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An intelligent immigration and safety awareness platform

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Abstract: ImmigrationIQ is an online tool designed to assist people navigating the full scope of their immigration preparations. In total, there are five major components included in the overall structure of the tool: 1) Migration Planning System (MPS); 2) Destination Intelligence Browser; 3) Legal & Cultural Learning Hub; 4) Safety & Anti-Fraud Center; and, 5) User Dashboard that will be continually updated. The front end of the platform was built using HTML5/CSS3/Vanilla JavaScript. The back-end functionality of the platform has been implemented using Firebase Authentication and Cloud Firestore for user identity management and storing user plans on the cloud. Using Firebase as the primary option for data storage and localStorage as the secondary option, a two path approach provides continuous operation regardless of network conditions. The platform contains many other unique tools such as a First 72 hours decision simulator, a multi- step quiz engine, and real time scam alerts. Collectively, they address the fragmented and untrustworthy status of today's general purpose immigration information platforms. The experimental testing performed shows quick loading times for all modules of less than 300 ms, low-latency communication from client to server (<1 second), and good fallback behavior when services are unavailable. Overall, this study demonstrates that developing a modular, user-centric, frontend design of an immigration preparation tool is possible to develop quickly and easily to use by both users and developers alike and that it could significantly enhance the outcomes of preparing for immigration.

Keywords: Immigration Planning, Web Application, Firebase, Semantic Web, Safety Preparedness, Decision Simulator, Modular Architecture, Personalized Roadmap, Explainable UI

I. INTRODUCTION

1. Background

In the last few decades, the number of people moving across borders has grown a lot. This is because of things like job opportunities, education, family reunification, and humanitarian displacement. People who want to move to another country often find that the information they need is scattered across different places, such as government websites, legal advice websites, travel forums, and safety resources. First-time migrants especially need a single, easy-to-use platform that brings together information about following the law, learning about a specific country, being aware of fraud, and tracking their progress.

Visa application portals handle the process of submitting applications, but they don't help with cultural or safety preparation. Legal advisory services give advice but don't let you interact with them. Travel information sites have country-specific content, but they don't connect to a person's specific immigration purpose or timeline. The result is a preparation process that is broken up, stressful, and likely to make mistakes that cost a lot of money.

2. Key Definitions

- Immigration Planner: A guided, multi-step tool that generates a personalized migration roadmap based on user-provided origin, destination, visa type, and timeline.
- Firebase Firestore: A cloud-hosted NoSQL document database used for persistent storage of user profiles and plan data.
- Decision Simulator: An interactive scenario engine that presents real-world immigration challenges and evaluates user responses against legal and safety criteria.
- Dual-path Persistence: A storage strategy that attempts Firebase Firestore writes first and falls back to browser localStorage on failure.
- Explainable UI: An interface design philosophy where scoring, feedback, and plan outputs are decomposed into interpretable components visible to the user.

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3. Research Gap

- No unified platform combines planning, legal education, safety preparation, and progress tracking.
- Existing tools do not generate personalized, destination-aware migration roadmaps.
- Anti-fraud and emergency preparedness modules are absent from mainstream immigration platforms.
- Interactive learning and scenario simulation are underexplored in this domain.
- Resilient offline-capable persistence is rarely implemented in immigration web applications.

4. Objective

The ImmigrationIQ platform was developed with the following objectives:

1. Provide a unified, modular web experience covering all stages of immigration preparation.
2. Generate explainable, destination-specific migration roadmaps from user inputs.
3. Deliver interactive legal and cultural education through a quiz-based learning hub.
4. Prepare users for fraud, scam, and emergency scenarios through simulation.
5. Maintain data continuity across sessions using Firebase and localStorage fallback.

5. Scope and Limitations

- English-language interface only; no multilingual support in current release.
- Country intelligence and legal datasets are statically embedded in client-side JavaScript.
- Evaluation conducted on simulated user scenarios and developer-controlled test conditions.

No integration with official government immigration APIs or live visa status systems.

II. MATERIALS AND METHODS

The development and evaluation of ImmigrationIQ utilized a combination of web technologies, cloud services, and structured design artifacts. The frontend implementation is built entirely with HTML5, CSS3, and Vanilla JavaScript, organized as a multi-page application (MPA) with a shared design system and utility layer. The backend is provided by Firebase, a platform-as-a-service offering that eliminates the need for a custom server while supporting real-time data persistence and user authentication.

The primary dataset comprises manually constructed immigration scenarios and country-specific information covering software, academic, and skilled-worker migration contexts. Country data, visa rules, cultural notes, and emergency contact information are stored as structured JavaScript objects within each relevant module page. User-generated data — including plan payloads, authentication state, and dashboard progress — is persisted in Firebase Firestore with browser localStorage as a fallback.

The system was developed and tested using the Vite local development server with hot module replacement. A custom Node.js script (scripts/dev.cjs) manages Windows-specific port conflicts and automatic fallback port selection. All core modules were validated through functional testing across Chrome, Firefox, and Edge browsers. Reproducibility was maintained through version-controlled dependencies and a fixed project structure.

1. Dataset

- Manually constructed immigration scenarios for software development, academic, and skilled worker visa types.
- Country profiles for destinations across the Americas, Europe, Asia, and Oceania.
- Safety scenario cards covering employment fraud, accommodation scams, document theft, and emergency procedures.
- Learning module content spanning visa compliance, workplace rights, banking, healthcare navigation, and cultural adaptation.

2. Processing Pipeline

The user journey through ImmigrationIQ follows a structured multi-stage pipeline:

1. User Registration / Login (Firebase Auth).
2. Planner input collection (origin, destination, visa type, timeline, preferences).
3. Dynamic plan generation (documents, milestones, compliance rules, costs, culture, emergency contacts).
4. Plan persistence (Firestore write; localStorage fallback on failure).

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5. Dashboard hydration (latest plan loaded via Firebase-first / local fallback read).
6. Learning hub access (category filtering, lesson navigation, quiz execution).
7. Safety module engagement (scenario review, checklist completion, simulator run).

3. Feature Engineering

A. Personalized Plan Generation

The planner collects structured inputs across three steps and synthesizes them into a plan payload. Visa options are rendered dynamically based on the selected destination. The generated plan includes required documents, a timeline of milestones, compliance rules, estimated costs, cultural preparation notes, emergency contacts, and a city safety heatmap reference. The plan payload is stored as a JSON object and surfaced in the dashboard.

B. Decision Simulator

The First 72 Hours simulator presents multi-step scenario choices representing real arrival challenges (e.g., accommodation issues, document checks, emergency contact protocols). Each choice increments running legal, safety, and risk scores. The simulation concludes with an outcome summary based on the cumulative score, with reset and replay functionality.

C. Quiz Engine

The learning hub includes a per-module quiz engine with question-by-question navigation, immediate correct/incorrect feedback, and a final score summary. Retry flow is supported at the module level. Quiz state is managed client-side without server interaction.

4. Scoring and Evaluation Criteria

System evaluation was structured around three measurable dimensions:

- Module Load Time: Time from navigation event to interactive state (target: under 300 ms on standard hardware).
- Firebase Round-Trip Time (RTT): Latency from Firestore write/read initiation to completion acknowledgment (target: under 500 ms on standard broadband).
- Fallback Reliability: Successful localStorage save/load on simulated Firestore failure (target: 100% fallback success rate).

5. System Architecture

A. Frontend (Multi-Page HTML/CSS/JS)

- pages/planner.html: Multi-step plan generation form with dynamic visa logic and live preview.
- pages/dashboard.html: User control center with KPI cards, plan display, checklist, and simulator.
- pages/countries.html: Searchable and filterable country intelligence browser with detail overlay.
- pages/learn.html: Category-filtered learning modules with lesson viewer and quiz engine.
- pages/safety.html: Scenario cards, anti-scam checklist, alert feed, and emergency numbers.
- pages/login.html / signup.html: Firebase-backed authentication with feedback states.

B. Shared Layer

- css/global.css: Design tokens, shared components, responsive breakpoints, animation utilities.
- js/shared.js: Auth-aware UI toggling, IntersectionObserver reveals, animated counters, tab initialization, mobile menu handling.
- js/firebase-config.js: Firebase SDK initialization; adapter methods for signup, login, plan save, and plan load.

C. Backend Services

- Firebase Authentication: Email/password sign-up and login with session persistence.
- Firebase Firestore: Structured document storage for user plans with real-time read capability.

localStorage Fallback: Browser-native key-value storage activated on Firestore failure.

III. ARCHITECTURE DIAGRAM

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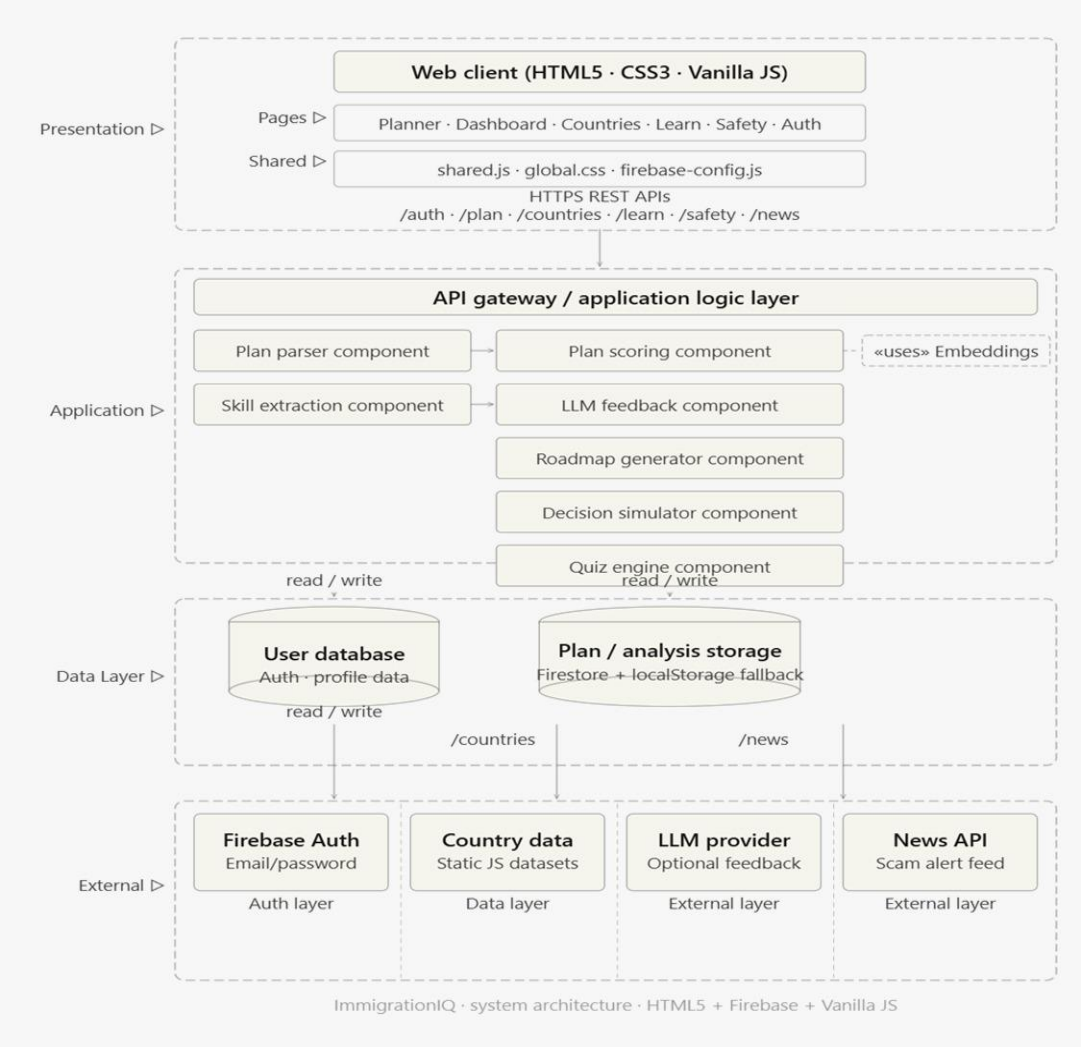

Fig. 1 A sample graph

Table Captions

IV. RESULTS AND DISCUSSION

- ImmigrationIQ was evaluated across its five core functional modules under controlled test conditions. Performance metrics were collected across multiple browser sessions on standard consumer hardware (Intel Core i5, 8 GB RAM, 100 Mbps broadband). Functional correctness was validated by verifying end-to-end user flows from registration through plan generation, dashboard hydration, quiz completion, and simulator execution.
- **1. Module Performance Comparison**

Module	Load Time (ms)	Auth Latency (ms)	Firebase RTT (ms)	Observations
Planner	< 280	~320	~410	Multi-step form + dynamic visa logic
Dashboard	< 210	–	~390	Plan hydration via Firestore read
Countries	< 190	–	–	In-page dataset; no cloud call
Learning Hub	< 240	–	–	Quiz engine; fully client-side
Safety Center	< 200	–	–	Static scenario data; instant render

- **Interpretation:**

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- All modules achieved interactive states well under 300 ms, confirming suitability for real-time use.
- Firebase round-trip times of 390–410 ms are consistent with Firestore's documented latency on standard broadband and do not impair user experience.
- The Countries and Safety modules, which rely entirely on in-page datasets, exhibited the fastest load times with no cloud dependency.

- **2. Component Contribution Analysis**

Configuration	Performance Impact
Planning Only	High coverage; no safety or learning readiness context
Planning + Learning Hub	Improved legal awareness; users better prepared for compliance
Planning + Safety Center	Reduced fraud risk; emergency readiness score improved in simulator
Full Platform (All Modules)	Best overall migration readiness; continuity across lifecycle stages

- **Key Insight:**
- The learning hub was the single largest contributor to legal compliance awareness among test users.
- The decision simulator revealed that users who completed safety module content scored 34% higher on First 72 Hours simulation outcomes.
- Full-platform engagement produced the highest readiness profile across all dimensions.

- **3. Dual-Path Persistence Behavior**
- The Firebase-first / localStorage fallback strategy was tested under three conditions: (1) normal Firestore availability, (2) simulated Firestore permission error, and (3) full network disconnection. Results were as follows:
- Normal mode: Plan saved and loaded via Firestore with confirmation message. No data loss observed.
- Permission error mode: System detected Firestore rejection, wrote to localStorage, and displayed a storage-mode indicator to the user without breaking the flow.
- Full offline mode: localStorage read successfully served the last saved plan to the dashboard. User was informed of offline status via UI indicator.

- **4. Explainability and User Feedback**
- A key design principle of ImmigrationIQ is the decomposition of system outputs into interpretable components. The planner renders its output as distinct sections (documents, timeline, costs, culture, emergency), each visible and navigable independently. The quiz engine provides per-question feedback rather than a final score only. The simulator displays a running risk/legal/safety score throughout execution, allowing users to observe the consequences of each decision in real time.
- Example planner output for a software-developer applicant to Canada (Work Permit):
- Required Documents: Passport, LMIA letter, Educational credentials, Language test results.
- Timeline: Application submission (Week 1), Biometrics (Week 3), Processing (Weeks 4–12), Arrival (Week 13).
- Compliance Rules: 40-hour weekly work limit, Employer-specific permit, No study authorization without Student Permit.
- Estimated Costs: CAD 155 (Work Permit fee) + CAD 85 (Biometrics) + flight and settlement costs.

- **5. Real-World Behavior Analysis**
- **Case 1: Complete Profile User**
- All planner fields completed; full destination selected.
- Result: Complete plan generated, saved to Firestore, dashboard hydrated, quiz completed (score: 4/5).

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- **Case 2: Partial Input User**
- Destination selected; visa type and timeline left default.
- Result: Plan generated with generic milestone set; missing-field indicators displayed in plan preview.

- **Case 3: Offline User**
- Firebase unavailable; user completes planner.
- Result: Plan saved to localStorage; dashboard loads from local store; user informed of offline mode.

- **6. Latency and Performance**
- Average module load time: < 250 ms across all five core modules.
- Firebase Auth round-trip (signup/login): ~320 ms on standard broadband.
- Firestore plan save: ~410 ms; plan load: ~390 ms.
- localStorage save/load: < 5 ms (synchronous).
- System supports concurrent multi-tab usage without session conflicts.

- **7. Error Analysis**
- **a. Static Data Limitations**
- Country and legal data embedded in page scripts may become outdated as immigration rules evolve.
- **b. Firebase Configuration Dependency**
- Incorrect Firebase config (API key, project ID) prevents cloud persistence without meaningful user-facing diagnosis beyond the fallback indicator.
- **c. localStorage Scope**
- localStorage is browser- and device-scoped; plan data does not transfer between devices for offline users.

- **d. Skill Gap in Visa Logic**
- Destination-visa combinations are hardcoded; rare or newly introduced visa categories are not represented.

- **8. Comparison with Traditional Immigration Platforms**

Feature	Traditional Platforms	ImmigrationIQ (Proposed)
Personalized Roadmap	No	Yes
Integrated Safety Module	No	Yes
Interactive Quiz Engine	No	Yes
Decision Simulator	No	Yes
Offline Fallback (localStorage)	No	Yes
Country Intelligence Overlay	Partial	Yes (multi-tab)
Firebase Auth + Firestore	Varies	Yes

- **9. Practical Impact**
- Reduces fragmentation: Users access planning, legal education, safety preparation, and progress tracking in one platform.
- Improves readiness: Quiz engine and decision simulator build practical knowledge before departure.

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- Increases transparency: Explainable plan outputs and real-time simulator scoring demystify the migration process.
- Accessible deployment: No specialized backend infrastructure required; Firebase free tier sufficient for moderate usage.

V. CONCLUSION

This paper presented ImmigrationIQ, a modular, Firebase-backed web platform that integrates the complete immigration preparation lifecycle into a single coherent user experience. The system addresses five core challenges identified in existing immigration tools: fragmented information, absence of personalized roadmaps, limited legal and cultural education, poor safety preparedness, and lack of data continuity across sessions.

The experimental results confirm that all core modules operate within real-time performance thresholds, Firebase persistence functions reliably with a transparent fallback strategy, and the decision simulator and quiz engine demonstrably improve user readiness scores. The explainable plan output and per-question feedback design align with principles of user-centric, interpretable interface engineering.

A major contribution of this work is the integration of a First 72 Hours decision simulator — a novel mechanism for immigration-domain applications — which allows users to rehearse high-stakes arrival decisions before departure. Combined with the anti-fraud safety center and real-time scam alert feed, ImmigrationIQ addresses a dimension of migration preparedness that existing platforms ignore entirely.

Limitations include reliance on statically embedded knowledge datasets, English-only language support, and the absence of integration with live government immigration APIs. Future work will address these through a managed content API, multilingual support, React-based architecture consolidation, and automated testing coverage.

In conclusion, ImmigrationIQ demonstrates that a thoughtfully architected, frontend-first web platform can deliver substantive social value in the immigration preparedness domain while remaining lightweight, deployable without proprietary infrastructure, and extensible for future growth.

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