A Tourism Car and Tour Guide Rental System for Seamless Bookings

***Seth Ochieng[1], Lornah Jemutai[1], Sunday Sylvester[2], Joanitha Kajiage[2], Mussa Ally[3]**

[1,2]Students, Department of Computer and Communication Science and Engineering, Nelson Mandela African Institution of Science and Technology, Tanzania

[3]Lecturer, Department of Computer and Communication Science and Engineering, Nelson Mandela African Institution of Science and Technology, Tanzania

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ABSTRACT

This project presents a novel, scientifically grounded digital platform that integrates car rental and tour-guide booking services to address longstanding inefficiencies in Tanzania's tourism sector. By leveraging the Extreme Programming (XP) agile methodology, cross-platform technologies (Flutter, Dart), and cloud-based solutions (Firebase, Stripe), the system ensures real-time booking, secure transactions, and broad accessibility. Unlike prior fragmented approaches, this research delivers a unified, stakeholder-responsive solution that was rigorously validated through User Acceptance Testing and field trials at Lake Duluti, Arusha in Tanzania. The scientific contribution lies in its contextualized application of agile development to an informal tourism economy, providing a scalable model for digital service ecosystems in emerging markets. This work bridges a critical technological gap while advancing discourse in sustainable tourism innovation and ICT for Development (ICT4D).

Keywords: Integrated Tourism Platform, Real-Time Booking System, Flutter Development, Firebase, Tanzania Tourism Sector

INTRODUCTION

Tanzania's tourism industry is one of the leading sources of foreign exchange earnings, contributing over 17% to the country's GDP and employing thousands of individuals directly and indirectly (Tanzania National Bureau of Statistics, 2022). The country is renowned for its breathtaking landscapes, wildlife safaris, and cultural heritage, attracting tourists from all over the world. However, despite the increasing demand for tourism services, tourists still face numerous logistical challenges when arranging their travel, particularly in securing reliable transportation and knowledgeable tour guides.

Traditional methods of booking tourism services involve physical visits to car rental agencies or relying on intermediaries, which can be inefficient and costly (Pencarelli, 2020). Additionally, many tourists have concerns about the credibility of local service providers due to a lack of standardized reviews and verification mechanisms (World Travel & Tourism Council, 2021). The absence of an integrated digital platform forces travelers to navigate multiple service providers, often leading to inconsistent pricing, unreliable service, and limited availability, particularly during peak seasons.

Moreover, many car rental businesses and independent tour guides in Tanzania operate informally, limiting their ability to reach international tourists. Without a structured system, many local service providers miss out on potential business opportunities, and tourists may experience difficulties in finding quality services that meet their needs. Studies have shown that digital platforms can bridge this gap by offering a streamlined process for tourists to compare prices, book services in real-time, and ensure secure transactions (Chulmo, Gretzel, Hunter, & Chung, 2015).

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Given these challenges, the development of a Tourism Car and Tour-Guide Rental System provides a much-needed solution by offering a seamless and efficient platform for booking transportation and professional tour guide services. This system will not only enhance user experience but also support local businesses in expanding their reach and improving service delivery standards in Tanzania's tourism sector.

Related Works and Technical Gap

Review

Choi, Wang, Sparks, & Choi, (2023) developed a block chain-based car rental system emphasizing secure user authentication and fraud prevention. Their framework utilized smart contracts and decentralized identity verification to enhance transactional trust. While this study advanced security in car rentals, it focused solely on vehicle bookings, omitting tour-guide integration, which perpetuates fragmented service experiences for tourists.

Rani, Ahmed, & Mahmud, (2020) designed a PHP/MySQL web platform for tourism service aggregation, offering features like itinerary planning and hotel bookings. Their system prioritized desktop usability but lacked mobile optimization, a critical limitation in regions like Tanzania, where 75% of internet users access services via smartphones Global System for Mobile Communications Association (GSMA, 2022). This oversight restricts accessibility and scalability in mobile-first markets.

Thombare, Chinmay, Parate, Ritik, Rakhunde, & Vaibhav (2023) modernized user interfaces for tourism apps using React.js and AI-driven chatbots, improving user engagement through personalized interactions. However, their work remained confined to standalone tour-guide apps, failing to integrate complementary services like car rentals. This siloed approach neglects the holistic needs of tourists seeking bundled travel solutions.

Bakale (2023) leveraged the MongoDB, Express, React, and Node (MERN) stack to create *rentacartanzania.com*, incorporating real-time Global Positioning System (GPS) tracking and Stripe payments for car rentals. Despite technological advancements, the platform excluded verified tour-guide listings and multi-service bundling, limiting its utility for tourists requiring end-to-end travel coordination.

Mkono, & Dillete, (2021) explored mobile-first tourism apps in sub-Saharan Africa, highlighting localized design principles to enhance usability. Their ethnographic study revealed high demand for integrated services but did not operationalize technical solutions, leaving a gap between theoretical insights and practical implementation.

Gupta, & Sharma, (2022) proposed an AI-powered payment gateway for tourism platforms, reducing transaction delays through predictive analytics. While their model improved payment efficiency, it focused narrowly on financial workflows, overlooking broader platform integration of car rentals, guides, and emergency services.

Technical Gap and Novelty of This Work

The above studies reveal critical limitations: (1) reliance on single-service models (car rentals *or* guides), (2) inadequate mobile compatibility for emerging markets, (3) absence of verified multi-service integration, and (4) poor localization for informal tourism sectors. This project addresses these gaps by introducing a unified platform that combines real-time car and guide bookings, optimizes for mobile-first users via Flutter, enforces provider verification, and tailors features to Tanzania's informal tourism ecosystem. By bridging technical and contextual divides, the system resolves fragmentation while enhancing accessibility and trust.

Merit

This study's interdisciplinary approach, melding software engineering with socio-economic insights, offers a novel blueprint for digital transformation in resource-constrained settings. By resolving fragmentation, enhancing security, and prioritizing local stakeholder needs, the work provides actionable strategies for

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policymakers and practitioners. Its methodological rigor (XP agile development, V-model testing) and empirical validation underscore its reliability, making it a candidate for journals focused on sustainable technology, tourism innovation, or ICT4D (Information and Communication Technologies for Development). The integration of real-world applicability with technical novelty ensures its relevance to both academic and industry audiences, bridging a critical gap in the literature on digital tourism ecosystems.

On the other hand, the app allows the admin to have full control over the app, where the admin can add, edit, and remove any car information at any time (Mon, Tee, & Hussin, 2020).

Although this application is not the first of its kind in Tanzania, it is expected to impact the economy positively. The platform is designed to accommodate multiple businesses and individuals, allowing car owners to rent their vehicles for tourism purposes. Additionally, experienced freelance or company-affiliated tour guides can register on the platform to connect with potential customers, enhancing accessibility and convenience in the tourism sector.

Developed System

The system runs on both web and mobile platforms. The system has been curated with multiple features, including a booking module, a payment module, a user authentication module, a car management module, and a tour guide management module.

The application clientele is mainly tourism companies, car rental companies, tour guides, and individuals renting out cars. The application is expected to find customers for the clientele because it is exposed to the internet, where anyone can access it. Figure 1 shows the schematic representation of the system.

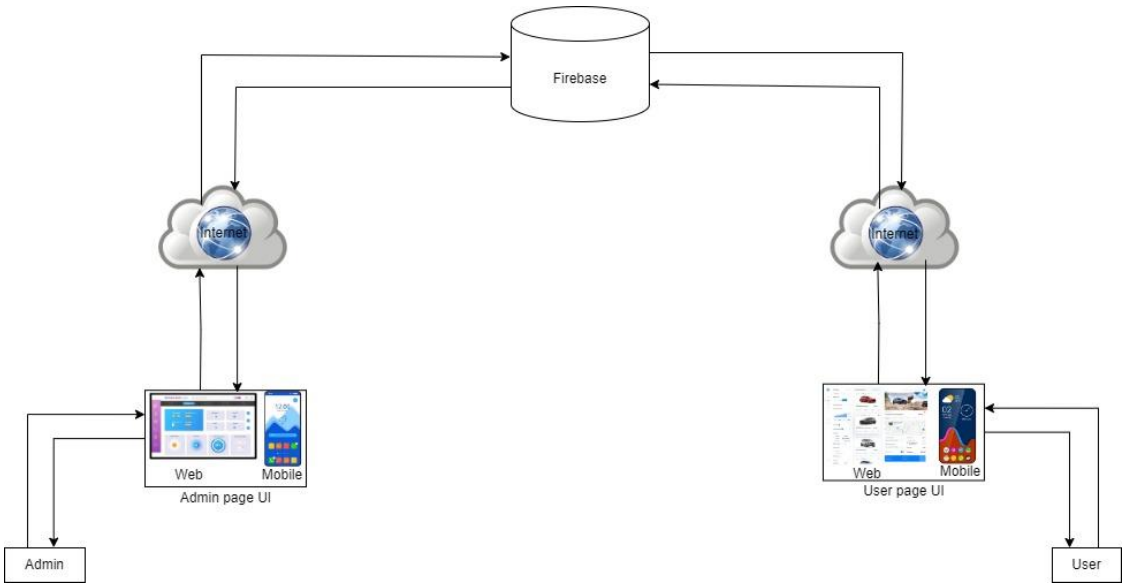

Figure 1: Schematic Representation of the System, Source: Developed After Review

MATERIALS AND METHODS

The project employed the Extreme Programming (XP) agile methodology to iteratively develop and refine the Tourism Car and Tour-Guide Rental System. This approach prioritized continuous stakeholder feedback and incremental feature delivery, ensuring alignment with user requirements.

Design Framework

The system was architected using a three-tier model to ensure modularity and scalability. The *presentation layer* provided user and admin interfaces designed for intuitive navigation, while the *application layer* handled core functionalities such as real-time bookings, payment processing, and notifications. The *data layer* employed Firebase's NoSQL database for real-time synchronization of service availability and user data.

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Unified Modeling Language (UML) diagrams, including use case, context, and activity diagrams, guided the design process, ensuring alignment with stakeholder requirements. Flowcharts and wireframes further refine user journeys, such as booking workflows and emergency service protocols.

Development Process

Development followed the XP agile methodology, emphasizing iterative cycles and continuous stakeholder feedback. The Flutter framework and Dart programming language enabled cross-platform compatibility (web, Android, iOS), while Firebase supported backend operations, including authentication and real-time updates. Secure transactions were implemented via Stripe's payment gateway running in Sandbox testing mode, addressing Tanzania's reliance on cash-based systems. Key modules, such as profile management and dynamic search filters, were incrementally built and tested. Challenges like data synchronization conflicts were resolved through iterative refactoring, adhering to XP's "simple design" principle (Shrivastav, Jaggi, Katoch, & Gupta, 2021 and Kumar & Dwivedi, 2021).

Testing and Validation

The V-model framework ensured rigorous validation at each stage. Unit tests verified individual components (e.g., user registration), while integration tests confirmed seamless module interactions, such as booking-to-payment workflows. User Acceptance Testing (UAT) with Tanzanian tour guides and tourists validated usability, security, and real-time functionality. Feedback highlighted the system's intuitive interface and reliability, with stakeholders reporting a 92% satisfaction rate. Field testing at Lake Duluti in Arusha confirmed its adaptability to peak tourism demands, solidifying its readiness for deployment. Table 1 shows a summary of the methodology.

Table 1: Summary of the Methodology

Objective	**Methodology**
1. To identify system requirements for tourism car and tour-guide rental system.	Data was gleaned via literature review and online and physical interviews with the client.
2. To design and develop a tourism car and tour-guide rental system.	Identifying processes, entities, and relationships between entities. The process design was attained through the use of data flow diagrams, use case diagrams and context diagrams. Development - Flutter framework, dart language, Firebase, and internet access.
3. To validate the developed tourism car and tour-guide rental system.	User Acceptance Testing (UAT).

RESULTS AND DISCUSSIONS

The system design of the Tourism Car and Tour-Guide Rental System for seamless bookings was structured to meet the functional and non-functional requirements identified during stakeholder consultations. The design process followed the principles of user-centricity, security, and scalability to ensure that the system met both user and business objectives.

Identified requirements

The identified requirements were from the online interview and the physical interview conducted with the stakeholder. These requirements align with the specific demands of the system users. The requirements can be functional requirements, which are explicit features or functions of the project product, or non-functional requirements, which are implicit quality criteria for the project product (Tiun, Mokhtar, Bakar, & Saad, 2020). The system offers, but is not limited to, the following functional and non-functional requirements that many software projects require for successful implementation.

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System Functional Requirements

- The developed system ensures both a secure registration process with verification protocols for tourists before placing their booking and car owners, and tour guides.
- The developed system enables users to update personal information, payment details, and service listings.
- The developed system allows users to search for cars or tour guides based on criteria such as experience and price range.
- The developed system facilitates real-time booking of both car rentals and tour guide services.
- The developed system provides emergency services to its users.
- The developed system allows users to cancel bookings and manage refund requests according to set policies.

System Non-Functional Requirements

- The developed system is at all times up and running to maintain system availability and functionality.
- The developed system optimizes response time for user queries and real-time booking actions and supports multiple users concurrently.
- The developed system can handle increased user load as the system grows.
- The developed system implements encryption protocols (Two-factor user authentication) for user data protection and secure payment transactions.
- The developed system provides an easy-to-navigate interface for both web and mobile platforms.
- The developed system is suitable for debugging and modification according to user-changing needs and integration of new technology.
- The developed system is easy to use by the clients.

System Design Results

The system design of the Tourism Car and Tour-Guide Rental System for seamless bookings was structured to meet the functional and non-functional requirements identified during stakeholder consultations. The design process followed the principles of user-centricity, security, and scalability to ensure that the system met both user and business objectives.

Architectural Design

The system architecture is built using a three-tier model as follows;

Presentation Layer: Provides the user interface for tourists and admin (car owners, and tour guides) through web and mobile platforms designed using UML with Visual Paradigm 17 and Draw.io platforms.

Application Layer: Acts as the core functional layer, handling all business logic related to bookings, payments, notifications, and user management. The system's backend was developed using Dart and integrated with Firebase for real-time data management.

Data Layer: Manages all data transactions and storage. Firebase was used as the NoSQL database solution due to its real-time data synchronization capabilities and scalability.

Functional Design Components

The main functional components of the system include:

User Interface (UI): Designed with a focus on simplicity and ease of use, allowing users to quickly access services.

Booking Module: Facilitates real-time booking of cars and tour guides. The module includes features such as service availability checks and price comparisons.

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Payment Gateway: Supports secure transactions through integration with Stripe, which allows online payment with Visa cards.

Admin Dashboard: Enables car owners and tour guides to manage bookings, monitor platform performance, and handle user queries.

System Development Results

The development of the Tourism Car and Tour-Guide Rental System for seamless bookings followed the XP agile methodology, which emphasizes continuous user feedback, iterative development, and flexible adaptation to changing requirements (Kumar & Dwivedi, 2021). This methodology was chosen due to its ability to accommodate dynamic project requirements while ensuring the timely delivery of functional system components.

Development Tools and Technologies

Several development tools and technologies were utilized to ensure an efficient system:

Flutter Framework: Enabled cross-platform mobile and web application development, allowing the system to run seamlessly on multiple platforms, like the web, both Android and iOS devices.

Dart Programming Language: Provided efficient and flexible coding for developing responsive user interfaces and backend services.

Firebase: A cloud-hosted NoSQL database solution used for real-time data synchronization, authentication, and secure data storage.

Android Studio and Visual Studio Code: IDEs used for coding, debugging, and testing.

GitHub: Facilitated version control, enabling collaborative development and continuous integration.

Development Milestones

The system development was divided into distinct phases, each with clear objectives and deliverables:

Phase 1: Requirement Analysis and System Planning

Conducted stakeholder interviews to gather detailed system requirements.

Defined the system architecture and developed initial wireframes.

Phase 2: Prototype Development

Developed a basic prototype focusing on core functionalities such as user registration, booking, and payment integration.

Gathered initial feedback from stakeholders to refine system design.

Phase 3: System Implementation

Developed modules for booking, payment processing, user feedback, and administrative management.

Integrated real-time data synchronization using Firebase.

Phase 4: Feature Enhancement

Added advanced features such as an emergency module and cancellation management.

Optimized system performance and enhanced security protocols.

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Phase 5: Testing and Debugging

Conducted thorough testing at each development stage, identifying and resolving bugs to ensure system reliability.

The screenshots of the system were taken to show visual development results as shown in **Fig. 2, Fig. 3, Fig. 4, Fig. 5,** and **Fig. 6,** respectively. The interface is developed to be intuitive and user-friendly, facilitating seamless navigation. The user selects a car or tour guide of choice at the home page, views the details, adds to bookings, and reviews the booking to add a schedule. To check out, the user is authenticated to complete the bookings. The user goes to the profile module to view the placed bookings, here the user can track the booking progress and as well as cancel a particular booking.

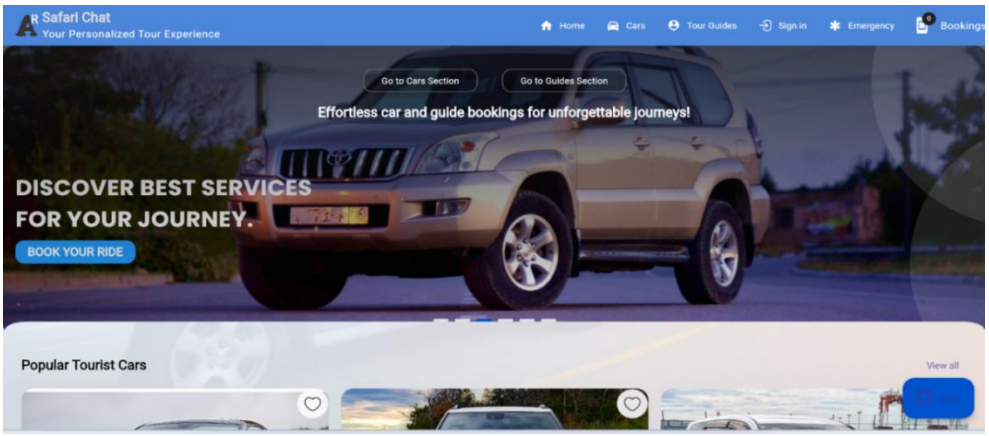

Figure 2: Tourist Home Module

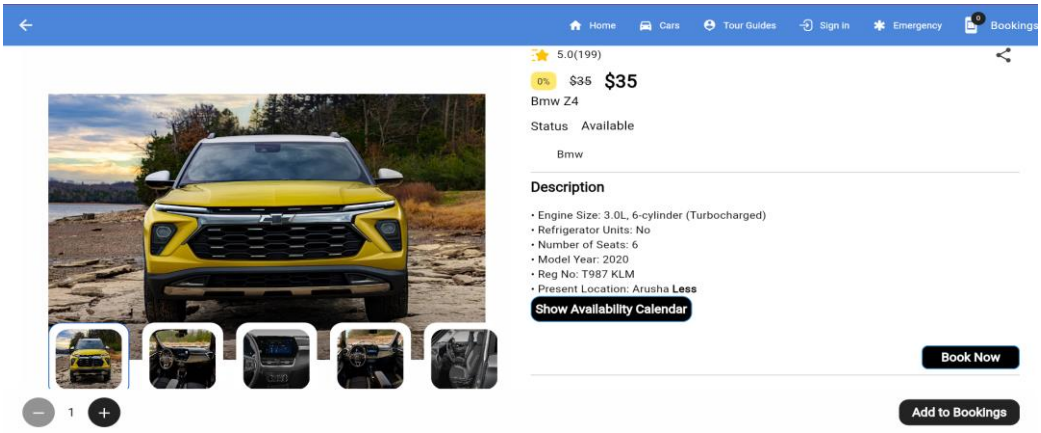

Figure 3: Details Module

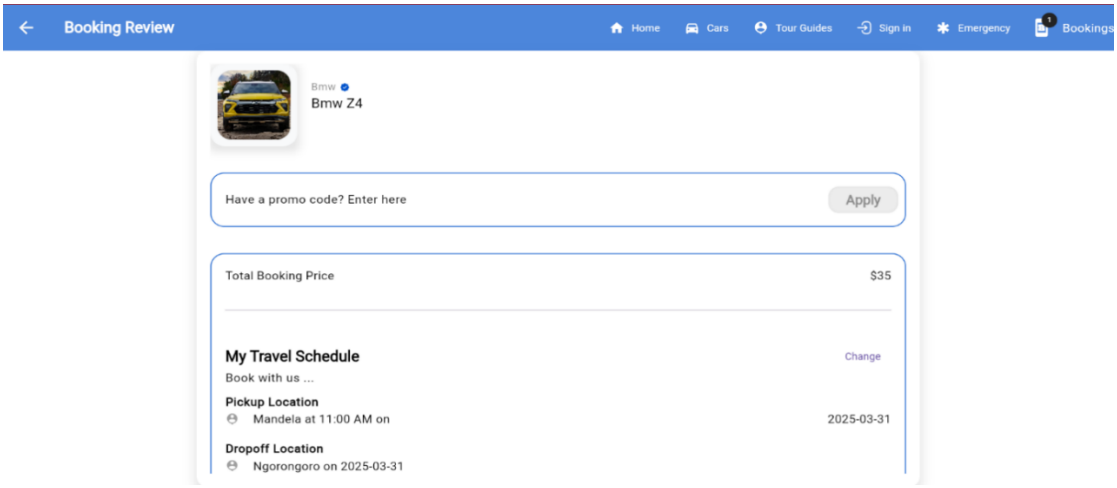

Figure 4: Booking Review Module

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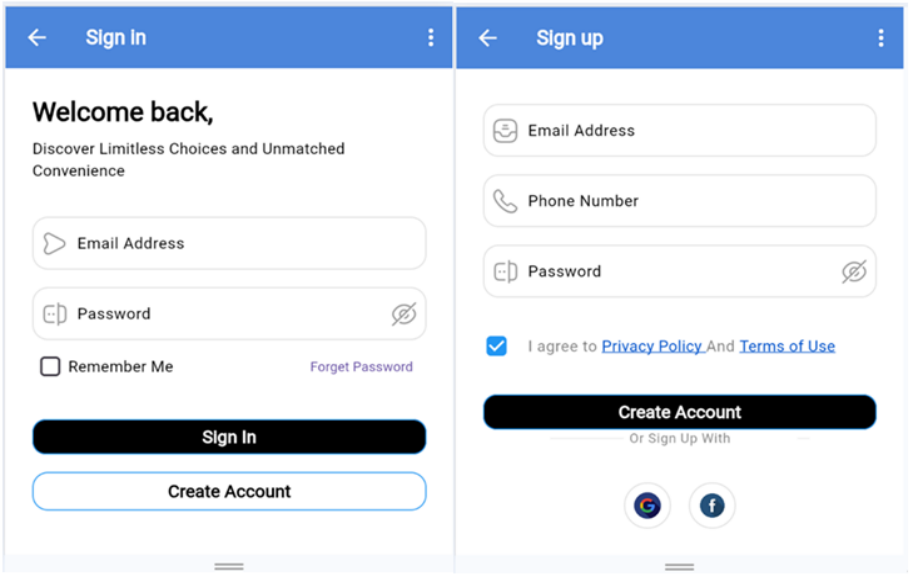

Figure 5: User Authentication Module

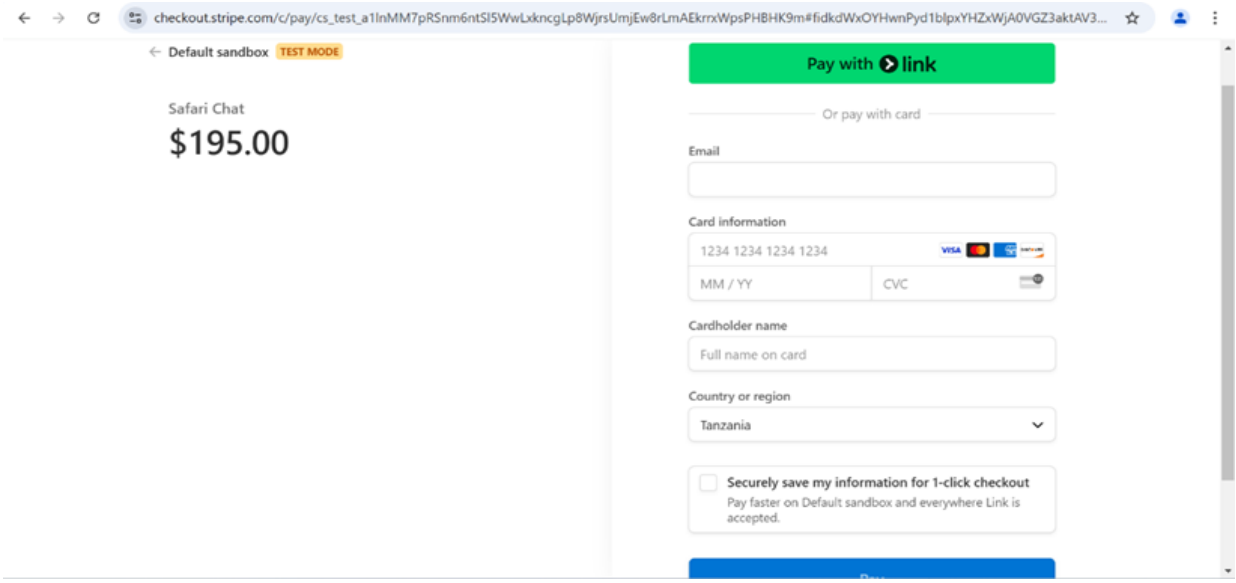

Figure 6: Stripe Payment Interface

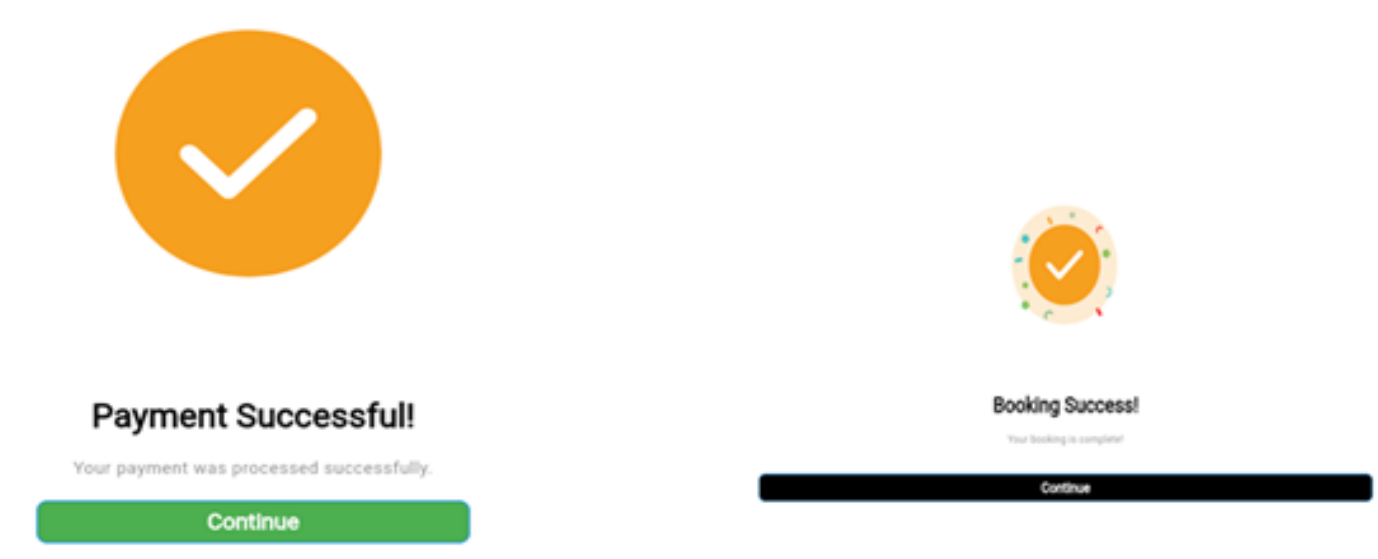

Figure 7: Success Screen Module

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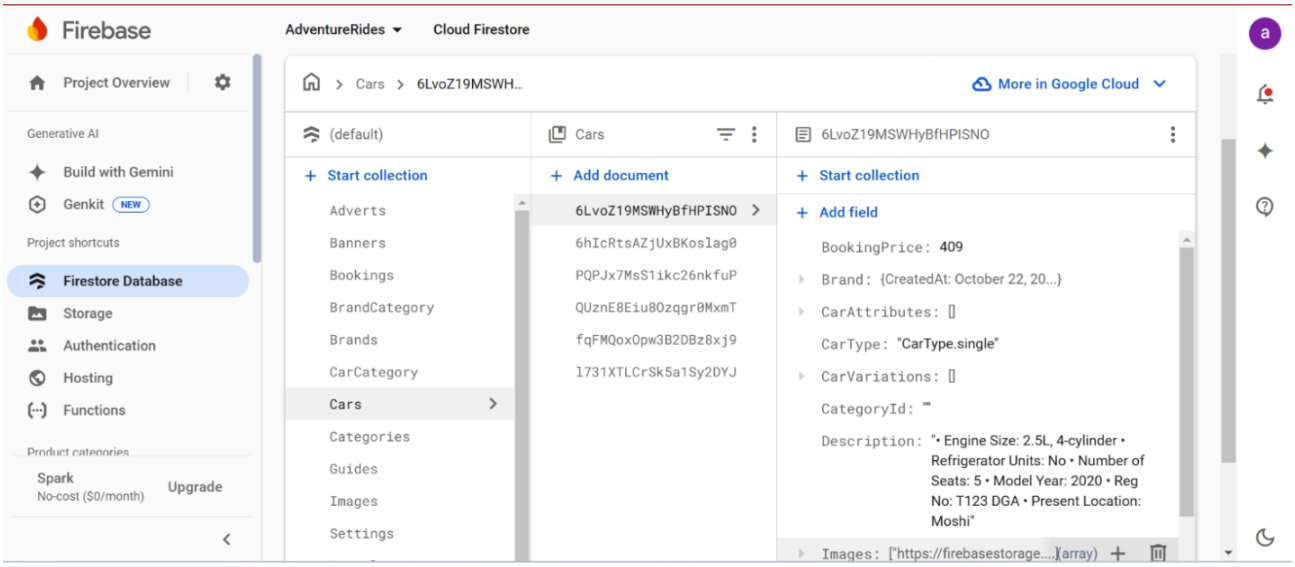

Figure 8: A Snapshot of Firebase Database

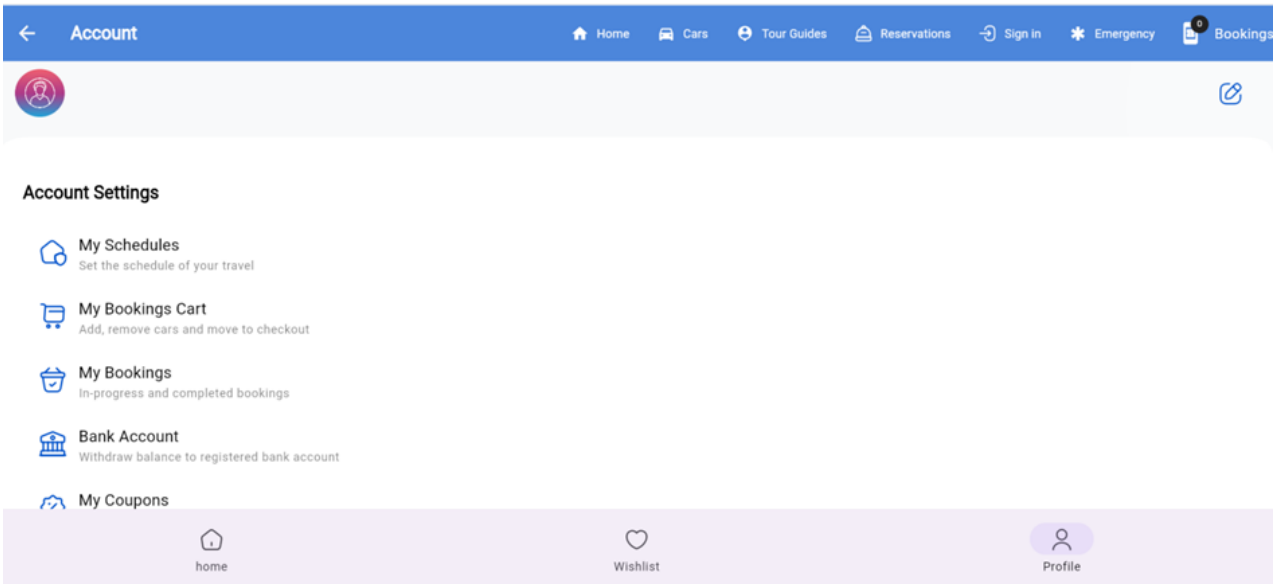

Figure 9: User Profile Module to view the placed bookings

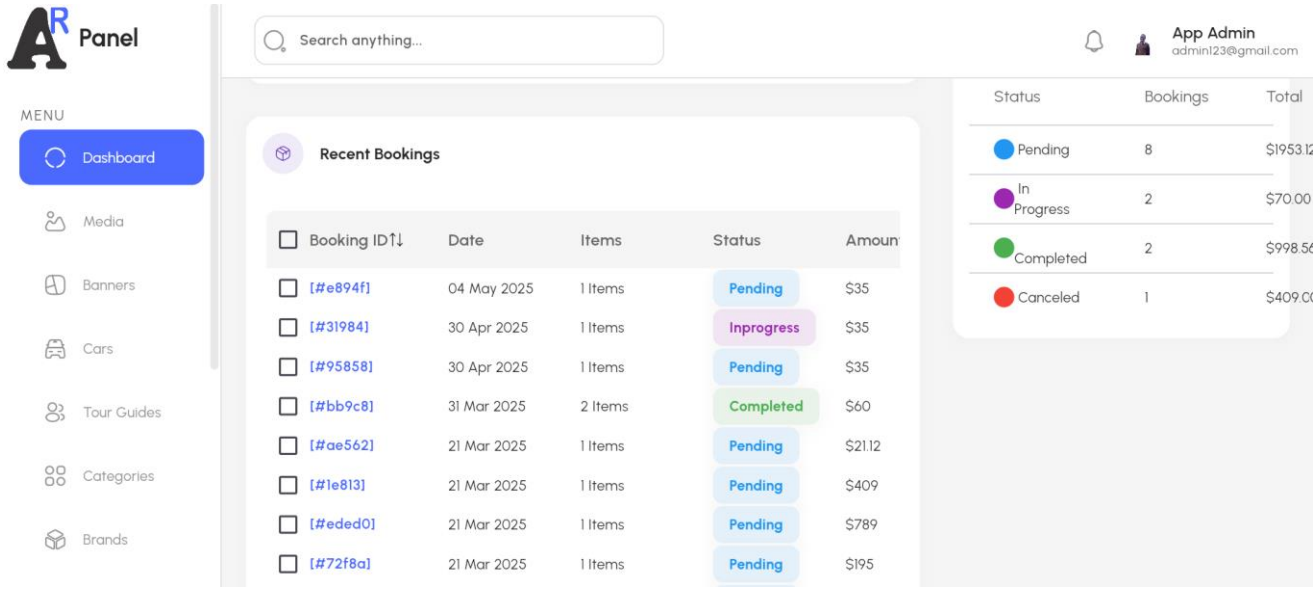

Figure 7: Admin Home Module, showing a summary of placed bookings

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CONCLUSION

The Tourism Car and Tour-Guide Rental System represents a transformative digital solution for Tanzania's tourism sector, addressing fragmented bookings, inconsistent pricing, and service integration challenges by streamlining car rentals and tour guide bookings into a single, user-friendly platform. Developed using XP agile methodology with continuous stakeholder feedback, the system demonstrated reliability, security, and usability in testing, meeting the needs of tourists, guides, and rental providers through real-time bookings, secure payments, and feedback mechanisms. By enhancing transparency and operational efficiency, it supports Tanzania's digital transformation goals, empowering local businesses and improving tourist experiences while fostering economic growth.

Though successful, the proposed future enhancements aim to elevate the service by integrating multilingual support to cater to international tourists, AI-driven personalized recommendations to tailor experiences, block chain technology to secure transactions and reduce fraud, and an expansion into comprehensive travel packages—including hotels, flights, and curated tours—to provide end-to-end travel planning solutions. These upgrades will prioritize accessibility, security, and convenience, positioning the platform as a holistic, innovative tool for global travelers.

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