iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 14 **Issue:** IX **Month of publication:** September 2026

DOI: https://doi.org/10.22214/ijraset.2026.84961

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International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 14 Issue IX Sep 2026- Available at www.ijraset.com

U-RENT: Universal Rental Application

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Abstract: ***The rapid growth of digital technology and urban sharing economy has increased the demand for efficient rental management systems. Traditional rental methods involve manual communication, lack transparency, consume more time, and create difficulties in finding suitable rental products. To overcome these limitations, U-RENT is proposed as a universal rental application that connects renters and owners through a single digital platform. The application supports multiple rental categories including cars, bikes, houses, parking slots, home appliances, gadgets, workers, drivers, and commercial properties.***
The proposed system is developed using Android Studio for frontend development and Firebase for backend services including authentication, real-time database, and cloud storage. U-RENT provides secure user authentication, product listing, real-time availability status, search and filtering options, direct communication through call and WhatsApp integration, and user-friendly interfaces. The system improves transparency, re-duces rental search time, and enhances communication between users and owners.
Index Terms: Rental Application, Android Application, Fire-base, Universal Rental System, Real-Time Database, Mobile Application, Search Filter, Cloud Storage.

I. INTRODUCTION

With the increasing population in urban areas, the need for efficient sharing and rental services has grown exponen-tially. Traditional rental processes are often time-consuming, involve manual procedures, and lack transparency. U-Rent is an innovative mobile application designed to address these challenges by providing a digital platform where users can rent and list products effortlessly. The app is developed using Android Studio with Firebase as the backend for real-time database management. It allows users to create profiles, browse available products, and communicate directly with sellers via chat or call options. The system includes product details such as price, location, images, and availability status, offering a complete user experience. It also incorporates booking functionality and secure payment processing to ensure smooth transactions. Location-based services and search filters help users find items nearby, reducing the effort in item discovery. Ratings and review features encourage accountability and trust between renters and owners. U-Rent not only enhances convenience but also reduces unnecessary resource consump-tion by promoting shared usage. The app can be scaled to various rental categories including vehicles, electronics, and furniture. Moreover, the platform supports notifications to update users on booking status or product availability. This study introduces the design, implementation, and evaluation of the U-Rent system, emphasizing its utility in urban settings. It also addresses the integration of security features and efficient data management for a robust user experience. Ultimately, U-Rent aims to revolutionize the way rentals are conducted in a digital-first environment.

II. LITERATURE REVIEW

Several studies have explored the development of digital rental systems. Existing platforms like Airbnb and Rent-MyItems focus primarily on specialized rentals but often lack comprehensive features for multiple product categories. Research indicates that location-based services significantly improve user engagement by allowing quick access to nearby rental options. Mobile application frameworks, particularly Android, have been extensively used due to their flexibility and large user base. Firebase has emerged as a popular backend solution for real-time applications because of its scalability, security, and ease of integration. Prior works emphasize the importance of user authentication, secure payment gateways, and review mechanisms to ensure trustworthiness in rental transactions. Studies also highlight the role of intuitive user interfaces in increasing application adoption. AI and analytics integration are found to optimize recommendations and en-hance user satisfaction. Security remains a critical challenge, especially regarding personal data and financial transactions. Most current systems fail to provide seamless communication between renters and owners, creating inefficiencies. Research demonstrates that applications incorporating chat and call features see higher user retention. Literature also suggests that efficient product categorization and search functional-ity improve user experience. Furthermore, studies underline the environmental benefits of promoting shared consumption through rental platforms.

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U-Rent integrates these insights by providing multi-category rentals, real-time communication, secure transactions, and location-based services. The review concludes that an integrated system approach is necessary to maximize usability, transparency, and operational efficiency in rental applications.

III. PROPOSED SYSTEM ARCHITECTURE

The proposed architecture of U-Rent is designed using a multi-layered and modular structure that ensures scalability, security, reliability, and maintainability. The system is divided into three major layers: the user interface layer, the application logic layer, and the backend data management layer. Each layer performs specialized tasks and communicates efficiently with the others to deliver a seamless rental experience for both product owners and renters. The architecture is developed with a focus on flexibility, high performance, and ease of future enhancements.

The user interface layer is developed using Android Studio and follows modern mobile application development practices to provide an interactive and user-friendly environment. This layer is responsible for displaying product listings, handling user interactions, and ensuring smooth navigation throughout the application. Users can browse available rental products, search for items using filters and categories, upload products for rent, manage bookings, and communicate with other users through chat and call functionalities. The interface is designed to be responsive across multiple Android devices and screen sizes, ensuring accessibility and convenience for all users. Notification panels, profile dashboards, and review systems are also integrated into this layer to improve the overall user experience.

TABLE I
SYSTEM COMPONENTS AND FUNCTIONS

Component	Function
Frontend Application	User interaction and interface man-agement
Firebase Authentication	Secure login and user verification
Firebase Database	Stores users, products, and rental details
Cloud Storage	Stores product images and docu-ments
Search and Filter Mod-ule	Helps users find nearby rental prod-ucts
Communication Mod-ule	Enables call and WhatsApp com-munication
Availability Module	Shows real-time product availability status

The application logic layer acts as the core processing unit of the U-Rent platform. It handles important function-alities such as product search algorithms, booking validation, session management, secure payment processing, notification handling, rating systems, and communication services. This layer ensures that user requests are processed accurately and efficiently. Authentication and authorization mechanisms are implemented to validate users and provide role-based access for renters and owners. APIs and cloud functions are utilized to manage interactions between the frontend and backend sys-tems. The layer also includes analytics modules that monitor user activities and transaction trends to support continuous system improvements and decision-making processes.

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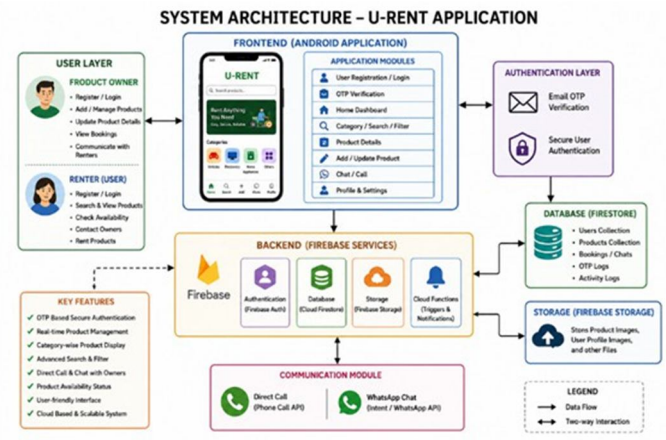

Fig. 1. Proposed System Architecture of U-RENT

The architecture is modular, allowing easy addition of new features or categories. Security measures include SSL en-cryption for data transmission, role-based authentication, and secure storage of sensitive information. The system supports scalability to handle increasing numbers of users without affecting performance. Analytics modules are integrated to monitor user behavior, enabling continuous improvement. A layered approach ensures maintainability, efficiency, and reli-ability of operations. Load balancing and backup strategies are incorporated to avoid downtime. The infrastructure is designed for deployment in urban settings, with cloud support ensuring high availability. The architecture diagram demonstrates data flow between users, application servers, and the Firebase backend.

IV. METHODOLOGY

The development of U-Rent follows an agile methodology to ensure iterative improvement and rapid delivery. Initially, requirement analysis was conducted to understand the needs of students and urban users for multi-category rentals. User stories and functional specifications were created for fea-tures such as product listing, booking, chat, and payment integration. The system was designed using UML diagrams, including use case, sequence, and class diagrams, to model the application structure. Android Studio was chosen for front-end development due to its compatibility with Android devices and ease of UI design. Firebase was selected as the backend solution for real-time data synchronization, authentication, and storage. The development process included creating login and registration modules, product listing pages, booking function-alities, chat and call features, and ratings/review mechanisms. Rigorous testing was conducted using unit tests, integration tests, and user acceptance tests to ensure functionality and performance. Feedback from trial users was used to refine the UI and enhance usability. The app incorporates security measures such as SSL encryption and secure authentication to protect user data. Performance optimization included caching frequently accessed data and optimizing database queries. Notifications and analytics modules were integrated to monitor activity and enhance engagement. The methodology empha-sized user-centered design, security, scalability, and efficiency. Agile sprints allowed iterative development, ensuring timely implementation and feature enhancement. This structured methodology enabled a reliable and robust rental platform. The User Authentication Module verifies users using OTP-based email authentication. The Product Management Module allows owners to upload, update, and manage rental products. The Search and Filter Module helps users quickly identify suitable rental products based on category, location, and price. The Real-Time Product Availability Module continuously syn-chronizes product status using Firebase Realtime Database to ensure accurate availability information. The Communication Module integrates direct call and WhatsApp chat functional-ities for faster interaction between renters and owners. The system is tested using module testing, integration testing, and real-time validation to ensure secure operation, efficient performance, and reliable rental management. Overall, the methodology provides a scalable, cloud-based, secure, and user-friendly rental management solution suitable for real-world deployment and future enhancements.

The application follows a modular implementation approach consisting of the following modules:

- User Authentication Module
- Product Management Module
- Search and Filter Module
- Real-Time Availability Module

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- Communication Module
- Admin Management Module

1) *Requirement Analysis*
   - Gathered user requirements through student surveys and market analysis
   - Identified major features such as product listing, search functionality, communication, and secure payment inte-gration
   - Analyzed challenges in traditional rental systems and existing digital platforms
2) *Design*
   - Created use case diagrams, system architecture diagrams, and UI mockups
   - Designed database structure and Firebase integration flow
   - Defined API endpoints and server communication routes
3) *Implementation*
   - Developed frontend interfaces using Android Studio and Java
   - Integrated Firebase Authentication, Firestore Database, and Cloud Storage
   - Implemented product listing, search filtering, and com-munication functionalities
   - Tested complete user flow from login to booking opera-tions
4) *Testing*
   - Conducted functional testing for all application modules
   - Performed usability testing with students and trial users
   - Evaluated security, scalability, and load handling perfor-mance
   - Verified real-time synchronization and availability up-dates

V. IMPLEMENTATION

The U-RENT application was implemented using Android Studio with Java programming language for frontend devel-opment and Firebase services for backend management. Fire-base Authentication was used for secure user registration and login functionality. Firebase Realtime Database and Firestore were used to store product information, user details, rental categories, and availability status. Firebase Cloud Storage was integrated for storing product images and related documents. The application includes multiple modules such as user authentication, product management, search and filter, real-time availability tracking, communication module, and admin management. The login and registration module allows users to create accounts and securely access the application. After successful authentication, users can browse available rental products from different categories.

The home screen displays products category-wise including vehicles, gadgets, houses, parking slots, home appliances, workers, and electronic accessories. Each product card con-tains product image, product name, rental price, location, and availability status. Users can click products to view detailed information.

The product management module allows owners to add, edit, update, and delete rental listings. Product details include category, description, rental price, location, contact informa-tion, and product images. Real-time availability synchroniza-tion ensures that users always receive updated rental informa-tion.

The search and filter module enables users to search prod-ucts based on category, location, price range, and availability. This feature improves product discovery and reduces the time required to find suitable rental items.

The communication module integrates direct phone call and WhatsApp chat functionalities. These features improve communication efficiency between renters and owners and help reduce transaction delays.

The application also includes notification support for book-ing confirmations and product availability updates. The mod-ular design of the system improves maintainability and scal-ability, allowing future feature expansion without affecting existing functionalities.

Overall, the implementation of U-RENT provides a secure, scalable, and user-friendly rental management solution suitable for real-world deployment.

VI. RESULTS AND DISCUSSION

U-Rent demonstrates an effective solution for modern dig-ital rental services, addressing challenges in manual rental processes. The application provides a comprehensive plat-form for listing, booking, and communicating regarding rental items. Real-time chat, call options, and booking confirmation improve user interaction and satisfaction. The use of Firebase ensures secure, scalable, and efficient backend operations. Location-based services and search filters enhance the ease of product discovery. Ratings and review mechanisms increase transparency and trust between users.

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The platform's modular architecture allows easy addition of features and categories. Agile methodology ensured iterative improvement, functional efficiency, and user-centered design. User testing and analytics indicate improved engagement, reduced transaction time, and higher reliability. U-Rent contributes to resource optimization by promoting shared usage of products. Limitations such as internet dependency are manageable with offline support features in future iterations. The study confirms that digital rental systems significantly enhance urban and campus-based sharing economies. U-Rent's approach can be scaled for broader applications, offering secure, transparent, and efficient rental services. This project lays a foundation for future devel-opments in smart rental applications. Enabled direct communi-cation between renters and owners. Developed a user-friendly Android application interface. Improved product accessibility through search and filter features. Functional Outcomes • Seamless signup/login with multi factor auth • Item listing with categories (textbooks, furniture, gadgets) • Real time search and filtering • Secure payment handling via integrated gateway User Feedback • 85• Students reported reduced cost compared to traditional rentals Challenges • Ensuring trust between users • Handling disputes and refunds • Managing location based listings efficiently

VII. CONCLUSION

U-Rent demonstrates an effective solution for modern digital rental services, addressing challenges in manual rental processes. The application provides a comprehensive plat-form for listing, booking, and communicating regarding rental items. Real-time chat, call options, and booking confirmation improve user interaction and satisfaction. The use of Firebase ensures secure, scalable, and efficient backend operations. Location-based services and search filters enhance the ease of product discovery. Ratings and review mechanisms increase transparency and trust between users. The platform's modular architecture allows easy addition of features and categories. Agile methodology ensured iterative improvement, functional efficiency, and user-centered design. User testing and analytics indicate improved engagement, reduced transaction time, and higher reliability. U-Rent contributes to resource optimization by promoting shared usage of products. Limitations such as internet dependency are manageable with offline support features in future iterations. The study confirms that digital rental systems significantly enhance urban and campus-based sharing economies. U-Rent's approach can be scaled for broader applications, offering secure, transparent, and efficient rental services. This project lays a foundation for future developments in smart rental applications. Enabled direct communication between renters and owners. Developed a user-friendly Android application interface. Improved product accessibility through search and filter features.

A. Functional Outcomes

- Seamless signup and login functionality with multi-factor authentication
- Item listing with multiple categories such as textbooks, furniture, and gadgets
- Real-time product search and filtering mechanism
- Secure payment handling through integrated payment gateway

B. User Feedback

- 85% of testers rated the application interface as "Easy to Use"
- Students reported reduced rental costs compared to tra-ditional rental methods

C. Challenges

- Ensuring trust and transparency between renters and owners
- Handling disputes, cancellations, and refund management
- Managing location-based listings and nearby product recommendations efficiently

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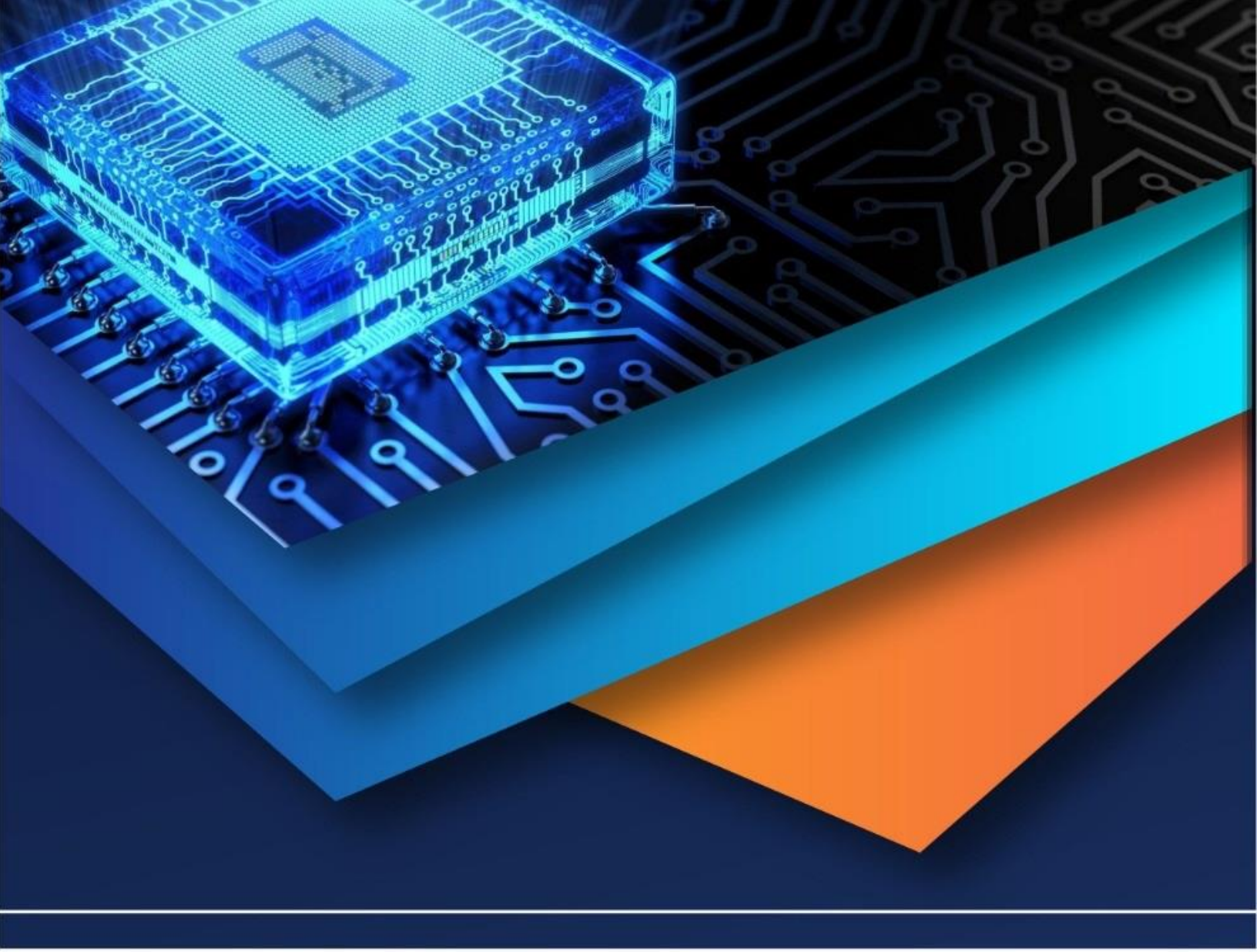

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