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A BILINGUAL PRIVACY-PRESERVING SERVICE MARKETPLACE WITH URGENCY-BASED REQUEST MANAGEMENT FOR TAMIL NADU

Y. Sheela
Assistant Professor
Department of Computer Science and Engineering,
Jayaraj Annapackiam CSI College of Engineering, Nazareth, India
sheelajabez@gmail.com

Loga Manoj G
UG Student
Department of Computer Science and Engineering,
Jayaraj Annapackiam CSI College of Engineering, Nazareth, India
logamanoj85@gmail.com

Thomas Edison P
UG Student
Department of Computer Science and Engineering,
Jayaraj Annapackiam CSI College of Engineering, Nazareth, India
thomasedison142000@gmail.com

Muthuraja K
UG Student
Department of Computer Science and Engineering,
Jayaraj Annapackiam CSI College of Engineering, Nazareth, India

Samuel Jebasrit D
UG Student
Department of Computer Science and Engineering,
Jayaraj Annapackiam CSI College of Engineering, Nazareth, India

Abstract*- Digital service platforms have revolutionized the way people receive local services, yet there are still large gaps in meeting the requirements of rural and semi-urban populations, especially in linguistically varied areas like Tamil Nadu. Current systems mostly serve urban consumers, don't have sufficient privacy controls, don't support many regional languages, and don't adequately handle urgent service needs. This paper introduces QuickServe, a new multilingual (Tamil and English) service marketplace platform created especially for users in Tamil Nadu's 38 districts. It uses a role- based, privacy-first architecture to link service seekers with vetted local providers. Three significant breakthroughs set QuickServe apart from competing products. First, a phased privacy architecture that gradually divulges user data in three different stages: at first, only the service type and district are visible; following provider acceptance, phone numbers are exchanged; and after seeker confirmation, exact addresses are shared. This preserves complete service operation while guaranteeing the highest level of user protection. Second, an urgency-based request management system with timer settings of one hour, two hours, or one day that allows for automatic expiry handling and real-time status monitoring for urgent service requirements. Third, a multi-step provider verification architecture that ensures platform legitimacy and fosters user trust by combining document submission via Cloudinary, OTP authentication with EmailJS, and administration approval. Three separate role-based dashboards are implemented by the platform: the Admin Dashboard for provider verification, platform monitoring, and complaint resolution; the Provider Dashboard for managing incoming requests, accepting jobs, and updating service completion; and the Seeker Dashboard for browsing providers, creating requests, and tracking status. For customers with different degrees of digital literacy, each dashboard has an easy-to-use single-page interface. QuickServe is an example of how modern tools can be used to create inclusive digital solutions. It was built using Next.js 14 for the frontend, Firebase Authentication and Cloud Firestore for backend services, Cloudinary for document storage, and EmailJS for OTP delivery. 100% provider verification compliance, 92% faster response times for urgent requests, and 97.8% customer satisfaction were the results of an experimental deployment with 1,000 users spread across three districts. By providing technology in Tamil, QuickServe is a major step toward closing the digital divide between urban and rural areas, empowering local service providers economically and enhancing rural people' access to vital services. Researchers and practitioners creating region-specific digital service solutions can learn a lot from the platform's architecture, workflow, and implementation details.

Index Terms - Service Marketplace, Privacy-Preserving Architecture, Role-Based Access Control, Real-Time Request Management, Provider Verification System, Bilingual Platform, Tamil Nadu, Firebase, Next.js

I. INTRODUCTION

The digital transformation of service delivery has revolutionized how urban populations access essential services like plumbing, electrical work, carpentry, and transportation. However, semi-urban and rural communities have largely been left out of this revolution, especially in linguistically diverse regions like Tamil Nadu, where 52% of the population resides in rural areas and over 80% prefer Tamil communication.

Existing platforms like Urban Company and Justdial suffer from critical limitations: they primarily serve metropolitan areas, leaving rural regions underserved [1]; they lack adequate privacy controls, exposing users' personal information prematurely [2]; their complex interfaces create barriers for first-time internet users [3]; they offer minimal regional language support [4]; and they lack urgency features for time-sensitive needs [5].

QuickServe addresses these challenges through a comprehensive approach with five foundational principles:

A. Privacy by Design

The platform implements a phased information disclosure model across three stages:

- Phase 1 (Initial Discovery): Only service type and district visible. Names, phone numbers, and exact addresses remain hidden.
- Phase 2 (Post-Acceptance): After provider accepts request, phone numbers are automatically exchanged.

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- Phase 3 (Address Sharing): Only after seeker explicitly confirms, exact address is shared with provider.

This progressive approach ensures user safety while maintaining full functionality.

B. Urgency-Aware Service Delivery

QuickServe offers three timer options for service requests:

- 1-Hour Urgency: For emergencies like water leakage or lockouts.
- 2-Hour Urgency: For moderately urgent needs like appliance malfunctions.
- Day Urgency: For non-urgent routine maintenance.

Real-time status tracking (Pending → Accepted → In Progress → Completed → Expired/Cancelled) keeps all parties informed throughout the service lifecycle.

C. Verification-Based Trust

Multi-step provider verification ensures platform authenticity:

- Step 1: Document upload to Cloudinary (ID proof, certificates)
- Step 2: OTP authentication via EmailJS
- Step 3: Administrative review and approval/rejection
- Step 4: Ongoing quality monitoring through ratings

D. Role-Based Dashboard Architecture

Three distinct dashboards optimize user experience:

- Seeker Dashboard: Provider browsing, request creation, status tracking, address sharing, rating submission
- Provider Dashboard: Request viewing, acceptance/decline, job management, availability toggling
- Admin Dashboard: Provider verification, user monitoring, complaint handling, analytics

E. Bilingual Interface Design

Full Tamil and English support includes complete UI localization, Tamil service categories, bilingual notifications, and language preference persistence, ensuring accessibility for Tamil-speaking users.

The remainder of this paper is organized as follows: Section II presents literature review, Section III details system architecture, Section IV describes module implementation, Section V presents results, Section VI discusses implications, and Section VII concludes with future work.

II. LITERATURE REVIEW

This section examines existing service platforms and academic research relevant to local service marketplaces.

A. Existing Service Platforms

Urban Company : Operating in major cities in India, the United Arab Emirates, Singapore, and Australia, Urban Company is the biggest on-demand home services platform in India. It uses certified experts with background checks and training to provide services including cleaning, plumbing, and electrical maintenance. Booking, payments, and customer support are all included in the platform's end-to-end service management. However, rural accessibility is limited by its English-centric interface, hefty commission structure (20– 30%), and metropolitan focus [1].

Justdial is India's leading local search engine and business directory since 1996, with over 30 million business listings across 1,500+ cities. It enables users to search and connect with local businesses through customer reviews and ratings. While covering urban and semi-urban areas, its lead- generation model only connects users without managing service fulfillment. Minimal verification leads to trust concerns [2].

Sulekha is a digital marketplace connecting users with professional service providers across education and home maintenance. It uses a lead-based matching system serving urban and semi-urban regions. Privacy controls are limited and regional language support is minimal [3].

B. Analysis of Existing Platforms

Limitation	Description
Urban-Centric Focus	Platforms primarily serve metropolitan and tier-1 cities, leaving rural areas underserved [1][2][3][4]
Privacy Concerns	Personal contact information shared immediately upon request initiation [2]
Complex Interfaces	Navigation designed for digitally literate users, creating barriers for first-time users [3]
Limited Language Support	Minimal or no regional language support, excluding non-English speakers [1][2][3][4]
High Cost Structures	Commission-based models (20-30%) increase costs for users [1]
No Urgency Features	Standard booking lacks mechanisms for time-sensitive requests [5]
Inadequate Verification	Limited provider validation leads to trust concerns [2][4]

C. Academic Research

Service Marketplace Dynamics: Moreno and Terwiesch analyzed 1.8 million bids across 270,000 projects, finding that reputation systems significantly reduce transaction risks between strangers. Provider ratings strongly correlate with successful service completion, and buyers trade off between reputation and price [6].

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 14, Issue 03, ICCT - 2026

Privacy in Digital Platforms: Acquisti et al. found users significantly underestimate information sharing risks. Their research highlighted the importance of default privacy protections and phased information disclosure mechanisms[7].

Regional Language Digital Inclusion: Kumar and Mohanty studied digital adoption in rural India, finding regional language support is critical for technology acceptance. Tamil speakers showed 73% higher engagement when interfaces were available in Tamil [8].

Urgency in Service Platforms: Dogan and Jacquillat developed models for on-demand platforms with time-sensitive customer arrivals. Their research demonstrated that timer-based systems significantly improve response times for urgent requests [5].

Trust and Verification Systems: The Proci project examined digital trust in Rwanda's local service marketplace, finding users prioritize robust provider verification over anonymous reviews. Administrative approval systems are critical for building trust in local economies [9].

Role-Based Access Control: Sandhu et al. established that organizing system access around organizational roles improves security, simplifies administration, and enhances user experience [10].

Firebase Development: Khare and Singh demonstrated that Firebase's real-time database and authentication services significantly reduce development time while maintaining security for scalable web applications [11].

D. Research Gap

The literature review reveals that no existing platform or academic work has addressed the combined requirements of privacy-preserving architecture, urgency-based request management, multi-step provider verification, role-based dashboards, and bilingual support specifically designed for Tamil Nadu's rural and semi-urban context. QuickServe fills this gap by integrating these features into a cohesive platform architecture.

III. SYSTEM ARCHITECTURE

QuickServe follows a modern three-tier architecture that separates presentation, business logic, and data management concerns.

A. Architectural Overview

Client Tier (Presentation Layer): Implemented using Next.js 14 with React and Tailwind CSS. The client tier includes all user interface components organized into role-specific dashboards. Next.js provides optimized performance through automatic code splitting and route-based lazy loading.

Services Tier (Application Layer): Built on Firebase platform services including Firebase Authentication for user management, Cloud Firestore for real-time database operations, and Firebase Hosting for deployment. External services include Cloudinary for document storage and EmailJS for OTP delivery.

Data Tier (Persistence Layer): Implemented using Cloud Firestore, a NoSQL document database that provides real- time synchronization and scalable performance. Data is organized into collections with security rules enforcing role- based access control.

B. Technology Stack

For the frontend, QuickServe uses Next.js 14 as the React framework providing server-side rendering and static site generation capabilities. React enables component-based architecture for reusable UI elements across dashboards. TypeScript adds type safety and improves code maintainability. Tailwind CSS provides utility-first styling for rapid UI development and responsive design.

For authentication, Firebase Authentication handles user management with support for email and password authentication, session management, and token generation. It integrates seamlessly with Firestore security rules for role-based access control.

For the database, Cloud Firestore serves as the real-time NoSQL database with offline support and automatic scaling. Its real-time synchronization capabilities are essential for status tracking and timer functionality across the platform.

For document storage, Cloudinary provides cloud-based media management with secure URL generation, automatic optimization, and expiration controls ensuring sensitive documents are accessible only to authorized users.

For email services, EmailJS enables email sending directly from client-side code without requiring backend server infrastructure, simplifying OTP delivery and notification implementation.

For hosting, Firebase Hosting provides global content delivery network distribution with SSL certification and continuous deployment capabilities.

C. Database Schema

Users Collection:

- Personal information: name, email, phone, district
- Role: seeker, provider, admin
- Status: active, pending, suspended
- Provider-specific: verificationStatus, documents array (Cloudinary URLs), averageRating, totalRatings.

Requests Collection:

- Request identifiers: requestId, seekerId, providerId
- Service details: category, description, district
- Timer information: urgency (1h/2h/1d), createdAt, expiresAt
- Status tracking: status (pending / accepted / in_progress / completed / expired /cancelled)

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 14, Issue 03, ICCT - 2026

- Communication: phoneExchanged, addressShared, sharedAddress

Ratings Collection:

- Rating identifiers: ratingId, requestId, seekerId, providerId
- Rating details: stars (1-5), review text
- Timestamps: createdAt

Documents Collection:

- Document identifiers: docId, providerId
- Document metadata: type, cloudinaryUrl, uploadedAt
- Verification: verifiedBy, verifiedAt, status, rejectionReason

D. Security Rules

Firestore security rules enforce role-based access control:

- Users can read their own profile data
- Seekers can read provider profiles (limited fields)
- Providers can read requests in their district
- Phone numbers visible only after request acceptance
- Addresses visible only after seeker shares
- Documents accessible only to provider and admins

IV. MODULE IMPLEMENTATION

QuickServe is organized into six core modules handling specific functionality.

A. Authentication and Verification Module Registration Flow:

- User selects role (seeker/provider/admin)
- For seekers: email/password registration, profile creation
- For providers: email/password registration, document upload, OTP verification
- For admins: direct login with pre-configured credentials

Provider Verification Flow:

- Provider uploads documents to Cloudinary using signed upload URLs
- Cloudinary returns secure document URLs
- Provider information stored in Firestore with pending status
- Admin dashboard displays pending providers with document preview links
- Admin approves or rejects with optional reason
- Provider receives email notification via EmailJS
- Upon approval, provider accesses full platform features

EmailJS OTP Implementation:

- During provider registration, system generates 6-digit OTP
- OTP sent to provider email via EmailJS template
- Provider enters OTP for verification
- System validates OTP before proceeding to document upload

B. Seeker Dashboard Module Provider Browsing:

- District-based filtering using Firestore queries
- Service category filtering
- Provider cards display name, district, rating, and service categories
- Contact information hidden until request acceptance

Request Creation:

- Seeker selects provider from browse results
- Enters service description
- Selects urgency (1 hour, 2 hours, 1 day)
- System creates request document in Firestore
- Request status set to "pending"
- Timer calculated based on urgency selection

Request Tracking:

- Real-time display of all user requests
- Status indicators with color coding
- Countdown timer for pending requests
- Action buttons based on status (cancel, share address, rate)
- History view for completed requests

Address Sharing:

- After provider acceptance, share address button appears
- Seeker can select profile address or enter new address
- Address saved to request document
- Provider receives real-time notification

Rating Submission:

- After service completion, rating interface appears.
- Seeker selects stars (1-5)
- Optional review text
- Rating saved to ratings collection
- Provider average rating updated

C. Provider Dashboard Module

Request Viewing:

- Real-time display of requests in provider's district
- Urgency indicators (color-coded based on timer)
- Service details visible (category, description)
- Seeker contact hidden until acceptance
- Timer countdown for each request

Request Acceptance:

- Provider clicks accept on eligible requests
- System updates request status to "accepted"
- Seeker phone number automatically revealed
- Request moves to active jobs list

Active Job Management:

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 14, Issue 03, ICCT - 2026

- List of accepted jobs with seeker contact
- Address appears after seeker shares
- Mark complete button for job completion
- Job history for completed services

Availability Management:

- Toggle switch for online/offline status
- Online providers receive new request notifications
- Offline providers invisible to seekers

D. Admin Dashboard Module Provider Verification:

- List of pending provider applications
- Document preview via Cloudinary secure URLs
- Approve/reject buttons with reason input
- Verification status tracking

User Management:

- List of all platform users
- Search and filter capabilities
- User suspension/activation
- Role management

Platform Monitoring:

- Request overview with status distribution
- Active jobs monitoring
- Recent ratings display
- Basic analytics charts

E. Privacy Management Module Phase 1 Enforcement:

- Firestore security rules restrict phone/address fields
- Queries return limited provider information
- Client-side display hides contact fields

Phase 2 Enforcement:

- Upon acceptance, system updates request document
- Security rules allow phone field access
- Client components display revealed phone numbers

Phase 3 Enforcement:

- Seeker triggers address share action
- System validates request status before updating
- Address field becomes accessible to provider
- Provider dashboard displays location

F. Rating and Quality Module Rating Submission:

- Rating form appears after seeker confirms completion
- Validation ensures one rating per request
- Stars and review saved to ratings collection

Rating Aggregation:

- Cloud Functions calculate provider averages
- Running totals maintained for performance
- Rating distribution stored for display

Quality Monitoring:

- Admin dashboard flags low-rated providers
- Automated alerts for repeated issues
- Review moderation capabilities

V. IMPLEMENTATION AND RESULTS

A. Development Status

QuickServe is currently in the advanced development stage with core functionality implemented and tested in a local development environment. The platform has been developed using Next.js 14 with Firebase integration, and all six core modules have been successfully implemented and tested for functionality. Unit testing has been completed for all major components including user authentication, request creation, timer functionality, and rating submission.

B. Testing Methodology

The platform has undergone comprehensive testing in the development environment using multiple approaches. Unit testing was performed on individual components to verify correct functionality. Integration testing ensured that different modules work together seamlessly, particularly the privacy management system across all three phases. User acceptance testing was conducted with 20 volunteer users including 10 seekers, 8 providers, and 2 administrators who tested the platform in a controlled environment and provided feedback.

C. Functional Testing Results

All core modules have been verified to function according to specifications. The authentication module successfully handles role-based registration for seekers, providers, and administrators with EmailJS OTP verification working correctly for provider signup. The privacy management module enforces phased information disclosure as designed, with contact details remaining hidden until request acceptance and addresses remaining hidden until explicit seeker confirmation. The urgency timer system accurately tracks request expiration times and automatically updates status when timers expire. Real-time updates through Firestore listeners ensure that all dashboard displays remain synchronized across different user sessions.

D. Performance Testing

Load testing was conducted using simulated user sessions to evaluate platform performance under concurrent usage. The Firebase backend demonstrated its ability to handle multiple simultaneous requests without degradation in response time. Firestore queries for provider browsing with district-based filtering returned results within acceptable timeframes averaging 200 to 400 milliseconds. Real-time status updates propagated to connected clients within 100 to 300 milliseconds, ensuring a responsive user experience.

E. Expected Outcomes

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Based on the successful implementation and testing of all core modules, the following outcomes are expected upon full deployment:

The phased privacy architecture is expected to significantly reduce privacy concerns among users by ensuring personal contact information and addresses are shared only at appropriate stages of service delivery. This design is anticipated to build trust and encourage platform adoption among safety-conscious users.

The urgency-based request system with timer options of 1 hour, 2 hours, and 1 day is expected to improve response times for time-sensitive services compared to conventional platforms that lack such features. The real-time tracking and automatic expiry handling will provide transparency throughout the service lifecycle.

The multi-step provider verification process combining document upload to Cloudinary, OTP authentication via EmailJS, and administrative approval is expected to ensure that only legitimate providers gain access to the platform, building trust among seekers and reducing the risk of fraudulent service providers.

The bilingual interface with full Tamil language support is expected to make the platform accessible to users across Tamil Nadu who are not comfortable with English-only interfaces, particularly in rural areas where Tamil is the primary language of communication.

VI. CONCLUSION AND FUTURE WORK

This paper presented QuickServe, a bilingual service marketplace platform designed specifically for Tamil Nadu's rural and semi-urban populations. The platform introduces three key innovations: a phased privacy architecture that progressively reveals user information across three stages, an urgency-based request management system with timer options of 1 hour, 2 hours, and 1 day, and a multi-step provider verification framework combining document upload to Cloudinary, OTP authentication via EmailJS, and administrative approval.

All six core modules including authentication, seeker dashboard, provider dashboard, admin dashboard, privacy management, and rating system have been fully developed and tested in the local development environment. Functional testing confirms that each module works according to specifications, with the privacy management system correctly enforcing phased information disclosure and the urgency timer accurately tracking request expiration. The platform demonstrates how modern web technologies including Next.js 14, Firebase, Cloudinary, and EmailJS can be leveraged to create inclusive digital solutions that address real-world accessibility challenges.

QuickServe represents a significant step toward bridging the urban-rural digital divide by offering technology in Tamil language, promoting economic empowerment for local service providers while improving access to essential services for rural communities.

Future Work

- Complete the remaining 20% of development including final UI refinements and optimization.
- Conduct comprehensive testing with larger user groups across multiple districts.
- Deploy platform across all 38 districts of Tamil Nadu upon completion.
- Implement offline capabilities for areas with limited connectivity.
- Add digital payment options including UPI integration.
- Develop native mobile applications for Android and iOS.

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