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**1. Introduction**

**1.1 Abstract**

In the current digital era, consumers are faced with a rapidly growing and complex smart device market, where frequent product releases, shifting prices, and evolving user needs make the decision-making process increasingly challenging. Existing platforms typically provide static comparisons and lack true personalization or transparency, resulting in limited support for users seeking tailored advice.

To overcome these gaps, there is a need for an AI-driven, cloud-native SaaS platform capable of delivering real-time, explainable, and user-centric recommendations for smartphones. By harnessing advanced machine learning, live market intelligence, and interactive user engagement, such a solution can empower individuals to make smarter, faster, and more confident purchase decisions in a dynamic technology landscape.

**1.2 Purpose**

The purpose of the **Cloud-AI Native Smartphone Intelligence Software (CANSIS)** is to deliver an AI-powered, cloud-native platform focused on recommending, comparing, and predicting the most suitable smartphones for each user.

This system is designed to:

* **Empower end-users** to make informed, confident purchase decisions through personalized AI-driven recommendations, feature comparisons, and future spec predictions.
* **Enable administrators and developers** to efficiently manage device data, train and deploy AI/ML models, and oversee cloud infrastructure in a scalable, modular manner.

**1.3 Scope**

The **CANSIS** will be delivered as a cloud-native SaaS platform, designed for rapid deployment, seamless scaling (including optional Kubernetes and edge support), and robust user engagement.

**Key features and modules include:**

1. **AI Persona Matching:**
   * Generates highly personalized smartphone recommendations based on user preferences, needs, and behavioral patterns using advanced clustering and NLP techniques.
2. **Price & Market Intelligence:**
   * Tracks live prices and stock status across online marketplaces and provides real-time updates to users.
3. **Explainable AI (XAI):**
   * Delivers transparent, human-readable justifications for each recommendation, leveraging SHAP/LIME and LLMs for explainability.
4. **Spec-to-Spec Comparison & Forecasting:**
   * Offers detailed device comparisons, performance benchmarking, and visual forecasting timelines for upcoming smartphones.
5. **Gamified User Interaction & Community Features:**
   * Engages users through community-based matchmaking, quizzes, polls, rewards, and multilingual voice queries to enhance retention and satisfaction.

**Benefits:**

* Empowers users with actionable, real-time data for confident smart device purchasing.
* Supports scalable, cloud-native architecture for efficient handling of dynamic market data and AI workloads.

**Limitations:**

* CANSIS does **not** facilitate direct product sales or transactions.

**1.4 Overview**

The remainder of this Software Requirements Specification (SRS) document for **CANSIS** is organized as follows:

* **Section 2:** Presents the overall description of the system, including product perspective, main functions, operating environment, and user characteristics.
* **Section 3:** Discusses drawbacks of existing solutions and justifies the need for the proposed CANSIS platform.
* **Section 4:** Illustrates the high-level cloud-native system architecture, including modular decomposition and data flow between major components.
* **Section 5:** Specifies the functional, non-functional, and external interface requirements necessary for implementation.
* **Section 6:** Details the core system features, including the AI/ML intelligence engine, live market intelligence module, and gamified user engagement layer.
* **Section 7 (Appendices):** Provides supporting materials such as a glossary, list of abbreviations, and references to relevant research papers.

**2. Overall Description**

**2.1 Project Perspective**

The **CANSIS** is a **standalone SaaS platform** designed to run on a **cloud-native microservices architecture**.

**Key architectural characteristics:**

* **Cloud-Native Deployment** – Uses Docker containers, Kubernetes (K8s), and horizontal scaling for high availability.
* **Modular Microservices** – Independent services for AI recommendations, price tracking, user management, and analytics.
* **Data-Driven Engine** – Fetches real-time data from multiple sources (GSMArena, Amazon, Flipkart) and processes it for recommendations and forecasts.
* **Integration-Ready** – Provides APIs for external applications and marketplaces to use recommendation data.

**2.2 Project Functions**

The major functions of the system are:

1. **AI Persona Matching & Device Recommendations**
   * Creates dynamic user personas from preferences and browsing history.
   * Recommends smartphones matching user profiles.
2. **Price & Market Intelligence**
   * Tracks real-time market data.
   * Predicts upcoming device specs using **ML regression models**.
3. **Explainable AI (XAI) Insights**
   * Provides **human-readable justifications** for each recommendation.
4. **Spec-to-Spec Comparison & Forecasting**
   * Allows users to **compare devices side by side** visually.
   * Predicts **upcoming specifications** of unreleased devices using **time-series analysis**.
5. **User Interaction & Gamification Layer**
   * Offers **badges and points** for engagement (optional gamified experience).

**2.3 User Classes and Characteristics**

|  |  |  |
| --- | --- | --- |
| User Class | Characteristics | Privileges |
| End Users | General customers looking for smart device recommendations | View recommendations, compare devices, receive alerts |
| Admin/Developer | Technical team managing AI models, cloud services, and database updates | Manage microservices, monitor performance, update dataset |
| Data Providers | Third-party APIs (GSMArena, Amazon, Flipkart) | Provide real-time market and spec data |

**3. Existing System Drawbacks & Proposed Improvements**

**3.1 Overview of Existing/Traditional Systems**

Existing smart device recommendation and marketplace monitoring platforms are typically fragmented and limited in scope. Most current solutions are restricted to static comparison websites or basic price tracking tools, offering little to no AI-driven personalization or transparency in how recommendations are made. These systems often lack real-time data integration, explainable decision-making, and advanced user engagement features, resulting in a less effective and user-friendly experience.

**3.2 Identified Drawbacks in Existing Systems**

|  |  |
| --- | --- |
| Drawback / Limitation | Impact on Users or Marketplaces |
| Static Recommendation Engines | Users receive **generic suggestions**, not personalized. |
| No Explainable AI (XAI) | Users **cannot understand why a phone is recommended**. |
| Limited Real-Time Data Processing | Device information and reviews **become outdated quickly**. |
| No Persona or Community-Based Matching | Users **cannot see community trends** or “people like you” insights. |
| No Gamification or Engagement Mechanisms | Low **user retention and repeat visits**. |

**3.3 Justification for Proposed System**

|  |  |
| --- | --- |
| Existing Drawback | Our Proposed Solution |
| Static Recommendations | **AI Persona Engine + Collaborative Filtering** for personalized suggestions. |
| No Explainable AI | **XAI** to justify “Why this phone?” recommendations. |
| Outdated Information | **Real-time web scraping + Firebase/MongoDB** updates. |
| No Persona or Community Matching | **Community AI Matchmaking** with “Users like you bought X”. |
| Poor Scalability | **Cloud-Native Microservices** with optional **Kubernetes HPA**. |
| No Gamification or Engagement | **Leaderboards, Polls, Badges** to increase retention and community activity. |

**4. High-Level Architecture & System Design**

**4.1 System Overview**

The **CANSIS** platform is organized into three primary modules, each designed for modular development and optional scaling via cloud-native microservices:

**Module 1 – Data & Marketplace Intelligence**

* Scrapes device specifications from multiple sources (e.g., GSMArena, Flipkart, Amazon).
* Stores and maintains historical data in Firebase or MongoDB.
* Sentiment Analysis on User Reviews.

**Module 2 – AI & ML Intelligence**

* Consumes cleaned marketplace and device data from Module 1.
* Generates:
  + AI persona-based device recommendations
  + Device performance predictions (AI Lab)
  + Device comparisons
  + Forecasts of upcoming device specifications
  + Explainable AI insights for transparency
* Returns predictions and insights to Module 3 for user-facing visualization.

**Module 3 – User Interaction & Cloud Deployment**

* Provides the main web interface and optional mobile interface.
* Displays AI-driven recommendations and gamification features for user engagement.
* Handles voice-based queries and user account management.
* Supports flexible cloud deployment via platforms such as Render, Railway, or optional Docker/Kubernetes microservices for enterprise scalability.

**4.2 System Architecture Diagram**

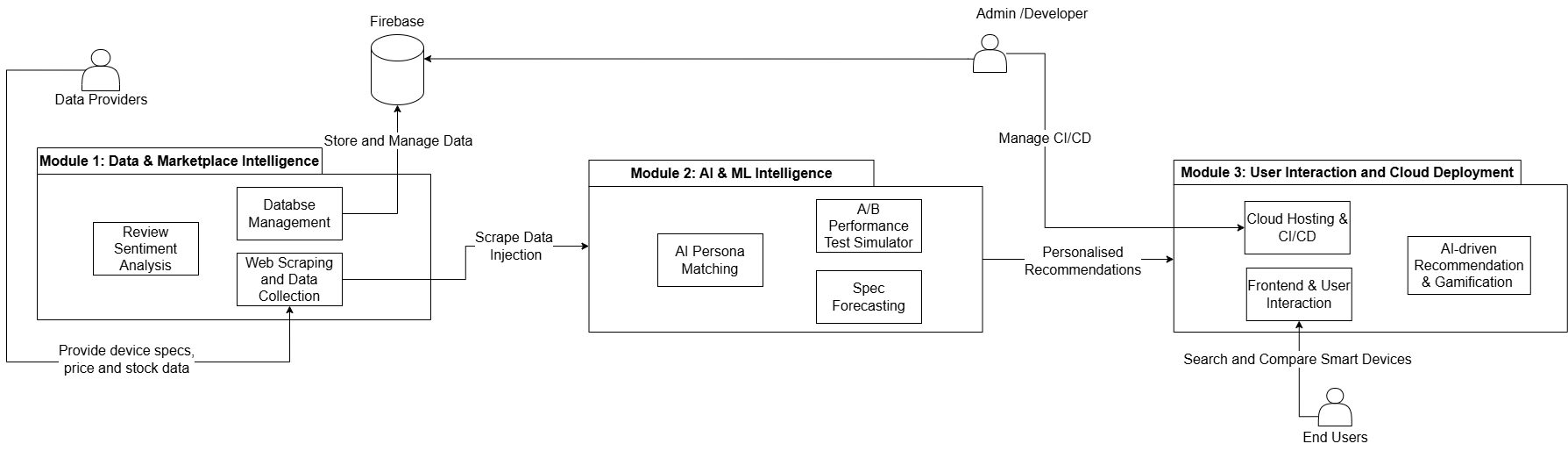


Fig. 4.1 High-Level Architecture Diagram

**5. Specific Requirements**

**5.1 Functional Requirements (FRs)**

The system shall provide the following key functionalities:

|  |  |
| --- | --- |
| FR ID | Functional Requirement |
| FR-1 | The system shall scrape real-time device specifications from multiple online sources (e.g., GSMArena, Flipkart, Amazon). |
| FR-2 | The system shall store cleaned, structured data in a cloud database (Firebase or MongoDB Atlas) for efficient real-time access and processing. |
| FR-3 | The system shall ensure all data scraping and updates occur automatically through scheduled tasks (cron jobs or cloud schedulers). |
| FR-4 | The system shall generate personalized smartphone recommendations based on user personas using AI/ML clustering techniques. |
| FR-5 | The system shall predict device performance using machine learning models (e.g., XGBoost, regression) within an AI Lab feature. |
| FR-6 | The system shall forecast future device specifications using time-series models and large language models (LLMs). |
| FR-7 | The system shall provide explainable AI (XAI) insights to offer transparent reasoning behind recommendations. |
| FR-8 | The system shall offer a web-based user interface for device comparison, timeline visualization, and interactive gamification features. |
| FR-9 | The system shall display leaderboards, polls, badges, and similar engagement mechanisms to enhance user participation. |
| FR-10 | The system shall support scalable backend hosting on platforms such as Render or Railway, with optional deployment as microservices via Kubernetes. |

**5.2 Non-Functional Requirements (NFRs)**

|  |  |
| --- | --- |
| Category | Non-Functional Requirement |
| Performance | The system shall process and update device data **within 10 minutes of scraping**. |
| Scalability | The system shall support **auto-scaling using Kubernetes HPA** to handle traffic spikes. |
| Availability | The system shall ensure **99% uptime** using cloud-native hosting with monitoring. |
| Security | All data transfers shall use **HTTPS & Firebase Auth** with **Google reCAPTCHA**. |
| Usability | The system shall provide a **responsive, mobile-friendly web interface**. |
| Maintainability | The system shall use **modular microservices** to allow easy updates and maintenance. |
| Portability | The backend shall run on **Docker containers** to allow **cloud and local deployment**. |

**5.3 System Interfaces**

**5.3.1 User Interfaces**

* **Web Dashboard:**
  + Displays device comparison, gamification leaderboards, and AI persona recommendations.
  + Provides **voice query** functionality for hands-free search.

**5.3.2 Hardware Interfaces**

* **End-User Devices:**
  + Minimum: Dual-core CPU, 4GB RAM, modern browser
* **Server Environment:**
  + Cloud-hosted Docker containers (1 vCPU, 1–2GB RAM per service)
  + Optional Kubernetes pods for scaling

**5.3.3 Software Interfaces**

* **Databases:** Firebase / MongoDB Atlas
* **APIs:**
  + Hugging Face Sentiment Analysis API
  + Whisper / Google Speech-to-Text (optional)
* **Scrapers:** GSMArena, Flipkart, Amazon

**5.3.4 Communications Interfaces**

* **HTTPS** for all communications
* **WebSockets / Socket.IO** for real-time dashboard updates
* **RESTful APIs** for module interactions

**6. Appendices**

This section contains supporting information that is **not essential to understanding the requirements**, but **provides reference material** useful for developers, researchers, and stakeholders.

**6.1 Glossary**

|  |  |
| --- | --- |
| Term | Definition |
| AI Persona Matching | A system that clusters users based on preferences and behaviors to recommend the best devices. |
| XAI (Explainable AI) | AI techniques like SHAP and LIME that provide human-understandable explanations for recommendations. |
| Cloud-Native | Applications designed to leverage cloud computing for scalability, resilience, and ease of deployment. |
| Microservices | Architectural style where the system is divided into small, independent services that communicate via APIs. |
| SLA (Service Level Agreement) | A performance guarantee in cloud services defining response times and availability. |
| Kubernetes (K8s) | Container orchestration platform for managing microservices and scaling cloud applications. |
| Prometheus/Grafana | Open-source tools for real-time monitoring and visualization of system metrics. |
| Gamification | Adding interactive elements like points, badges, and leaderboards to improve user engagement. |

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