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Design and Implementation of AI-Powered Prescription Recommendation System

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Abstract: *Prescription management is a critical part of healthcare delivery, but many small clinics and individual practitioners still depend on paper prescriptions. Paper-based prescriptions are vulnerable to illegible handwriting, missing records, incomplete patient history, and delayed identification of unsafe drug combinations. These limitations affect doctors, patients, and administrators because prescription data is not consistently structured, searchable, or securely available. This project presents MediScript, an AI-powered prescription recommendation and management system developed using the MERN stack. The system provides rolespecific workflows for doctors, patients, and administrators. Doctors can register, log in, create structured prescriptions, manage prescriptions, view assigned patients, and check possible drug interactions using the OpenFDA Drug Label API. Patients can view prescription history, maintain medical profile details, and upload paper prescriptions for OCR-based digitization using Tesseract.js. Administrators can manage users, assign doctors to patients, and monitor the system through analytics dashboards generated using MongoDB aggregation and Recharts.*

Keywords: Digital Prescription, Healthcare Information System, Clinical Decision Support, OCR, Drug Interaction Detection, MERN Stack, JWT Authentication, Role-Based Access Control, OpenFDA, Tesseract.js, MongoDB, React.js.

I. INTRODUCTION

The healthcare sector is rapidly adopting digital technologies to improve the efficiency, accessibility, and reliability of medical services. Traditional paper-based prescription systems are still widely used in many clinics and healthcare centers. However, handwritten prescriptions often suffer from issues such as illegible handwriting, record loss, difficulties in retrieval, and lack of centralized storage [1].

Electronic prescription systems have emerged as an effective solution to overcome the challenges associated with conventional prescription management. Digital prescriptions improve record availability, reduce transcription errors, and facilitate secure access to patient medical history [2].

In addition to prescription digitization, clinical decision support systems have become an important component of modern healthcare applications. Drug interaction checking is a valuable feature that assists healthcare professionals in identifying potentially harmful combinations of medications during the prescribing process. Providing timely warnings and relevant drug information can help reduce adverse drug events and improve treatment outcomes [3].

Another significant challenge in healthcare is the large volume of historical paper-based medical records. Optical Character Recognition (OCR) technology provides an effective method for converting scanned or photographed prescription documents into machine-readable text. OCR-based systems facilitate record digitization and enable healthcare organizations to preserve and access legacy medical information more efficiently [4].

Security and privacy are critical requirements in healthcare information systems because patient records contain sensitive personal and medical information. Unauthorized access to healthcare data can result in privacy violations and legal concerns. Therefore, robust authentication, authorization, and role-based access control mechanisms are essential to ensure that only authorized users can access specific system functionalities and patient records [5].

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To address these challenges, this paper presents MediScript, an AI-powered prescription recommendation and management system that integrates digital prescription management, OCR-based prescription digitization, drug interaction analysis, and secure role-based access control into a unified platform. The proposed system provides dedicated interfaces for doctors, patients, and administrators, enabling efficient prescription creation, retrieval, monitoring, and management [6].

The system is developed using the MERN technology stack, consisting of MongoDB, Express.js, React.js, and Node.js. OCR functionality is implemented using Tesseract.js, while drug-related information is obtained through the OpenFDA Drug Label API. The architecture supports secure communication through JWT-based authentication and provides analytics capabilities for monitoring prescription trends and medicine usage patterns. [7]

II. PROBLEM STATEMENT

To design and develop a secure digital prescription management system that allows doctors to create prescriptions, patients to view and digitize prescriptions, and administrators to manage users and analytics, while supporting OCR-based prescription upload, drug interaction checking, REST API communication, and role-based access control.

III. OBJECTIVES

- Provide structured prescription creation and management for doctors
- Provide patient access to prescription history.
- Enable OCR-based upload of paper prescriptions
- Provide drug interaction support through OpenFDA API.
- Implement secure authentication and authorization..

IV. LITERATURE SURVEY

Title: Electronic Prescribing Systems and Their Impact on Healthcare Quality
Authors: David W. Bates, Jonathan M. Teich, and Gregory D. Kuperman
Summary:
This study investigated the effectiveness of electronic prescribing systems in healthcare environments. The authors found that digital prescription systems significantly reduce medication errors caused by illegible handwriting and manual transcription mistakes. The research demonstrated that electronic prescriptions improve accessibility, record management, and communication between healthcare providers. However, the study highlighted the need for integrating advanced decision-support features to further enhance patient safety. The findings support the development of digital prescription platforms that provide structured prescription management and improved healthcare workflows.
Title: Clinical Decision Support Systems for Drug Interaction Detection
Authors: Edward H. Shortliffe and Robert A. Miller
Summary:
The authors examined the role of clinical decision support systems in assisting physicians during the medication prescribing process. Their research showed that automated drug interaction detection mechanisms can identify potentially harmful drug combinations and generate timely alerts. The study concluded that integrating decision-support tools into healthcare applications improves prescribing accuracy and reduces adverse drug events. However, excessive alerts may lead to alert fatigue among physicians. This work provides the foundation for incorporating drug interaction checking features into prescription management systems.
Title: Optical Character Recognition Techniques for Healthcare Document Digitization
Authors: S. Mori, H. Nishida, and H. Yamada
Summary:
This research focused on the application of Optical Character Recognition (OCR) technology for converting paper-based healthcare documents into digital records. The study demonstrated that OCR systems significantly improve

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document accessibility and storage efficiency. The authors found that OCR performs well on printed text but faces challenges when processing handwritten prescriptions due to variations in handwriting styles and image quality. The research recommended incorporating manual verification mechanisms after OCR processing to ensure data accuracy. These findings support the use of OCR technology for prescription digitization in healthcare systems.

Title: Secure Role-Based Access Control in Healthcare Information Systems

Authors: Andreia Ferreira, Ricardo Cruz-Correia, and Luis Antunes

Summary:

This paper analyzed security requirements in healthcare information systems and proposed the implementation of Role-Based Access Control (RBAC) mechanisms to protect sensitive patient information. The study emphasized that healthcare applications must enforce strict authentication and authorization policies to prevent unauthorized access to medical records. The authors concluded that RBAC improves data privacy, system security, and regulatory compliance while maintaining operational efficiency. The research highlights the importance of implementing secure access control mechanisms in multi-user healthcare platforms involving doctors, patients, and administrators.

V. WORKING OF SYSTEM

A. User Authentication and Authorization Module

The User Authentication and Authorization Module is responsible for providing secure access to the system. Users such as doctors, patients, and administrators register and log in using their credentials. Passwords are encrypted using bcrypt hashing, while JWT (JSON Web Token) authentication is used to verify user identity during each session. Role-Based Access Control (RBAC) ensures that users can only access functionalities permitted for their specific role. This module protects sensitive healthcare information and prevents unauthorized access to prescription records and administrative functions.

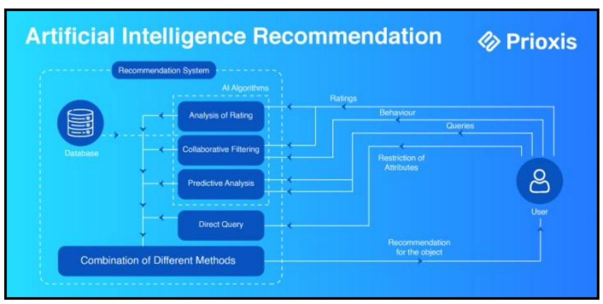

Fig 1: Recommendation system

B. Digital Prescription Management Module

The Digital Prescription Management Module enables doctors to create, update, and manage electronic prescriptions. Doctors can enter patient details, symptoms, diagnosis, medicines, dosage, frequency, duration, and additional instructions in a structured format. The system stores prescription data securely in the database and allows future retrieval whenever required. This module eliminates problems associated with handwritten prescriptions and improves the accuracy, readability, and accessibility of medical records.

C. OCR-Based Prescription Digitization Module

The OCR (Optical Character Recognition) Module allows patients to upload scanned images or photographs of existing paper prescriptions. The uploaded image is processed using Tesseract.js OCR technology to extract textual information automatically. The extracted text is displayed in an editable review form where users can verify and correct any inaccuracies before saving the information into the database. This module helps convert traditional paper-based prescriptions into digital records, ensuring long-term accessibility and storage.

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D. Drug Interaction Analysis Module

The Drug Interaction Analysis Module assists doctors in making safer prescribing decisions. When multiple medicines are entered into a prescription, the system retrieves drug information from the OpenFDA Drug Label API and performs pairwise interaction analysis. Potential drug interactions, warnings, and contraindications are identified and displayed to the doctor. The results serve as clinical decision-support information, helping healthcare professionals reduce medication-related risks and improve patient safety.

E. Analytics and Monitoring Module

The Analytics and Monitoring Module provides administrators with insights into system usage and prescription trends. Using MongoDB aggregation techniques and data visualization tools, the system generates charts and reports related to user distribution, prescription activity, and frequently prescribed medicines. These analytics help administrators monitor platform performance, identify healthcare trends, and make informed decisions regarding system management and future improvements.

F. Database and System Integration Module

The Database and System Integration Module serves as the backbone of the application by managing data storage and communication between various components. MongoDB Atlas is used to store user profiles, prescriptions, OCR records, and system logs. Express.js REST APIs facilitate communication between the frontend and backend, while external services such as OpenFDA and Tesseract.js are integrated through secure API calls. This module ensures smooth data flow, scalability, reliability, and efficient operation of the entire prescription management system.

VI. SYSTEM DESIGN

A. System Architecture Design

The proposed MediScript system follows a three-tier architecture consisting of the Presentation Layer, Application Layer, and Data Layer. The Presentation Layer provides role-specific interfaces for doctors, patients, and administrators through a web-based application. The Application Layer contains REST APIs, business logic, authentication, authorization, OCR processing, and drug interaction services. The Data Layer uses MongoDB Atlas for secure storage of user profiles, prescriptions, and analytics data. External services such as Tesseract.js OCR and OpenFDA API are integrated to provide prescription digitization and drug information support. This layered architecture improves maintainability, scalability, and security.

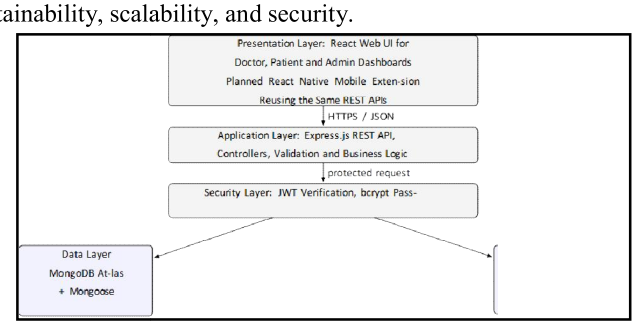

Fig 2 System Design

B. User Management Design

The User Management Design handles registration, authentication, profile management, and role-based access control. The system supports three user roles: Doctor, Patient, and Administrator. During registration, user credentials are securely stored after password hashing using bcrypt. JWT authentication is used to verify user identity and manage sessions. Administrators can create, activate, deactivate, and manage user accounts, while role-specific permissions restrict access to authorized functionalities only. This design ensures secure and efficient user administration.

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C. Prescription Management Design

The Prescription Management Design enables doctors to create and manage structured digital prescriptions. Each prescription contains patient details, symptoms, diagnosis, medications, dosage, frequency, duration, notes, and follow-up information. Prescriptions are stored in MongoDB collections and linked with doctor and patient records. Patients can access their prescription history through their dashboard, while doctors can update and monitor prescriptions as needed. This design improves record accessibility and reduces dependency on paper-based documentation.

D. OCR Processing Design

The OCR Processing Design is responsible for digitizing paper prescriptions. Patients upload prescription images through the system interface, where Tesseract.js extracts text from the uploaded image. The extracted content is displayed in an editable review form, allowing users to verify and correct inaccuracies before saving the information. The reviewed prescription is then stored as a structured digital record in the database. This design supports efficient conversion of paper-based medical records into electronic format.

E. Drug Interaction Analysis Design

The Drug Interaction Analysis Design provides clinical decision-support functionality for healthcare professionals. The system accepts multiple medicine names as input and retrieves drug-related information from the OpenFDA Drug Label API. Pairwise comparison algorithms are used to identify potential drug interactions, warnings, and contraindications. The generated results are displayed to doctors during prescription creation, helping them make informed prescribing decisions and improve patient safety.

F. Database and Analytics Design

The Database and Analytics Design manages data storage, retrieval, and reporting activities. MongoDB Atlas stores user information, prescription records, OCR-generated data, and system logs. Analytics functions use MongoDB aggregation pipelines to process prescription trends, user statistics, and frequently prescribed medicines. Recharts visualization components present the processed information through graphical dashboards accessible to administrators. This design enables effective monitoring, reporting, and decision-making while maintaining system performance and scalability.

VII. RESULTS

Module-wise Results

The implemented system provides three main role-specific modules. The doctor module supports prescription creation, prescription management, patient management, profile management, and drug interaction checking. The patient module supports prescription history, OCR upload, and medical profile management. The admin module supports user management, doctor assignment, system monitoring, and analytics

Feature-wise Analysis

Feature	Observed Result	Discussion
Prescription Creation	Structured prescription records are saved.	Improves readability and retrieval compared with paper records.
OCR Upload	Extracted text is displayed for review.	Useful for digitizing paper prescriptions, but manual correction remains necessary.
Drug Interaction Checker	Pairwise results are generated using OpenFDA.	Provides decision-support information, not final medical judgement.
Authentication	JWT-based sessions protect routes.	Supports secure role-based access.

OCR Results

OCR results depend on image quality, lighting, text clarity, and handwriting. For printed or clear prescriptions, Tesseract.js can extract useful text. For handwritten prescriptions, OCR may misread medicine names or dosage.

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Drug Interaction Results

The drug interaction module supports multiple drug inputs and checks pairwise com-binations. OpenFDA label data provides warnings and interaction-related text where available. If data is unavailable, the system communicates that no label result was found instead of incorrectly marking the combination as safe.

Screenshot Placeholders

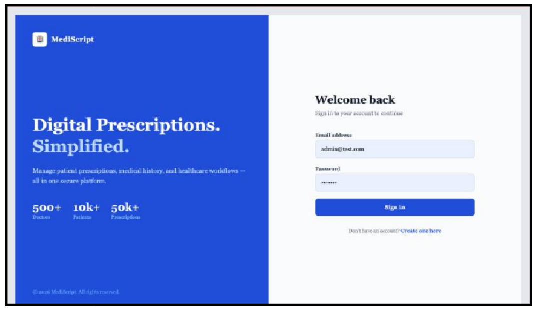

Fig 3: Login Page Screenshot

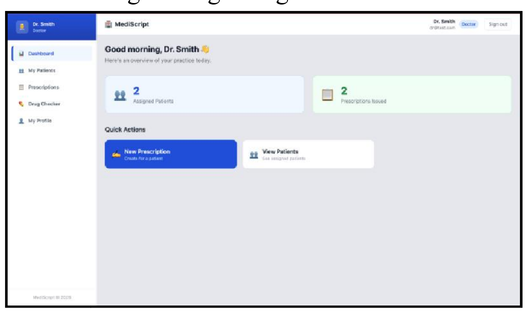

Fig 4: Doctor Dashboard Screenshot

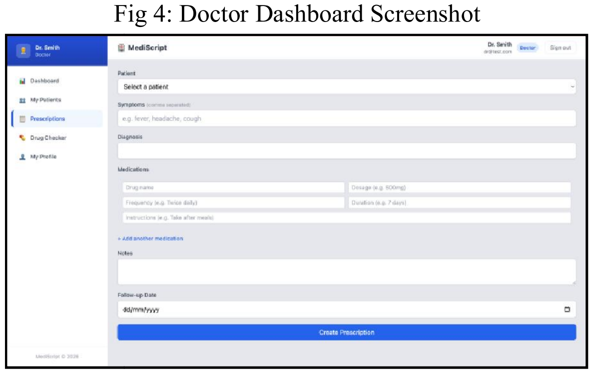

Fig 5: Create Prescription Screenshot

Authentication Results

Authentication results show that valid credentials generate a JWT, invalid credentials are rejected, and protected routes require valid tokens. Role-based checks prevent patients from accessing doctor or admin functions

Dashboard Results

Dashboards provide role-specific information. The doctor dashboard focuses on prescrip-tion operations. The patient dashboard focuses on history and OCR upload. The admin dashboard focuses on user management and analytics

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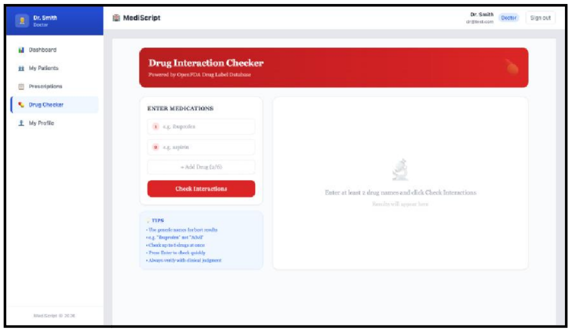

Fig 6: Drug Interaction Checker Screenshot

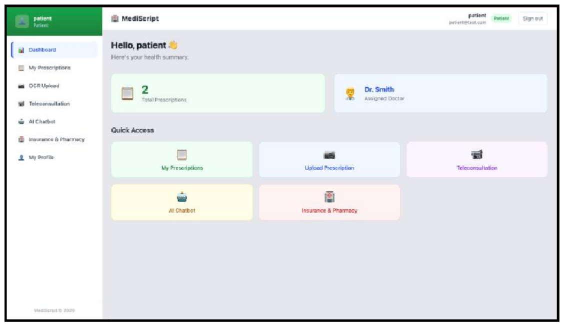

Fig 7: Patient Dashboard and History Screenshot

The project successfully demonstrates how a MERN-based system can support digital prescription workflows. It improves record structure, reduces dependency on paper doc-uments, supports OCR digitization, provides drug information support, and gives ad-ministrators operational visibility. Limitations remain in OCR accuracy, OpenFDA data coverage, and production-level healthcare compliance, but these are clearly identified for future work

Fig 8: OCR Upload Screenshot

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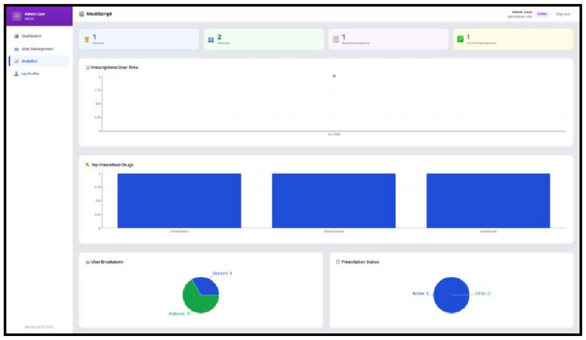

Fig 9: Admin Analytics Screenshot

IX. FUTURE SCOPE

The proposed MediScript system provides a robust platform for digital prescription management, but there are several opportunities for future enhancement. One of the major improvements includes the development of a mobile application using React Native, which would allow doctors and patients to access healthcare services, prescriptions, and notifications conveniently through smartphones. This would increase accessibility and improve user engagement across different healthcare environments.

Artificial Intelligence and Machine Learning techniques can be incorporated into the system to provide intelligent prescription recommendations and clinical decision support. By analyzing patient history, symptoms, and previous treatments, the system could assist healthcare professionals in selecting appropriate medications and identifying potential health risks. Such capabilities would further improve the quality and efficiency of patient care.

X. CONCLUSION

The MediScript system successfully addresses the challenges associated with traditional paper-based prescription management by providing a secure, efficient, and user-friendly digital healthcare platform. The system integrates electronic prescription creation, OCR-based prescription digitization, drug interaction analysis, and role-based access control within a unified environment. By enabling doctors to create structured prescriptions, patients to access and manage their medical records, and administrators to monitor system activities, the platform improves healthcare workflow efficiency and record accessibility.

The implementation of OCR technology helps convert paper prescriptions into digital records, reducing dependency on physical documents and supporting long-term data preservation. The integration of the OpenFDA Drug Label API provides valuable drug interaction information that assists healthcare professionals in making safer prescribing decisions. Additionally, the use of JWT authentication, bcrypt password encryption, and role-based authorization ensures the security and privacy of sensitive healthcare information.

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