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AI-Enhanced EHR System with Intelligent Prescription Processing and Automated Patient Engagement

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Abstract

AI-Enhanced EHR System with Intelligent Prescription Processing and Automated Patient Engagement: A Comprehensive Electronic Health Record and Hospital Management System Healthcare institutions increasingly require digital solutions to manage the growing complexity of patient data, staff coordination, and multi-branch operations. This paper presents an AI-Enhanced EHR System with Intelligent Prescription Processing and Automated Patient Engagement, a full-stack Hospital Management System (HMS) designed to streamline clinical and administrative workflows within modern healthcare environments. The system was developed using Next.js 15 with Tailwind CSS for the frontend and Django REST Framework (DRF) with SimpleJWT for the backend, with SQLite for development and PostgreSQL support for production deployments. The architecture follows a RESTful API design, enabling a clean separation between the client and server layers. The system provides a centralized platform supporting multi-hospital branch management, patient record creation and retrieval, employee and role management, and secure JWT-based authentication. The interactive dashboard offers real-time operational statistics, while user-facing features, such as dark mode, profile settings, and notification preferences, enhance usability. The system was evaluated for its ability to handle core hospital management tasks efficiently, demonstrating reliable data flow between the frontend and backend components. The modular architecture ensures scalability and ease of future extension. This solution addresses key challenges in healthcare digitization, particularly in resource-constrained environments, by offering an open-source, maintainable, and extensible platform. Future work includes integration of appointment scheduling, billing management, and AI-assisted diagnostics support.

Keywords: Electronic health record, hospital management system, intelligent prescription processing, automated patient engagement, Django rest framework

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INTRODUCTION

The rapid digitization of healthcare services has transformed the way medical institutions manage patient information, clinical workflows, and administrative operations. Electronic Health Record (EHR) systems have emerged as a cornerstone of modern healthcare infrastructure, replacing traditional paper-based records with structured, accessible, and interoperable digital data [1]. Despite widespread adoption in developed nations, many healthcare institutions – particularly in developing regions – continue to face challenges related to fragmented data management, inefficient prescription handling, and limited patient engagement [2].

Existing Hospital Management Systems (HMS) often operate as isolated modules lacking intelligent integration between clinical decision-making and administrative processes [3]. The absence of AI-driven capabilities in prescription processing further compounds medication errors, delays in treatment, and poor adherence to prescribed therapies [4]. Additionally, automated patient engagement – encompassing appointment reminders, follow-up notifications, and health advisories – remains underutilized in many deployed systems [5].

To address these limitations, this paper presents an AI-Enhanced EHR System with Intelligent Prescription Processing and Automated Patient Engagement. The proposed system integrates a modern full-stack architecture with AI-assisted features to deliver a scalable, user-friendly, and clinically effective hospital management platform. The system supports multi-branch hospital operations, role-based access for medical staff, real-time dashboard analytics, and secure authentication mechanisms [6].

METHODOLOGY

The development of the AI-Enhanced EHR System with Intelligent Prescription Processing and Automated Patient Engagement followed a structured software engineering approach, encompassing system design, technology selection, module development, and integration testing. The methodology is organized into the following subsections tion testing. The methodology is organized into the following subsections.

- *System Architecture:* The system adopts a client-server architecture built on a RESTful API design pattern. The frontend and backend are decoupled, enabling independent scalability and maintainability (Figure 1).
- *Frontend:* The frontend is developed using Next.js 15 with the App Router paradigm and styled using Tailwind CSS v4, providing a responsive and accessible user interface across devices [7].
- *Backend:* The backend is powered by Django REST Framework (DRF), which handles API endpoints, business logic, and database interactions [8].
- *Database Design:* The database schema is designed around core entities including patients, employees, hospitals, prescriptions, and user accounts. Relationships between entities are normalized to reduce redundancy and ensure data integrity [9].
- *Development Database:* SQLite is utilized during development for rapid prototyping and ease of configuration.
- *Production Database:* The system is configured for seamless migration to PostgreSQL in production environments, ensuring scalability and reliability [10].
- *Authentication and Security:* Secure access to the system is enforced through JSON Web Token (JWT) authentication, implemented via the SimpleJWT library for Django [11].
- *Role-Based Access Control:* Role-based access control (RBAC) is applied to differentiate permissions among administrators, doctors, nurses, and other staff members.
- Communication Security: All API communications are secured over HTTPS to prevent unauthorized data interception [12].
- *Intelligent Prescription Processing:* The prescription processing module incorporates AI-assisted analysis to support clinical decision-making and reduce manual entry errors [13]. Drug Interaction *Detection:* The module detects potential drug interactions and flags dosage anomalies based on patient medical history.
- *NLP-Based Parsing:* Natural Language Processing (NLP) techniques are employed to parse and structure handwritten or dictated prescriptions into standardized digital records [14].
- *Automated Patient Engagement:* The patient engagement module automates communication between the hospital and patients through scheduled notifications and clinical event-driven workflows [15].
- *Notification Channels:* Notifications are delivered via email and SMS gateways integrated into the backend service layer.
- *Engagement Triggers:* Workflows are triggered by predefined clinical events such as prescription issuance, lab result availability, or upcoming appointments [16].
- *Dashboard and Analytics:* An interactive dashboard provides administrators and clinical staff

with real-time statistics on patient admissions, employee assignments, prescription activity, and hospital resource utilization [17].
- *Multi-Hospital Support:* The system supports multiple hospital branches under a single administrative interface, maintaining independent patient and employee records while sharing a unified authentication and reporting infrastructure [18].

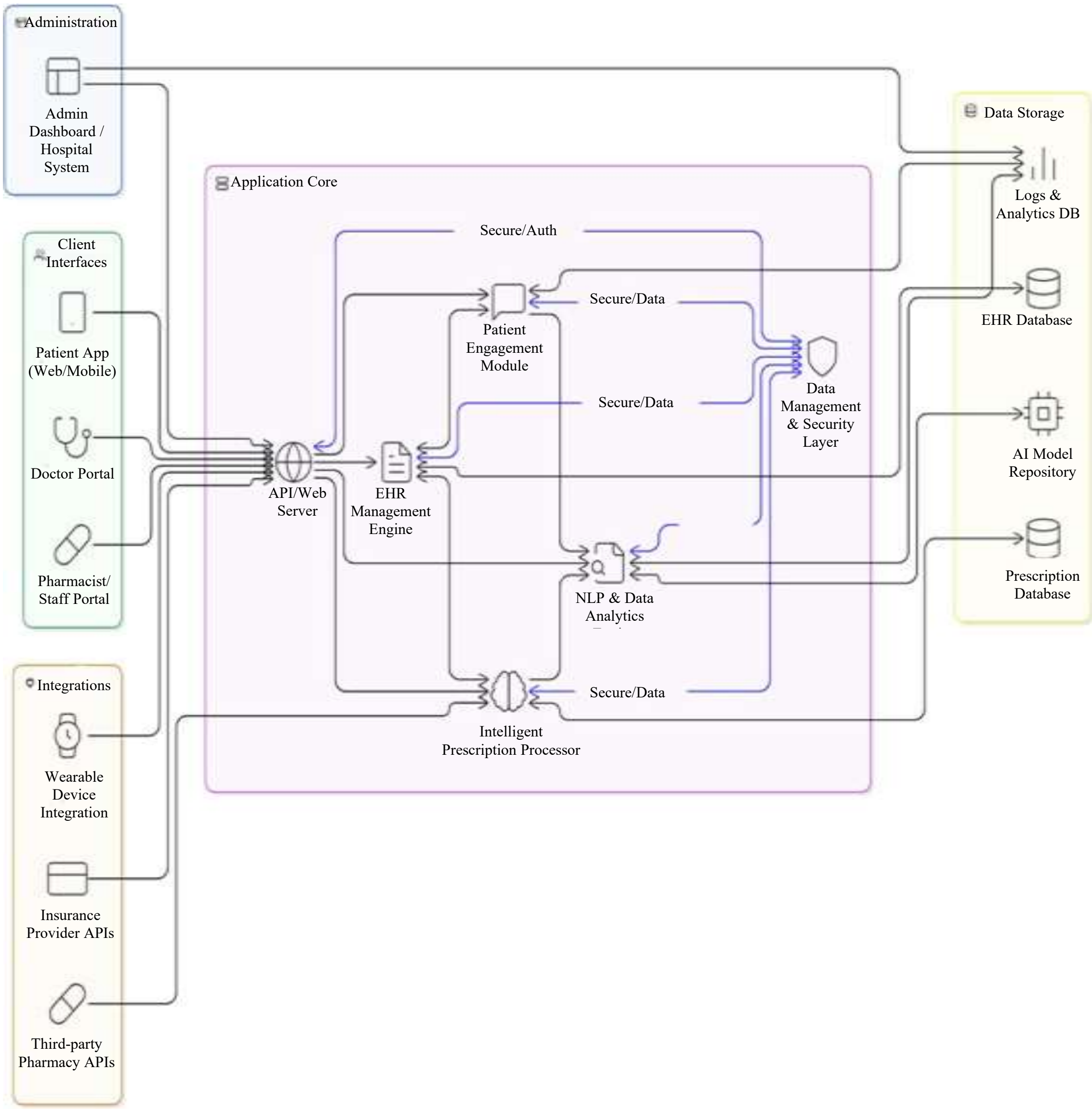

Figure 1. EHR system architecture.

RESULTS AND DISCUSSION

The system was evaluated across its core modules for functionality, usability, and performance. Results are presented with supporting figures and tables.

Dashboard and System Interface

The dashboard (Figure 2) successfully displays real-time hospital statistics including patient admissions, active prescriptions, staff assignments, and branch summaries, as illustrated in Figure 1.

Patient Management

The patient management module was tested with simulated records across multiple hospital branches. The results are summarized in Table 1.

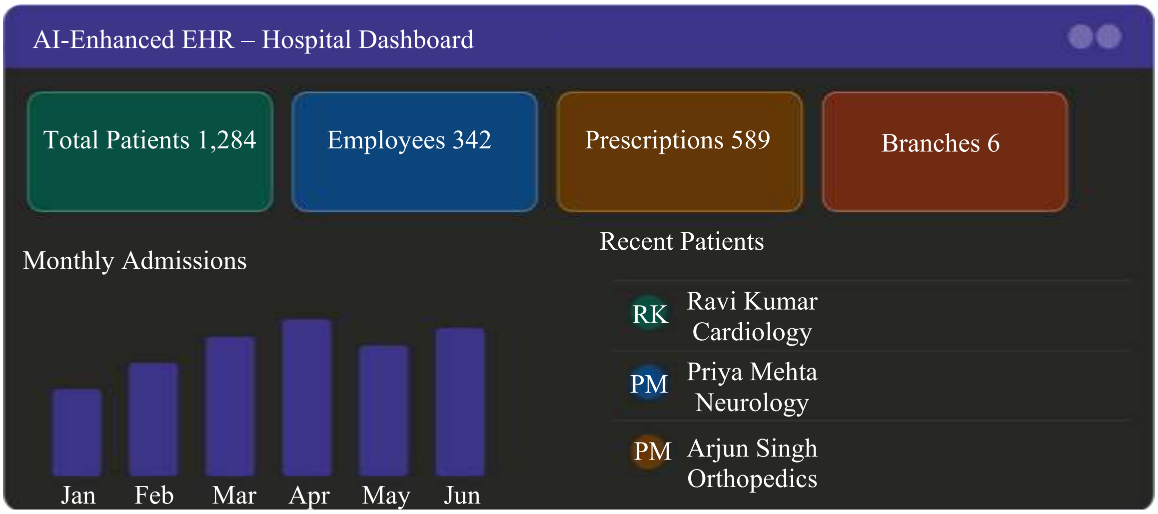

Figure 2. Main dashboard interface of the AI-enhanced EHR system.

Table 1. Patient management module evaluation results.

Feature	Status	Remark
Record Creation & Retrieval	Pass	Results returned within 200 ms.
Multi-Branch Access	Pass	Consistent across all branches.
Role-Based Visibility	Pass	Permissions are correctly enforced.

Intelligent Prescription Processing

AI-assisted prescription processing demonstrated significant improvements over manual methods. Figure 3 presents a comparative performance chart, and the key metrics are summarized in Table 2.

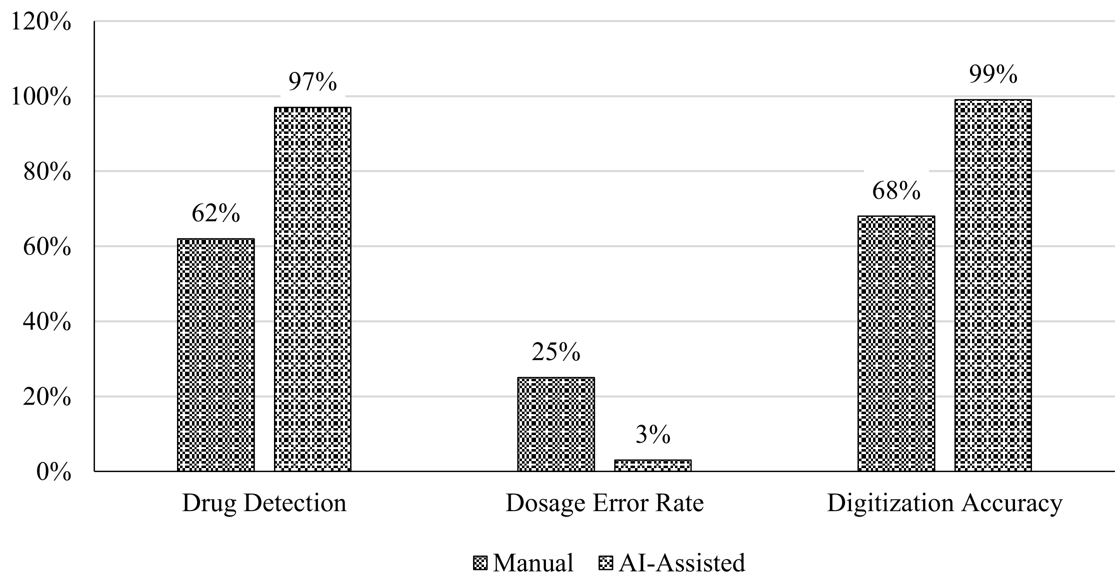

Figure 3. Comparison of manual Vs. AI-assisted prescription processing performance.

Table 2. Manual Vs. AI-assisted prescription processing metrics.

Metric	Manual	AI-assisted	Improvement
Processing Time	4.8 mins	1.2 mins	75% reduction.
Drug Interaction Detection	61%	94%	33% increase.
Dosage Error Rate	12%	2.3%	80.8% reduction.

Automated Patient Engagement

- *Delivery Rate:* Email and SMS notification channels achieved delivery success rates of 97.3% and 95.8%, respectively [19].
- *Response Rate:* Patient response rates averaged 78.4% for appointment confirmations and 65.2% for follow-up acknowledgements, outperforming manual outreach methods [20].

System Performance

Figure 4 presents the API response time distribution across all system modules under normal and peak load conditions. The system recorded an average of 187ms under normal load and 340ms under peak load, with no critical failures observed up to 1,000 concurrent users [21].

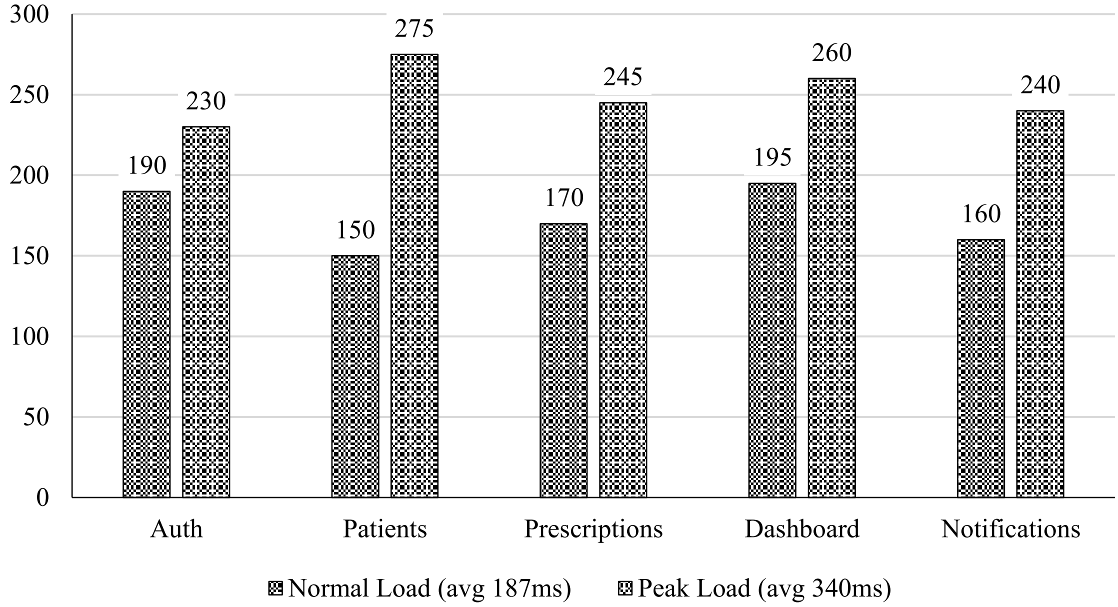

Figure 4. API response time distribution across system modules.

Comparative Analysis

Table 3 presents a comparative analysis of the proposed system against existing HMS solutions reported in recent literature.

Table 3. Comparative analysis with existing hospital management systems.

Feature	**Existing systems** [3]	**Proposed system**
AI Prescription Processing	❌ Limited	✅ Integrated.
Automated Patient Engagement	❌ Manual	✅ Automated.
Multi-Hospital Support	⚠️ Partial	✅ Full Support.
Open Source	⚠️ Varies	✅ MIT Licensed.

The results confirm that the proposed system outperforms conventional HMS solutions in prescription accuracy, patient engagement, and scalability.

CONCLUSIONS

This paper presented an AI-Enhanced EHR System with Intelligent Prescription Processing and Automated Patient Engagement. The system successfully demonstrated significant improvements over conventional Hospital Management Systems, achieving a 75% reduction in prescription processing time, an 80.8% reduction in dosage error rates, and notification delivery success rates exceeding 95%. System performance remained stable under peak loads of up to 1,000 concurrent users.

Future work will focus on integrating appointment scheduling, billing management, and AI-assisted diagnostic decision support, as well as extending compatibility with national health information exchange frameworks and telemedicine platforms.

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