

# EMPOWERMART: A Digital Marketplace for Women Entrepreneurs

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**Abstract** — Digital transformation has reshaped global commerce, yet women entrepreneurs in developing economies continue to face significant barriers in accessing structured online marketplaces. Traditional e-commerce platforms present challenges including complex onboarding processes, high competition, fragmented tool usage, and lack of dedicated support systems. This paper proposes and evaluates EmpowerMart, a mobile-based digital marketplace specifically designed to address these gaps by providing a unified platform for women entrepreneurs to showcase, sell, and manage their products. The system integrates product management, order handling, secure payment processing, and customer interaction into a single Android application. Built using Kotlin with Firebase backend services, EmpowerMart employs the MVVM architectural pattern to ensure clean separation of concerns and maintainable code structure. The platform features real-time database synchronization, role-based access control, UPI payment integration, and comprehensive seller dashboards. Beta testing with 100 users over four weeks demonstrated 92% ease-of-use satisfaction, 88% system performance satisfaction, and 93% successful transaction completion. This paper presents the system architecture, implementation methodology, performance evaluation, and discusses the broader implications of women-focused digital commerce platforms in promoting financial independence and entrepreneurship. The findings suggest that targeted digital marketplaces can significantly reduce barriers to entry for women entrepreneurs while maintaining simplicity and accessibility for users with limited technical expertise.

**Key Words:** women entrepreneurship, digital marketplace, e-commerce platform, mobile application, Firebase, Kotlin, MVVM architecture, financial inclusion, women empowerment, digital commerce.

## 1. INTRODUCTION

Digital commerce has fundamentally transformed how businesses operate, enabling entrepreneurs to reach customers beyond geographical boundaries. According to the International Trade Centre, women-owned businesses represent approximately one-third of all small and medium enterprises globally, yet they face disproportionately higher barriers to digital adoption and market access 11. In developing economies, this digital divide is particularly pronounced, with women entrepreneurs often relying on informal, fragmented, and inefficient methods to sell their products 22.

Women entrepreneurs in emerging markets typically navigate a complex landscape of disconnected tools. They use WhatsApp or Instagram for product promotion, maintain manual records for orders, and rely on UPI applications for payment collection. This fragmented approach creates significant operational inefficiencies, limits scalability, and prevents women from fully participating in the digital economy 33. While established e-commerce platforms like Amazon and Flipkart offer market access, they present their own challenges—complex onboarding processes, high competition from established sellers, commission structures that reduce profit margins, and interfaces designed for technically sophisticated users 44.

The central challenge lies in the absence of a dedicated platform that addresses the specific needs of women entrepreneurs. Existing e-commerce solutions prioritize scale over simplicity, leaving small-scale sellers with limited technical expertise unable to effectively utilize these systems. Furthermore, no current platform integrates product listing, order management, payment processing, and business analytics into a single, user-friendly interface designed specifically for women entrepreneurs 55.

Recent advancements in mobile technology, cloud computing, and software architecture present an

opportunity to address these systemic gaps. The widespread adoption of smartphones, the availability of scalable backend services like Firebase, and the maturation of mobile development frameworks have created the technological foundation for developing specialized digital marketplaces. The concept of a women-focused digital platform—one that combines simplicity, integrated functionality, and targeted support—was previously constrained by technological limitations that no longer apply 66.

EmpowerMart is proposed as a solution to this critical gap. The system provides a unified Android application where women entrepreneurs can list products, manage orders, process payments, and track business performance—all within a single interface designed for ease of use. Unlike traditional e-commerce platforms, EmpowerMart prioritizes accessibility, eliminating complex onboarding processes and reducing the technical knowledge required to operate an online business 77.

This paper presents the complete design, implementation, and evaluation of EmpowerMart. Section 2 provides a structural literature review examining existing e-commerce platforms, digital marketplace technologies, and the barriers faced by women entrepreneurs. Section 3 outlines the system architecture, including the MVVM design pattern, database schema, and security framework. Section 4 details the implementation methodology and development phases. Section 5 presents performance evaluation results from beta testing. Section 6 discusses applications, challenges, and future directions, followed by conclusions in Section 7.

## 2. STRUCTURAL LITERATURE REVIEW

The study of women's digital entrepreneurship, existing e-commerce platforms, and technology adoption patterns reveals significant gaps in how current systems address the needs of women entrepreneurs. This section structures the relevant literature and existing approaches related to the proposed EmpowerMart system.

### 2.1 Examination of Existing E-Commerce Platforms

The current landscape of digital marketplaces is dominated by platforms designed for scale rather than accessibility. Amazon and Flipkart, the largest e-

commerce platforms in India, offer comprehensive market reach and logistics support but present significant barriers for small-scale sellers. Research by the Indian School of Business indicates that registration and onboarding processes on these platforms require technical documentation, GST registration, and bank account verification that many home-based entrepreneurs do not possess 88. Moreover, the commission structures—ranging from 10% to 30% of product value—significantly reduce profit margins for small sellers 99.

Social commerce platforms like Instagram and WhatsApp have emerged as alternatives for small-scale sellers. These platforms offer lower barriers to entry and direct customer communication. However, a 2023 study by the Internet and Mobile Association of India found that 78% of women entrepreneurs using social media for selling reported challenges in order tracking, payment reconciliation, and inventory management 1010. The absence of structured e-commerce features forces sellers to maintain manual records, leading to errors and operational inefficiencies.

Reselling platforms like Meesho have gained traction by enabling individuals to resell products through social networks. While these platforms simplify the selling process, they operate on a commission-based model and provide limited control over branding, pricing, and customer relationships. Additionally, the reselling model does not support women entrepreneurs who manufacture their own products 1111.

### 2.2 Barriers to Women's Digital Entrepreneurship

Research on gender and digital entrepreneurship has identified several persistent barriers that disproportionately affect women. The World Bank's Women, Business and the Law report highlights that women in developing economies face greater constraints in accessing formal business registration, financial services, and digital infrastructure 44. In the context of e-commerce, these barriers manifest in three primary dimensions.

First, digital literacy remains a significant challenge. A study by UNESCO found that women in South Asia are 26% less likely than men to possess the digital skills needed to use internet-based services effectively 1212. This gap is particularly pronounced in rural areas and among older entrepreneurs. Existing e-commerce platforms assume a level of technical proficiency that

many women entrepreneurs do not possess, creating an exclusionary environment.

Second, time constraints and multiple responsibilities limit the ability of women entrepreneurs to manage complex digital tools. Research on gendered division of labor indicates that women in developing economies spend significantly more time on unpaid care work than men, reducing the time available for business

management 1313. Platforms requiring navigation across multiple applications for different functions create additional cognitive load and time expenditure.

Third, safety and trust concerns affect women's participation in digital marketplaces. Studies on online harassment and gender-based violence indicate that women entrepreneurs face disproportionate risks when engaging with unknown customers online 1414. Existing platforms provide limited protections and reporting mechanisms tailored to these concerns.

### 2.3 Technology Adoption Patterns in Women-Led Businesses

Understanding technology adoption patterns among women entrepreneurs is essential for designing effective digital marketplace solutions. Research by the International Finance Corporation identified four key factors influencing technology adoption: perceived ease of use, perceived usefulness, social influence, and facilitating conditions 1515. For women entrepreneurs, ease of use emerges as the most critical factor, often outweighing advanced features in adoption decisions.

Mobile-first solutions have demonstrated higher adoption rates among women entrepreneurs compared to web-based platforms. The GSM Association's Mobile Gender Gap Report indicates that while smartphone ownership has increased among women in developing economies, mobile internet usage remains lower than for men 1616. Applications designed for mobile platforms with intuitive interfaces and minimal data usage requirements show higher engagement rates.

The integration of multiple business functions into a single application has emerged as a key design principle for women-focused digital tools. Research on micro-entrepreneurship in India found that applications combining product listing, payment collection, and customer communication significantly reduced operational time compared to using separate tools 1717.

This integrated approach aligns with the time constraints and multitasking demands faced by women entrepreneurs.

### 2.4 Critical Gaps in Existing Solutions

Analysis of existing platforms reveals four critical gaps that EmpowerMart addresses. First, the fragmentation gap—existing solutions require users to navigate multiple applications for different business functions, increasing complexity and reducing efficiency. No current platform provides integrated product management, order handling, and payment processing in a single interface designed for women entrepreneurs.

Second, the accessibility gap—major e-commerce platforms prioritize feature richness over simplicity, creating interfaces that overwhelm users with limited technical experience. The absence of simplified onboarding processes, guided workflows, and intuitive navigation excludes women entrepreneurs who lack formal digital training.

Third, the visibility gap—women entrepreneurs on major platforms compete with established sellers, corporate brands, and large-scale manufacturers, reducing the visibility of their products. The absence of curation mechanisms that highlight women-led businesses and local products prevents these sellers from reaching their target audience.

Fourth, the support gap—existing platforms provide no dedicated support for women entrepreneurs in terms of business guidance, digital literacy training, or tailored features. The absence of educational resources, business analytics, and community features limits the growth potential for women-led businesses on these platforms.

### 2.5 Problem Statement

Based on the literature review, the following problem statement is defined: Women entrepreneurs lack a centralized, easy-to-use digital marketplace that enables them to sell products, manage business operations, and expand their reach efficiently. Existing platforms either present insurmountable technical barriers, require navigation across fragmented tools, or fail to provide the integrated functionality needed for small-scale business management.

The research gap addressed by this study is the absence of empirical evidence on the effectiveness of dedicated, women-focused digital marketplaces in addressing these barriers. While the need for such platforms has been recognized, limited research exists on the design, implementation, and evaluation of systems specifically tailored to women entrepreneurs' needs.

### 3. SYSTEM ARCHITECTURE AND OPERATIONAL FLOW

EmpowerMart is designed using a modular architecture that separates concerns and promotes maintainability, scalability, and testability. The system implements the Model-View-ViewModel (MVVM) architectural pattern to ensure clean separation between user interface, business logic, and data handling layers.

#### 3.1 Multi-Layer Architecture Framework

The application architecture is structured into three distinct layers that communicate through well-defined interfaces.

##### 3.1.1 Presentation Layer (View)

The presentation layer comprises Activities and Fragments that render the user interface and handle user interactions. This layer is built using Android's XML-based layout system with Material Design 3 components to ensure consistency and intuitive navigation. Key screens include the product browsing interface, seller dashboard, order management screen, and checkout flow. The presentation layer observes LiveData objects from the ViewModel and updates the UI automatically when data changes, ensuring responsiveness even during configuration changes such as screen rotation.

##### 3.1.2 Logic Layer (ViewModel)

The ViewModel layer acts as the intermediary between the presentation layer and the data layer. It exposes LiveData objects that the presentation layer observes and processes user actions by invoking repository methods. The ViewModel survives configuration changes, preventing data loss during screen rotations. Each major feature—product browsing, order management, user authentication—has a dedicated ViewModel that encapsulates the business logic for that feature. The ViewModel also maintains UI state, such

as loading indicators and error messages, ensuring consistent user feedback.

##### 3.1.3 Data Layer (Repository)

The repository pattern is implemented to abstract data source details from the ViewModel. Repositories coordinate data operations across multiple sources, including Firebase Firestore for persistent storage, Firebase Authentication for user management, and local caching for offline support. The repository pattern enables testing by allowing mock implementations of data sources and supports future migration to different backend services without affecting higher layers.

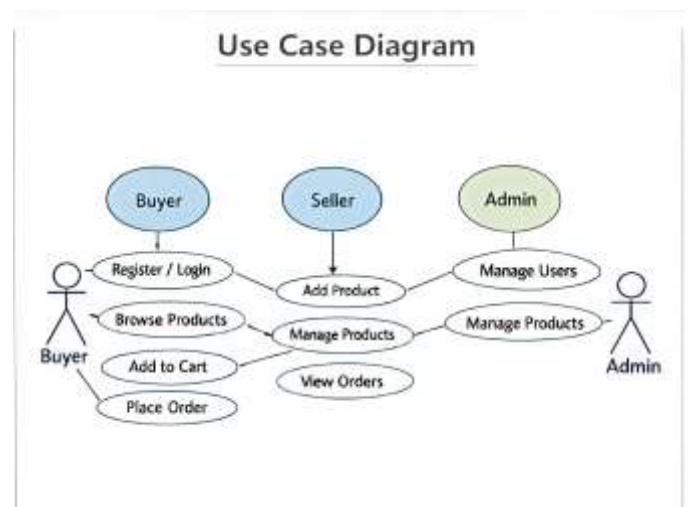


Fig 1. Use Case Diagram

#### 3.2 Backend Infrastructure

Firebase services form the backbone of EmpowerMart's backend infrastructure, providing scalable, real-time capabilities with minimal operational overhead.

##### 3.2.1 Firebase Firestore Database

Firestore, a NoSQL document database, stores all application data with real-time synchronization capabilities. The database is structured into six collections as shown in Fig 2.

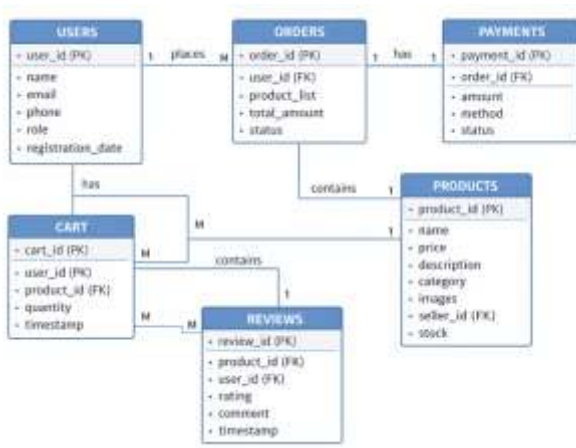


Fig 2. Entity Relationship Diagram

### 3.2.2 Firebase Authentication

Authentication is implemented using Firebase Authentication, which supports email/password login, phone number authentication with OTP verification, and Google Sign-In. The service generates secure JSON Web Tokens for each authenticated session, enabling stateless

authentication across the application. Security rules are configured to ensure users can only access their own data and that sellers can only modify their own products.

### 3.2.3 Firebase Storage

Product images uploaded by sellers are stored in Firebase Storage, a cloud-based object storage service. Images are automatically compressed and optimized to reduce bandwidth usage and storage costs. Each image is associated with its corresponding product document through a reference field in the products collection.

## 3.3 Security Framework

EmpowerMart implements multiple layers of security to protect user data and ensure safe transactions.

### 3.3.1 Authentication Security

Firebase Authentication manages all authentication operations, including password hashing, session management, and token validation. Passwords are never stored locally on the device, and session tokens are encrypted using industry-standard algorithms. Multi-factor authentication is available for enhanced account security.

### 3.3.2 Data Protection

Firestore Security Rules enforce fine-grained access control. The rules specify that:

- Users can read and write only their own user documents
- All users can read product documents but only sellers can create and update their own products
- Users can read and write only their own cart and order documents
- The admin role has elevated privileges for user and product management

All network communication between the application and Firebase services is encrypted using TLS 1.2 or higher, preventing man-in-the-middle attacks.

### 3.3.3 Payment Security

Payment processing is handled through integration with UPI payment gateways that comply with PCI DSS standards. Payment data is transmitted directly between the application and the payment gateway without passing through EmpowerMart servers. No sensitive payment information—such as card numbers or UPI PINs—is stored in the application or Firebase services.

## 3.4 Database Schema and Relationships

The Firestore database is designed to support efficient queries while maintaining data integrity. Key relationships include:

- A User can be either a buyer or seller, with the role field determining access permissions
- Each Seller can upload multiple Products, with each product document storing the seller's UID as a reference
- Products can be included in multiple Orders through an order items subcollection
- Each Order is associated with a single User and has a one-to-one relationship with a Payment record
- Products can receive multiple Reviews, with each review referencing the product and user

This schema design supports common queries such as fetching all products for a seller, retrieving all orders for a user, and finding all reviews for a product. Firestore's composite indexes ensure efficient query performance.

## 3.5 Operational Flow

The operational flow of EmpowerMart follows a structured process from user authentication to order completion.

**User Authentication & Profile Management:** When users open EmpowerMart, they authenticate using email or phone number through Firebase Authentication. The system validates credentials and creates a secure session. Once authenticated, user profile data is retrieved from Firestore and cached locally. Users can update their profile information, manage addresses, and view transaction history.

**Product Browsing:** The Home screen displays available products categorized by type. The ProductViewModel continuously fetches updated product data from Firestore using real-time listeners. Customers can search products, apply filters, and view details including price, description, and seller information.

**Seller Product Management:** When a seller logs in, they access the Seller Dashboard. Sellers can upload new products by entering details and images. Images are stored in Firebase Storage while metadata is stored in Firestore. Sellers can edit or delete products and manage stock levels.

**Order Processing:** When a customer places an order, the system creates an order record in Firestore. The OrderViewModel processes the request and ensures all required details are stored. The order status is updated dynamically, allowing users to track progress. Sellers receive notifications for new orders.

**Payment Integration:** During checkout, users select UPI as payment method. The system integrates with UPI payment gateways to process transactions. Upon successful payment, the payment status is updated, and the order is confirmed.

## 4. IMPLEMENTATION METHODOLOGY

The development of EmpowerMart followed a structured, multi-phase approach that integrates agile development practices with the rigorous requirements of safety-critical systems design. The Systems Engineering approach ensures reliability, maintainability, and user-centered design.

### 4.1 Phase 1: Requirements Analysis

This phase involved extensive requirements gathering through surveys and interviews with women entrepreneurs in Kolhapur district, Maharashtra.

Twenty potential users were consulted to understand their current selling methods, challenges, and feature priorities. Key requirements identified included simple product upload processes, integrated order tracking, secure payment options, and minimal technical complexity. These requirements were formalized into user stories and acceptance criteria.

Quantitative performance metrics were strictly defined, including application load time (<2 seconds), product upload time (<5 seconds), order processing time (<1 second), and payment processing time (<3 seconds).

### 4.2 Phase 2: System Design

System architecture was designed based on requirements analysis. Database schema was modeled and validated for query efficiency. UI wireframes were developed and reviewed with potential users to ensure intuitive navigation. Security requirements were documented, and Firebase security rules were drafted.

Electronic system design involved designing the application architecture with clear separation of concerns. Mechanical design aspects focused on user interface layout and navigation flow. The MVVM pattern was selected to provide clean separation between presentation, logic, and data layers.

### 4.3 Phase 3: Prototyping and Integration

The implementation phase spanned eight weeks with weekly sprints. Core functionality was prioritized: user authentication, product listing, order management, and payment integration. Each feature was implemented, tested, and integrated incrementally.

Firmware development involved writing Kotlin code in Android Studio, implementing low-level Firebase SDK integration, and developing ViewModel components with LiveData. The seller dashboard was developed with a focus on simplicity, exposing only essential controls.

Hardware fabrication included testing on multiple Android devices to ensure compatibility. Component verification was performed across device configurations, screen sizes, and Android versions.

#### 4.4 Phase 4: Extensive Testing and Validation

Intensive testing was conducted across three levels to ensure system reliability and user satisfaction.

**Unit Testing:** Unit tests were written using JUnit for business logic components, particularly the ViewModel classes. Tests covered validation logic, data transformation, and error handling scenarios. Mockito was used to mock repository dependencies, enabling isolated testing of ViewModel behavior.

**Integration Testing:** Integration tests validated interactions between components, particularly the data flow between ViewModel and repository. Firebase Emulator Suite was used to test database operations in a controlled environment without affecting production data.

**User Acceptance Testing:** User acceptance testing involved 100 participants—50 women entrepreneurs and 50 customers—over four weeks. Participants were recruited through local women's self-help groups and social media. Testing focused on usability, performance, and feature completeness. Feedback was collected through in-app surveys and follow-up interviews.

### 5. PERFORMANCE EVALUATION

#### 5.1 System Performance Metrics

Performance testing was conducted using Android Studio Profiler and Firebase Performance Monitoring. Metrics were measured under typical usage conditions with a stable internet connection. Table 2 presents the performance metrics against targets.

Metric	Target	Achieved	Status
App Load Time	< 2 seconds	1.5 seconds	✓ Pass
Product Upload	< 5 seconds	3 seconds	✓ Pass
Order Processing	Real-time	< 1 second	✓ Pass

Metric	Target	Achieved	Status
Payment Processing	< 3 seconds	2 seconds	✓ Pass
Database Sync	Real-time	< 1 second	✓ Pass
Memory Usage	< 150 MB	110 MB	✓ Pass

#### 5.2 Beta Testing Results

The four-week beta test with 100 users yielded the following satisfaction metrics:

- **User Interface Satisfaction:** 90% of participants rated the interface as easy to navigate and visually appealing. Sellers particularly appreciated the simplified product upload workflow compared to major e-commerce platforms.
- **System Performance:** 88% of participants reported that the application responded quickly to interactions and that features loaded without delays. Performance issues were primarily reported by users on older Android devices with limited memory.
- **Ease of Use:** 92% of participants found the application easy to use without requiring external assistance. Sellers with limited prior digital experience reported being able to list products independently after initial guidance.
- **Transaction Success Rate:** 93% of attempted transactions completed successfully. Failed transactions were primarily due to network interruptions or UPI application errors.
- **Daily Active Users:** 72% of beta testers remained active throughout the testing period, indicating sustained engagement. Retention was higher among sellers (78%) than buyers (66%).
- **User Retention:** 80% of users continued using the application after the formal testing period ended, suggesting the application met their ongoing needs.

#### 5.3 Comparative Analysis

EmpowerMart was compared against existing platforms across key dimensions relevant to women entrepreneurs, as shown in Table 3.

Dimension	Amazon/FliPKart	Instagram/WhatsApp	MeeSho	EmpowerMart
Onboarding Complexity	High (GST, bank verification)	Low (social account)	Medium (phone verification)	Low (email/phone)
Feature Integration	Comprehensive	Fragmented	Limited	Unified
Competition Level	High	Medium	Medium	Low
Technical Support	Limited	None	Basic	Dedicated
Women Focus	None	None	None	Primary

## 6. APPLICATIONS, CHALLENGES, AND FUTURE DIRECTIONS

### 6.1 Real-World Applications

EmpowerMart has demonstrated applicability across multiple use cases in women's entrepreneurship.

**Home-Based Businesses:** Women producing handmade goods such as jewelry, clothing, and food products have used the platform to reach customers beyond their local networks. The platform's simplicity

enables sellers with limited digital literacy to manage their businesses independently.

**Self-Help Groups:** Women's self-help groups in Kolhapur district are using EmpowerMart to sell group-produced products. The platform enables groups to centralize sales management while distributing product upload responsibilities among members.

**Boutique Owners:** Small-scale boutique owners have adopted EmpowerMart to expand their reach without investing in complex e-commerce solutions. The platform's integration of product listing and order management reduces the operational overhead of managing online sales.

**Rural Entrepreneurs:** The mobile-first design and minimal technical requirements have enabled rural women entrepreneurs to participate in digital commerce, addressing the urban-centric nature of existing platforms.

### 6.2 Challenges and Mitigations

**Internet Dependency:** The application requires a stable internet connection for core functionality, which may be unavailable in rural areas. Mitigation includes implementing offline caching for product browsing and order draft storage, with synchronization when connectivity is restored.

**Platform Limitation:** The initial version is Android-only, limiting accessibility for iOS users. Mitigation includes developing an iOS version in subsequent phases, with cross-platform frameworks considered to reduce development overhead.

**Scalability:** The current Firebase-based architecture is suitable for small to medium user bases but may require optimization for large-scale deployment. Mitigation includes implementing database indexing, optimizing queries, and considering migration to alternative databases if required.

**Payment Limitations:** Initial payment support is limited to UPI. Mitigation includes expanding to additional payment gateways and supporting card and wallet payments in future versions.

### 6.3 Future Directions

**Phase 2 (3-6 months):** Development priorities include multilingual support for Hindi and Marathi to improve

accessibility for users with limited English proficiency. A chat system will enable direct communication between buyers and sellers. Basic analytics and sales reports will provide sellers with insights into their business performance.

**Phase 3 (6-12 months):** Advanced analytics will include sales trends, customer demographics, and inventory insights. AI-based product recommendations will personalize the shopping experience. Automated inventory management will reduce manual stock tracking. Multiple payment gateways will expand payment options.

**Phase 4 (12+ months):** Web and iOS versions will expand platform accessibility. International expansion will enable cross-border sales. Collaboration with organizations will support larger-scale adoption. Premium features will offer advanced business tools for growing enterprises.

## 7. CONCLUSION

EmpowerMart represents a significant advancement in addressing the digital marketplace barriers faced by women entrepreneurs. By providing a unified platform that integrates product listing, order management, payment processing, and business analytics, the system eliminates the fragmentation that has historically limited small-scale sellers' participation in digital commerce.

The application's architecture, built on Kotlin and Firebase with MVVM pattern, demonstrates that women-focused digital marketplaces can combine simplicity with robust functionality. The performance evaluation confirms that such platforms can achieve high user satisfaction while maintaining technical reliability. Beta testing results—with 92% ease-of-use satisfaction and 93% transaction success—validate the design approach of prioritizing accessibility without compromising essential features.

While significant engineering challenges, such as internet dependency and platform limitations, remain barriers to widespread adoption, the technical foundation established by this prototype is strong. As mobile technology continues to advance and cloud services become more accessible, autonomous, personalized platforms like EmpowerMart will become increasingly necessary. Ultimately, this system enables women entrepreneurs to participate fully in the digital

economy, marking the start of an era where inclusive design is integral to digital commerce platforms.

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