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Research Article

TriGO: An Android-Based App for Enhancing Tricycle Commuting in the City of Ilagan, Philippines

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About Article

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ABSTRACT

This study developed TriGO: A Mobile Application for Optimizing Tricycle Transportation in the City of Ilagan, Philippines to address persistent issues in the city's tricycle system, including safety, accessibility, and fare inconsistencies. While several transportation applications exist, most of these focus on large-scale services such as taxis and ride-hailing cars. Evidently, there is a gap in research and technological innovation that addresses small-scale, community-based transportation like tricycles, which remain a primary mode of commuting in many provincial cities. Thus, TriGO was designed to provide a localized, user-centered digital solution tailored to the needs of City of Ilagan commuters and drivers. Using the Waterfall Model, the system was developed across five phases: requirements analysis, design, testing, implementation, and maintenance and comprises three modules: Registration, Transaction, and Reports Generation. The application was evaluated by commuters, tricycle drivers, and operators, and IT experts using questionnaires based on ISO 25010 software quality standards. Findings revealed that TriGO is highly functional, usable, efficient, compatible, portable, reliable, and maintainable, achieving an overall mean rating of 4.67 (Strongly Agree). Minor issues such as slow registration loading were observed, but overall, TriGO shows strong potential as an innovative, sustainable solution for improving local tricycle transportation.

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1. INTRODUCTION

Public transportation is an important component of modern society, serving as the backbone of economic and social mobility. Every country has its unique modes of transportation: air, sea, and land, all of which are designed to help individuals reach their destinations efficiently.

In the Philippines, transportation has evolved from traditional kalesas to contemporary modes such as jeepneys, buses, trains, taxis, and other public utility vehicles (PUVs).

In the City of Ilagan, a rapidly developing urban center in Northern Luzon, tricycles remain one of the most common and preferred modes of transportation. Their affordability, convenience, and accessibility make them essential for daily commuting. However, commuters and operators face persistent challenges such as passenger safety concerns, irregular fare rates, limited accessibility during peak hours, and the absence of a unified booking and monitoring system. These issues contribute to inefficiency, commuter dissatisfaction, and operational disorganization within the local transportation system.

Previous studies (Shaheen, 2016; Campbell-Dollaghan, 2012) have emphasized how transportation apps can improve mobility by reducing waiting times, enhancing safety, and increasing commuter satisfaction. Yet, existing mobile transportation applications in the Philippines, such as Grab and other ride-hailing platforms, primarily cater to large-scale, car-based services in metropolitan areas. There remains a lack of digital innovations specifically designed for small-scale, community-based transport modes such as tricycles, which continue to dominate everyday commuting in many provincial cities.

This gap reveals the need for a localized and context-sensitive transportation system that integrates digital technology into the tricycle industry. Addressing this issue, the present study developed TriGO: A Mobile Application for Optimizing Tricycle Transportation in Ilagan, Philippines, a mobile-based platform aimed at improving commuter safety, accessibility, and fare transparency while enhancing drivers' operational efficiency. By focusing on tricycle transportation in a provincial urban context, the study fills the research and development gap in small-scale, technology-driven mobility solutions and contributes to advancing sustainable and inclusive transport systems in the Philippines.

1.1. Objectives of the Study

The main objective of the study was to develop "TriGO: An Android-Based App for Enhancing Tricycle Commuting in the City of Ilagan, Philippines". Specifically, it sought to:

1. Develop TriGO: An Android-Based App for Enhancing Tricycle Commuting in the City of Ilagan, Philippines that will include the following modules:
 - a. Registration
 - b. Transaction
 - c. Reports Generation
2. Test the functionality, usability, efficiency, compatibility, portability, maintainability, and reliability of the Android-based TriGO: An Android-Based App for Enhancing Tricycle Commuting in the City of Ilagan, Philippines.
3. Determine the perception of respondents on functionality,

usability, and efficiency based on ISO 25010 with respect to the following:

- a. Registration
- b. Transaction
- c. Reports Generation

4. Integrate improvements that can be incorporated to further enhance the developed system.

2. LITERATURE REVIEW

Technology has changed how people travel. Mobile applications now make commuting faster and more convenient. Shaheen (2016) found that transportation apps help reduce travel time, improve efficiency, and make trips less stressful. In another study, Campbell-Dollaghan (2012) found that commuters who use travel apps report feeling happier and less anxious while on the road. These studies reveal that technology can make public transportation easier and more pleasant to use for the public.

In recent years, many ride-hailing services such as Grab and Uber have become popular in cities. They allow passengers to book rides quickly and easily using their phones. Siyal (2021) explained that users value these apps because they are reliable, easy to use, and save time. Also, Schmitz (2016) stated that an app's success depends on its usability and the trust it builds with its users.

However, most of these apps are made for big cities and private cars. They do not fit smaller or local transport systems. According to Paronda (2017), while Grab and Uber improved travel in Metro Manila, they did not address the needs of small public vehicles like tricycles in the provinces. In many towns and cities, tricycles are still the main way for people to get around, yet little has been done to improve their system through technology.

This gap shows a clear need for a mobile app that supports local and community-based transport. Tricycle drivers and commuters still deal with problems like unclear fares, limited routes, safety issues, and a lack of booking systems. A simple digital solution could help solve these problems.

To build reliable and user-friendly apps, developers often use the Waterfall Model. Saxena (2019) explained that this step-by-step method helps ensure that systems are tested and improved before use. For quality checking, ISO 25010 standards are also used to measure how well an app performs. These include aspects such as usability, reliability, efficiency, and maintainability (Agmon & Ahituv, 1987; Srivaramangai & Srinivasan, 2010).

To sum it up, aforementioned studies show that mobile apps can improve transportation, but most focus on large-scale services. There is little research on apps made for tricycle systems in smaller cities. This study, thus, aims to fill that gap by developing TriGO: A Mobile Application for Optimizing Tricycle Transportation in the City of Ilagan, Philippines, a local and practical solution that supports safe, efficient, and accessible commuting.

3. METHODOLOGY

The researchers adopted the Waterfall Model of the system development life cycle in designing the project, as its sequential stages are deemed appropriate to ensure success (Saxena,



2019). The model consisted of five phases: Requirements Analysis, System Design, Testing, Implementation, and Maintenance. In the requirements stage, data were gathered through questionnaires, interviews, and related research. The system design phase focused on the configuration of the development process, including the graphical user interface

and database. For testing, both Alpha Testing (internal testing by researchers) and Beta Testing (user acceptance testing) were conducted to evaluate the system in real-world conditions. The implementation phase involved planning for full deployment of the application, while the maintenance stage ensured continuous improvements.

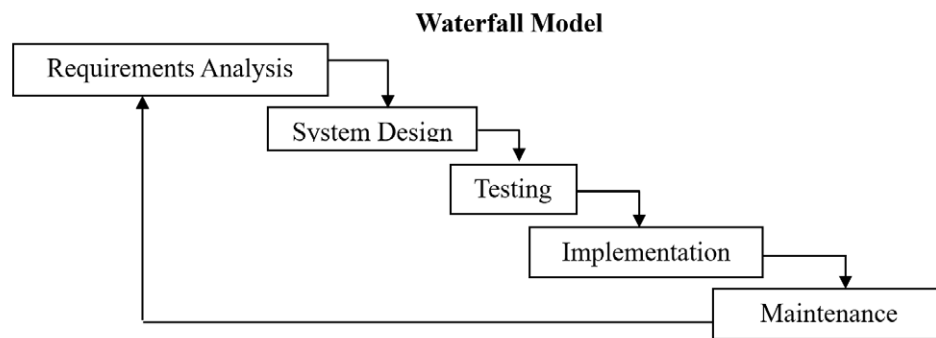


Figure 1. The Methodology Used for System Development

In the requirements analysis and definition, the researchers identified problems in the current tricycle transportation system and formulated possible solutions. Several data-gathering techniques were employed: observation of the local transportation system in Ilagan City; interviews with tricycle commuters and operators; library research for reference materials; and internet research for supplemental information. The proposed TriGO application was designed to benefit both commuters and drivers by offering faster and more convenient tricycle reservations. Hardware and software requirements were specified, ranging from minimum to recommended configurations for laptops and Android phones.

For security measures, tricycle operators were required to register with their basic personal and vehicle information, while commuters needed individual accounts to ensure data protection and prevent unauthorized use.

The respondents of the study included commuters, tricycle drivers or operators, and IT experts. For data analysis, the researchers applied the Weighted Average Mean formula and Likert Scale interpretation to evaluate the system based on respondent feedback.

3.1. Design and Methodology

The researchers adopted the Waterfall Model of the system development life cycle in designing the project. This model was chosen because it provides a clear and structured approach to software development. Each phase, requirements analysis, system design, implementation, testing, and maintenance, must be completed before moving to the next. This sequence helps ensure that the project is well-organized, thoroughly documented, and systematically evaluated.

The Waterfall Model was selected as the framework for developing the TriGO mobile application because it offers a straightforward, step-by-step process that ensures all requirements are addressed before the next stage begins. It allows for better planning, monitoring, and documentation of every activity throughout the system's development.

Although iterative models like Agile are commonly used in app development, they rely heavily on constant communication and feedback from users. In this study, the main users (tricycle drivers, commuters, and local transport operators) were not always available to provide input during the development phase. The research also operated under limited time and resources, which made it difficult to implement multiple iterations. For these reasons, a linear and controlled approach like the Waterfall Model was more practical and suited to the project's conditions.

In addition, academic system development projects require well-defined documentation and measurable outputs at every stage. The Waterfall Model supports this by ensuring that each phase produces specific deliverables, such as requirement specifications, design documents, and testing reports. It also minimizes unexpected changes and allows the researchers to verify system performance before moving to implementation. In this way, the model provided clarity, discipline, and reliability. These are qualities that ensured the TriGO app was completed systematically and evaluated rigorously.

3.2. The Waterfall Model Phases

The Waterfall Model used in this study consisted of five major phases, namely Requirements Analysis, System Design, Testing, Implementation, and Maintenance.

1. Requirements Analysis: In this phase, the researchers gathered data through surveys, interviews, and observations of the current tricycle transportation system in Ilagan City. Problems such as fare inconsistency, safety concerns, and limited accessibility were identified, and corresponding system requirements were defined.

2. System Design: Based on the requirements, the researchers created a detailed design for the TriGO application. This included the user interface layout, system architecture, and database design. Hardware and software specifications were also identified to ensure compatibility and optimal performance.

3. Implementation: The researchers developed the TriGO



system using Android Studio. The app was designed to have three main modules: Registration, Transaction, and Reports Generation. Each module was built according to the requirements defined earlier and integrated into the final system.

4. *Testing*: Initial internal testing (Alpha) was performed by the research team to identify bugs or functionality issues. After revisions, Beta Testing was conducted with actual end-users, including commuters, tricycle drivers or operators, and IT experts.

5. *Maintenance*: After testing, adjustments and refinements were made based on user feedback. This phase ensured that the application remained functional, efficient, and responsive to user needs.

3.3. Testing and Evaluation Process

After the development phase, two levels of testing were performed: Alpha Testing and Beta Testing. Alpha Testing focused on checking the app's overall functionality, accuracy of data flow, and integration among modules. Once errors were resolved, Beta Testing allowed real users to interact with the app under real-world conditions.

The app was evaluated using ISO 25010 software quality standards, which include functionality, usability, efficiency, compatibility, reliability, portability, and maintainability. Respondents, comprising commuters, tricycle drivers/operators, and IT experts, rated their experiences through structured questionnaires. The data were analyzed using the Weighted Average Mean and interpreted using a Likert Scale.

This comprehensive testing process helped evaluate both the technical performance and user satisfaction with the TriGO application. It also allowed the researchers to identify issues, such as occasional slow loading during registration, and propose improvements. Overall, the testing and evaluation stages confirmed that TriGO met the project's objectives. It provided a reliable, user-friendly, and sustainable transportation solution for the City of Ilagan.

4. RESULTS AND DISCUSSION

Development of TriGO: An Android-Based App for Enhancing Tricycle Commuting in the City of Ilagan, Philippines

The researchers employed the Waterfall Model in developing TriGO: An Android-Based App for Enhancing Tricycle Commuting in the City of Ilagan, Philippines. Each phase was carried out sequentially, with the output of one stage serving as the input for the next.

In the requirements analysis phase, the researchers observed the current tricycle transportation system in the City of Ilagan. They noted that tricycles have long preceded local public transport policies and currently serve as the main source of livelihood for approximately 10,000 families. However, despite their growing numbers, tricycle drivers face increasing competition, declining net daily income, and environmental concerns.

A feasibility study was conducted among tricycle commuters and drivers in the Población Region. Findings revealed that tricycles remain the most common mode of transport for commuters, many of whom supported the idea of applying the concept of Grab or Uber to tricycles to improve accessibility and

efficiency. On the drivers' side, most acknowledged that their income often does not meet daily expenses, and they viewed the adoption of app-based booking as a means to increase earnings and enhance the transportation system.

Based on these findings, the researchers developed TriGO, which consists of three primary modules:

1. Registration Module allows commuters and drivers to register quickly and conveniently using their mobile devices, eliminating the need for manual registration at the Tricycle Operators and Drivers' Association (TODA).

2. Transaction Module enables commuters to easily book tricycles without long waits, particularly during rush hours, and provides drivers with faster access to passengers compared to the traditional roaming method.

3. Report Generation Module allows administrators to produce accurate reports directly from the system database, streamlining record-keeping compared to the manual reporting process of the existing federation.

In general, the results show that TriGO can address the limitations of the current tricycle transportation system by offering greater efficiency, income opportunities, and convenience for both commuters and operators.

Testing Period of TriGO: An Android-Based App for Enhancing Tricycle Commuting in the City of Ilagan, Philippines

Prior to public release, the researchers conducted Alpha testing to identify strengths, weaknesses, and critical issues in the application. This stage involved self-evaluation and the preparation of a test plan, which revealed several errors affecting system functionality that required further improvement. After resolving these issues, the application underwent Beta testing with end-users. During this phase, the researchers demonstrated the proper use of the application before allowing commuters, tricycle drivers, and IT experts to test its full operation by booking rides through the system.

The testing focused on three modules: Registration, Transaction, and Report Generation. Overall, most functionalities were deemed effective and user-friendly. However, users reported that the registration page did not load as quickly as expected. The delay was attributed to unstable internet connectivity in the Philippines and the limited processing power of lower-end Android devices. Despite this limitation, the system was positively evaluated as functional, convenient, and responsive to the needs of commuters and operators.

4.1. Evaluation Period of TriGO: An Android-Based App for Enhancing Tricycle Commuting in the City of Ilagan, Philippines

The evaluation of TriGO: An Android-Based App for Enhancing Tricycle Commuting in Ilagan City was conducted to assess its performance across multiple software quality dimensions, including functionality, usability, efficiency, compatibility, portability, reliability, and maintainability, in accordance with ISO 25010. Data were gathered from commuters, tricycle drivers/operators, and IT experts through structured questionnaires. Overall results revealed that respondents "strongly agree" that the system meets its objectives, yielding a grand mean of 4.67, which affirms its potential as an innovative and reliable transportation solution.



Table 1. Summary Results of the Developed System or Application

Criteria	Total Mean	Descriptive Interpretation
Functionality of Registration Module	4.73	Strongly Agree
Usability of Registration Module	4.53	Strongly Agree
Efficiency of Registration Module	4.53	Strongly Agree
Compatibility of Registration Module	4.67	Strongly Agree
Portability of Registration Module	4.79	Strongly Agree
Reliability of Registration Module	4.77	Strongly Agree
Maintainability of Registration Module	4.63	Strongly Agree
Functionality of Transaction Module	4.69	Strongly Agree
Usability of Transaction Module	4.68	Strongly Agree
Efficiency of Transaction Module	4.61	Strongly Agree
Compatibility of Transaction Module	4.41	Strongly Agree
Portability of Transaction Module	4.71	Strongly Agree
Reliability of Transaction Module	4.7	Strongly Agree
Maintainability of Transaction Module	4.5	Strongly Agree
Functionality of Reports Generation Module	5	Strongly Agree
Usability of Reports Generation Module	4.87	Strongly Agree
Efficiency of Reports Generation Module	4.8	Strongly Agree
Compatibility of Reports Generation Module	4.6	Strongly Agree
Portability of Reports Generation Module	4.73	Strongly Agree
Reliability of Reports Generation Module	4.81	Strongly Agree
Maintainability of Reports Generation Module	4.72	Strongly Agree
Grand Mean	4.67	Strongly Agree

4.2. Registration Module

The registration module was rated highly by respondents, with functionality ($M = 4.73$) and portability ($M = 4.79$) emerging as its strongest features. Users emphasized that the system allows for quick and seamless registration without excessive memory or data consumption, which is consistent with Swari (2025), who noted that efficient registration processes minimize data burden and improve user engagement. Usability ($M = 4.53$) and compatibility ($M = 4.67$) further highlight the module's accessibility across various devices, enabling both commuters and drivers to register conveniently. Reliability ($M = 4.77$) also indicates that user data is stored securely, in line with Agmon & Ahituv's (1987) assertion that compatibility and reliability testing are critical for user trust and system stability.

4.3. Transaction Module

The transaction module likewise received positive evaluations, particularly in terms of functionality ($M = 4.69$) and usability ($M = 4.68$). Respondents emphasized that booking tricycles through the application is significantly faster and more convenient than the traditional system, particularly during peak hours. This finding resonates with Siyal (2021), who explained that app-based transport services, such as taxis, succeed due to their

efficiency and simplicity. The module was also rated highly in portability ($M = 4.71$) and reliability ($M = 4.70$), confirming that the application performs consistently across devices and ensures stable, secure transactions. Efficiency, rated at $M = 4.61$, suggests that the app requires minimal resources, supporting Schmitz's (2016) and Kim *et al.*'s (2016) views that mobile apps enhance user experience while minimizing memory and data usage.

4.4. Reports Generation Module

Of the three modules, the report generation module gained the highest ratings across all criteria. Its functionality was rated $M = 5.00$, indicating unanimous agreement among respondents that it fully serves its intended purpose of generating accurate and timely reports. Usability ($M = 4.87$) and efficiency ($M = 4.80$) demonstrate that the reporting system is user-friendly and capable of delivering results with minimal effort. Reliability ($M = 4.81$) further ensures that records are secure and recoverable when needed. These results align with Akingbemisilu's (2016) emphasis on the significance of reliable reporting in ensuring organizational efficiency. Compatibility ($M = 4.60$) and portability ($M = 4.73$) confirm its adaptability across systems, while maintainability ($M = 4.72$) reflects its capacity for continuous improvement, supporting Tanna's (2017) argument on the



importance of mobile application testing and enhancement.

The overall evaluation indicates that TriGO successfully integrates the qualities of functionality, efficiency, and reliability that are central to transportation innovation. With its grand mean of 4.67, the system proves to be user-friendly, practical, and beneficial to both commuters and drivers. These findings echo Paronda (2017), who argues that digital transportation platforms reduce commuting stress, provide safer rides, and enhance convenience similar to established services such as Grab and Uber.

In conclusion, the results show that TriGO has strong potential for adoption as a sustainable and innovative tricycle transportation system. Its high ratings across all modules affirm its effectiveness in addressing existing challenges in Ilagan City's local transportation, while its design and functionality reflect best practices in mobile application development.

Recommendation Period of TriGO: An Android-Based App for Enhancing Tricycle Commuting in the City of Ilagan, Philippines

Based on evaluations of commuters, drivers/operators, and IT experts, the researchers identified areas for improvement in the TriGO application. Specifically, the registration module's loading speed did not fully meet user expectations, as pages and data did not respond as quickly as desired. This indicates a need to enhance the module's efficiency to ensure smoother user registration.

To address these issues, the researchers recommended incorporating the feedback and suggestions of respondents to refine the system's performance. Improvements in application responsiveness, optimization for lower-end devices, and adaptability to varying internet conditions are vital. These enhancements will further strengthen TriGO's capacity to deliver a more reliable, efficient, and user-friendly service to the tricycle transportation system.

In conclusion, the high score for the Reports Generation Module shows that automation and accurate reporting are key features found valuable by both users and managers. It reflects the growing importance of digital record systems in improving transparency, governance, and efficiency in local transport operations.

5. CONCLUSION

The study on TriGO: An Android-Based App for Enhancing Tricycle Commuting in the City of Ilagan, Philippines, reveals that the system is functional, usable, efficient, maintainable, and compatible with the needs of commuters and drivers. It meets the quality standards of ISO 25010, proof that it is reliable and practical for everyday use. The application makes commuting faster and more convenient for passengers, while helping drivers find customers easily. Although some issues, such as slow registration loading, were found, the system remains effective and beneficial. Overall, TriGO can improve the tricycle transportation system by offering a modern, efficient, and user-friendly solution for the community.

RECOMMENDATIONS

Based on the evaluation of respondents and the identified limitations of the mobile application, the following are

recommended to further enhance TriGO:

1. GPS tracking should be integrated to accurately identify the real-time location of tricycles and improve service efficiency.
2. An in-app payment system has to be included to allow secure and convenient transactions between commuters and drivers/operators.
3. Push notifications and in-app messaging should be added to support smooth communication between users and operators.
4. Cross-platform compatibility should be ensured by making the application available for iOS devices in addition to Android.

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