minor areas for improvement. Overall, the results confirm that the system meets ISO/IEC 25010 quality standards and is ready for real-world deployment.

Table 6. Cyclist Evaluation Results (n = 43)

Criteria	Mean	Interpretation
Functional Suitability	4.70	Excellent
Usability	4.75	Excellent
Reliability	4.58	Excellent
Performance Efficiency	4.62	Excellent
Security	4.60	Excellent

Table 7. IT Expert Evaluation Results (n = 7)

Criteria	Mean	Interpretation
Functional Suitability	4.65	Excellent
Usability	4.60	Excellent
Reliability	4.55	Excellent
Performance Efficiency	4.58	Excellent
Security	4.63	Excellent
Maintainability	4.50	Excellent
Portability	4.57	Excellent

User acceptability of the GeoCycleSJDM

Both groups demonstrated strong acceptance of the system, indicating that it is useful, efficient, and reliable for its intended purpose. Table 8 shows that cyclists (n = 43) rated the system at 4.65 (Excellent), while IT experts (n = 7) rated it at 4.58 (Excellent), confirming high overall acceptability across both groups.

Table 8. Overall Acceptability

Group	Mean Score	Interpretation
Cyclists (n=43)	4.65	Excellent
IT Experts (n=7)	4.58	Excellent

Summary of Findings

The results confirm that GeoCycleSJDM is an effective and reliable intelligent cycling safety and route analytics system for use in San Jose del Monte, Bulacan.

Table 9. Summary of Findings

Key Area	Result Summary
System Development	Successfully implemented
System Performance	Efficient and responsive
Route Analytics	Generated meaningful insights
System Evaluation	Rated Excellent
User Acceptability	High acceptance

Interpretation of Findings

The findings of the study demonstrate that GeoCycleSJDM effectively integrates GPS tracking, group coordination, and safety features into a unified mobile platform. The system achieved high usability and functional suitability ratings, indicating that users were able to interact with the application efficiently and without difficulty. This result suggests that the integration of real-time GPS tracking with a user-centered interface enhances user experience and system accessibility. The effectiveness of GPS-based route tracking in the system can be attributed to its ability to provide accurate and continuous location data. This supports the findings of Chen et al. (2019), who emphasized that GPS data improves route understanding and user navigation behavior. In the context of this study, the accurate mapping of routes and real-time tracking enabled cyclists to monitor their movement and make informed decisions, which contributes to safer and more efficient cycling. Mobile and intelligent systems have further enhanced the functionality of transportation technologies. GPS-enabled systems and geospatial analytics allow researchers and transportation planners to analyze cyclist movement patterns, identify high-risk areas, and support data-driven safety interventions. Strauss et al. (2015) demonstrated that smartphone GPS data can be effectively utilized to map cyclist activity and assess injury risk across transportation networks, highlighting the value of intelligent data-driven systems in improving cycling safety and mobility planning. The results of this study extend their findings by applying geospatial analysis within a localized mobile application, allowing real-time identification of hazard-prone areas specific to San Jose del Monte. Furthermore, the implementation of the SOS emergency alert feature enhances cyclist safety by enabling immediate response during emergencies. This supports the study of Nourbakhshrezaei et al. (2023), which highlighted that intelligent systems with situational awareness capabilities can significantly improve user safety by providing timely alerts and risk detection. In this study, the integration of real-time GPS data with emergency alert functionality ensures that users can quickly communicate their location during critical situations. Despite these positive results, the system's performance is influenced by external factors such as internet connectivity and GPS signal strength. This limitation is consistent with the observations of Heesch and Langdon (2016), who noted that GPS-based systems depend on environmental and infrastructure conditions. This indicates that while the system performs effectively under normal conditions, its reliability may vary in areas with poor network coverage.
Overall, the findings confirm that GeoCycleSJDM not only aligns with existing studies on GPS-based transportation systems but also extends current research by introducing a localized, group-based, and safety-oriented cycling platform. The integration of real-time tracking, analytics, and emergency response demonstrates the potential of intelligent systems in enhancing cyclist safety and supporting data-driven urban mobility solutions.

Comparison with Existing Studies

The findings of this study show strong alignment with existing research on GPS-based transportation and cycling safety systems, while also highlighting key improvements in system integration and localization.

International Journal of Research on Multidisciplinary Studies
Online ISSN: 3116-4137 | Print ISSN: 3116-4145
Volume 1, Issue 5, pp. 412-425, June 2026
https://ijroms.com
Original Article

The implementation of real-time GPS tracking in GeoCycleSJDM is consistent with the work of Chen et al. (2019), who demonstrated that GPS data enhances route monitoring and user navigation behavior. However, while their study focused primarily on analyzing cycling patterns, the present study extends this functionality by integrating real-time tracking within a mobile application that supports both navigation and safety features. This indicates that GeoCycleSJDM not only utilizes GPS for analysis but also for active, real-time user support. In terms of safety, the inclusion of the SOS emergency alert feature aligns with the findings of Nourbakhshrezaei et al. (2023), who emphasized the importance of intelligent systems in improving situational awareness and reducing risk. Unlike previous systems that focus mainly on hazard detection, the current study enhances safety by incorporating immediate emergency response capabilities, allowing users to transmit their real-time location during critical situations. This demonstrates an advancement from passive monitoring to active safety intervention. The use of geospatial analytics in identifying frequently used routes and high-risk areas is supported by Strauss et al. (2015), who utilized GPS data to map cyclist activity and detect accident-prone zones. While their study focused on post-analysis of collected data, GeoCycleSJDM extends this concept by integrating analytics directly into the application, enabling users to access route insights in real time. This shift from static analysis to dynamic, user-accessible analytics represents a significant improvement in practical application. In contrast, GeoCycleSJDM introduces real-time group coordination, allowing cyclists to monitor each other's positions and maintain group cohesion. This adds a collaborative dimension that is often lacking in traditional navigation systems. Additionally, the system contributes to infrastructure planning, similar to the work of Larsen et al. (2013) and Zare et al. (2022), who highlighted the use of geospatial data in improving cycling infrastructure. However, unlike these studies which focus on planning and design, the current system provides real-time and user-generated data that can be used continuously for decision-making. This demonstrates a transition from static planning tools to dynamic, data-driven systems. Overall, while existing studies have explored GPS tracking, safety systems, and geospatial analytics independently, this study integrates these components into a single, localized platform. The key contribution of GeoCycleSJDM lies in its ability to combine real-time tracking, intelligent safety features, group coordination, and route analytics, providing a comprehensive solution tailored to the needs of cyclists in San Jose del Monte, Bulacan.

Relationship to ISO/IEC 25010 Standards

The excellent ratings obtained for functional suitability, usability, performance efficiency, and security demonstrate compliance with the quality characteristics prescribed by ISO/IEC 25010. The results indicate that the system successfully fulfills user requirements, maintains efficient operation under normal usage conditions, and provides adequate protection of user information. These findings support the suitability of GeoCycleSJDM for practical deployment within community-based cycling environments.

Practical Implications

The results of this study provide several practical implications for cyclists, local government units, and system developers, particularly in the context of improving cycling safety and urban mobility in San Jose del Monte, Bulacan. For cyclists, the system enhances safety and navigation by providing real-time GPS tracking, group ride coordination, and emergency response features. The high usability rating (mean = 4.75) indicates that users can easily interact with the system during actual rides. Additionally, the identification of frequently used routes and high-risk areas enables cyclists to make safer route choices, particularly during peak cycling hours (5:00 AM–7:00 AM). The SOS alert feature further ensures immediate assistance by allowing users to transmit their exact location during emergencies. For local government units and urban planners, the system provides data-driven insights that can support infrastructure development and policy-making. The route analytics generated by the system, such as commonly used routes (e.g., Muzon to Tungkong Mangga) and identified hazard-prone areas, can be used to prioritize the development of dedicated bike lanes, improve road conditions, and enhance traffic safety measures. This transforms raw GPS data into actionable information for urban planning and smart city initiatives. For system developers, the study demonstrates a scalable model for integrating mobile applications, real-time GPS tracking, and geospatial analytics into a unified platform. The system's efficient performance, with response times below one second across key operations, indicates that optimized database structures and real-time processing can support reliable application performance. Furthermore, the successful implementation of group synchronization and safety features highlights the feasibility of developing intelligent, user-centered systems for transportation applications. Overall, the practical implications of the study emphasize the value of combining real-time data, intelligent analytics, and user-centered design to improve safety, coordination, and decision-making in cycling environments. The system serves not only as a tool for individual users but also as a potential support system for community-based mobility and data-driven urban development.

Theoretical Contribution

This study contributes to the field of Intelligent Transportation Systems (ITS) and information systems research by demonstrating how real-time GPS data, geospatial analytics, and mobile technologies can be integrated into a unified, user-centered system for cycling safety and mobility. First, the study extends existing knowledge on GPS-based transportation systems by introducing a localized and context-aware approach to mobility solutions. While previous studies such as Chen et al. (2019) focused on analyzing GPS data for route behavior and planning, this study advances the concept by integrating real-time data processing with user interaction and safety features within a single platform. This highlights the transition from passive data analysis to interactive and application-driven intelligence in transportation systems. Second, the study contributes to safety-related theories in transportation by demonstrating how intelligent systems can move from reactive to proactive safety mechanisms. Existing research, such as Nourbakhshrezaei et al. (2023), emphasizes situational awareness in detecting risks. This study extends that concept by incorporating real-time emergency response (SOS alerts) and hazard identification, showing how mobile systems can actively intervene in safety-critical situations. Third, the study provides a conceptual contribution to group-based mobility systems by introducing real-time synchronization among users in a cycling environment. Unlike traditional navigation systems that focus on individual users, this study demonstrates that mobility systems can be designed to support collective movement and coordination, thereby expanding the scope of user interaction in transportation technologies. Finally, from a Design Science Research perspective, the study contributes by presenting a functional artifact (GeoCycleSJDM) that integrates multiple components—GPS tracking, analytics, group coordination, and safety features—into a cohesive system. This demonstrates how complex real-world problems in transportation can be addressed through the design and evaluation of an intelligent, data-driven application. Overall, the study contributes to theory by proposing that effective transportation systems should not only collect and analyze data but also deliver real-time, context-aware, and user-centered intelligence that enhances safety, coordination, and decision-making in localized environments.

Ethical Considerations

The study complied with the principles of voluntary participation, informed consent, confidentiality, and responsible data management. Prior to participation, all respondents were informed of the study objectives, procedures, and intended use of collected information. Written informed consent was obtained from all participants. Because the system collects location-based information, all GPS coordinates and route histories were processed solely for research and system evaluation purposes. Personally identifiable information was removed through anonymization procedures, and collected data were stored in secured databases accessible only to authorized researchers. The study adhered to the principles of the Philippine Data Privacy Act of 2012 (Republic Act No. 10173) regarding the collection, processing, storage, and protection of personal information.

Conclusion

This study designed, developed, and evaluated GeoCycleSJDM, a GPS-enabled intelligent mobile application for group cycling safety and route analytics in San Jose del Monte, Bulacan. The findings demonstrate that the system effectively addresses the identified problem of the absence of a localized cycling support platform by integrating real-time GPS tracking, group ride coordination, SOS emergency response, and route analytics within a single application. The system achieved high evaluation results from both cyclists and IT professionals, with cyclists assigning a mean rating of 4.65 and IT experts providing a rating of 4.58, both interpreted as excellent. These results indicate strong user acceptance, high usability, and robust functional performance, confirming that the system operates effectively under real-time conditions and satisfies established software quality standards. Furthermore, the route analytics module produced clear and meaningful outputs by identifying frequently used routes, peak cycling periods, and hazard-prone areas, demonstrating the system's capability to transform raw data into actionable insights. This supports informed decision-making among cyclists and provides valuable data for urban planning and safety improvements. Overall, the study confirms that GeoCycleSJDM is an effective, reliable, and practical intelligent system that enhances cyclist safety, strengthens group coordination, and contributes to data-driven mobility planning in a localized context. Future research may focus on incorporating machine learning-based route recommendations, predictive hazard detection, weather-aware route optimization, and Internet of Things (IoT) integration through smart helmets and wearable devices. Further studies may also expand implementation to neighboring municipalities and evaluate long-term impacts on cyclist safety and urban mobility planning.

Recommendations

Based on the findings of the study, several recommendations are proposed for key stakeholders. For cyclists and local communities, individuals in San Jose del Monte, Bulacan are encouraged to adopt the system to enhance route safety, improve group ride coordination, and strengthen emergency response capabilities, while local cycling organizations and community groups may utilize the platform as a coordination and safety tool for organized rides. For local government units and urban planners, the generated route analytics data should be considered in planning initiatives such as dedicated bike lanes, road safety improvements, hazard-prone route interventions, and cyclist-friendly urban infrastructure, with the system also serving as a potential support tool for smart city and sustainable transportation initiatives. For future researchers, it is recommended to explore the integration of advanced features such as machine learning-based route recommendation, predictive hazard detection, AI-driven traffic and cyclist behavior analytics, and weather-aware route optimization to enhance the system's intelligence and predictive capabilities, as well as to expand the scope of the study to include neighboring cities and municipalities for comparative route analytics. Lastly, for system enhancement, future versions should incorporate functionalities such as push notifications for live hazards, real-time weather integration, wearable device connectivity, integration with smart helmets and IoT sensors, and a cloud-based analytics dashboard for administrators, thereby strengthening both the practical application and research value of the system.

References

Alderete, M. V. (2021). Determinants of smart city commitment among citizens from a middle city in Argentina. *Smart Cities, 4*(3), 1113–1129. https://doi.org/10.3390/smartcities4030059

Ameen, I. A. (2025). Intelligent bicycle safety and tracking system: A GPS and GSM-based approach. Jupiter Journal of Engineering and Informatics. https://doi.org/10.61132/jupiter.v3i1.713

Chen, Z., He, Q., & Zhang, J. (2019). Understanding cycling trip purpose and route choice using GPS data. Proceedings of the ACM on Interactive, Mobile, Wearable and Ubiquitous Technologies, 3(2). https://doi.org/10.1145/3314407

Dabiri, S., & Heaslip, K. (2018). Inferring transportation modes from GPS trajectories using a convolutional neural network. arXiv. https://arxiv.org/abs/1804.02386

Elmasri, R., & Navathe, S. B. (2016). Fundamentals of database systems (7th ed.). Pearson.

Fishman, E. (2016). Bikeshare: A review of recent literature. Transport Reviews, 36(1), 92–113. https://doi.org/10.1080/01441647.2015.1033036

Gu, Y., Liu, M., Souza, M., & Shorten, R. (2018). On the design of an intelligent speed advisory system for cyclists. arXiv. https://arxiv.org/abs/1804.08282

Heesch, K. C., & Langdon, M. (2016). The usefulness of GPS bicycle tracking data for evaluating the impact of infrastructure change on cycling behaviour. Health Promotion Journal of Australia, 27(3), 217–221. https://doi.org/10.1071/HE16032

Hevner, A. R., March, S. T., Park, J., & Ram, S. (2004). Design science in information systems research. MIS Quarterly, 28(1), 75–105. https://doi.org/10.2307/25148625

Hood, J., Sall, E., & Charlton, B. (2011). A GPS-based bicycle route choice model for San Francisco, California. *Transportation Letters, 3*(1), 63–75. https://doi.org/10.3328/TL.2011.03.01.63-75

Jensen, P., Rouquier, J. B., Ovtracht, N., & Robardet, C. (2010). Characterizing the speed and paths of shared bicycle use in Lyon. Transportation Research Part D, 15(8), 522–524. https://doi.org/10.1016/j.trd.2010.07.002

Kapousizis, G., Ulak, M. B., Geurs, K., & Havinga, P. J. M. (2022). A review of state-of-the-art bicycle technologies affecting cycling safety. Transport Reviews, 42(6), 787–807. https://doi.org/10.1080/01441647.2022.2122625

Krizek, K. J., El-Geneidy, A., & Thompson, K. (2007). A detailed analysis of how an urban trail system affects cyclists' travel. Transportation, 34(5), 611–624. https://doi.org/10.1007/s11116-007-9130-z

Larsen, J., El-Geneidy, A., & Yasmin, F. (2013). Using geographic information systems to plan bicycle infrastructure. Retrieved from https://tram.mcgill.ca/Research/Publications/Building%20for%20bicycling.pdf

Menghini, G., Carrasco, N., Schüssler, N., & Axhausen, K. W. (2010). Route choice of cyclists in Zurich. Transportation Research Part A, 44(9), 754–765. https://doi.org/10.1016/j.tra.2010.07.008

Nourbakhshrezaei, A., Jadidi, M., & Sohn, G. (2023). Improving cyclists' safety using intelligent situational awareness system. Sustainability, 15(4), 2866. https://doi.org/10.3390/su15042866

Romanillos, G., Zaltz Austwick, M., Ettema, D., & De Kruijf, J. (2016). Big data and cycling. *Transport Reviews, 36*(1), 114–133. https://doi.org/10.1080/01441647.2015.1084067

International Journal of Research on Multidisciplinary Studies
Online ISSN: 3116-4137 | Print ISSN: 3116-4145
Volume 1, Issue 5, pp. 412-425, June 2026
https://ijroms.com
Original Article

Schwaber, K., & Sutherland, J. (2020). The Scrum Guide. Retrieved from https://scrumguides.org

Strauss, J., Miranda-Moreno, L. F., & Morency, P. (2015). Mapping cyclist activity and injury risk using smartphone and GPS data. *Transportation Research Record, 2519*(1), 9–17. https://doi.org/10.3141/2519-02

Wang, K., Akar, G., & Chen, Y.-J. (2018). Bike sharing differences among millennials, Gen Xers, and baby boomers: Lessons learnt from New York City's bike share. *Transportation Research Part A: Policy and Practice, 116*, 1–14. https://doi.org/10.1016/j.tra.2018.06.001

Winters, M., Brauer, M., Setton, E. M., & Teschke, K. (2015). Mapping bikeability: A spatial tool to support sustainable travel. *Environment and Planning B: Planning and Design, 42*(5), 864–883. https://doi.org/10.1068/b38185

Zare, P., et al. (2022). Geo-design in planning for bicycling: An evidence-based approach. Land, 11(11), 1943. https://doi.org/10.3390/land11111943

