Mr. Connect - Bridging Gap Between Mr. And Doctors

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***Abstract*—MR. CONNECT is a smart healthcare communication system designed to improve digital interaction between doc-tors and Medical Representatives (MRs). In many pharmaceutical industries, tasks like doctor visit recording, medicine promotion, and feedback management are often performed manually. These traditional methods may result in communication delays, improper record maintenance, higher workload, and difficulty in handling large amounts of information. To overcome these issues, the proposed project offers a web-based platform that automates healthcare communication and simplifies management activities through advanced digital technologies.**

The application is developed using React.js for designing the frontend interface, Flask REST API for handling backend services, and MongoDB Atlas for storing and managing cloud-based data. The system contains separate interfaces for doctors and medical representatives so that users can access function-alities according to their assigned roles. The platform includes features such as medicine information management, visit history maintenance, doctor feedback submission, analytics tracking, and profile management.

The project also focuses on maintaining security and data privacy. User authentication is implemented using JWT tokens, while passwords are protected through Bcrypt encryption tech-niques. Secure API communication and role-based access control are used to prevent unauthorized access to sensitive information. Interactive dashboards and graphical reports are also provided to help users understand visit records, feedback trends, and analytical data more effectively.

***Index Terms*—component, formatting, style, styling, insert**

I. INTRODUCTION

With the rapid growth of digital technology, the healthcare and pharmaceutical sectors are increasingly adopting modern systems to improve communication, organize information, and enhance operational performance. Conventional approaches followed by doctors and medical representatives often rely on physical documentation, handwritten visit reports, and manual communication processes. These methods can be time-consuming, difficult to manage, and more prone to data-related mistakes. Due to these challenges, there is a strong demand for an advanced digital platform that can streamline communication, manage records systematically, and assist users with smarter and more efficient decision-making support. MR. CONNECT is designed as an intelligent web-based platform that supports digital communication and healthcare management between doctors and Medical Representatives (MRs). The system aims to enhance professional interaction in the pharmaceutical field through the use of advanced web technologies, cloud-based data storage, and AI-driven functionalities. It allows users to maintain medicine information, monitor doctor visit activities, handle feedback records, and access customized recommendations through a centralized application.

The system includes dedicated dashboards for doctors and medical representatives based on their specific roles within the platform. Medical representatives are able to store visit records, update medicine-related information, review feedback responses, and access analytical data. Doctors can explore medicine details, receive suggested products, submit their opinions, and review previous interaction records. This role-oriented design improves system organization, enhances us-ability, and strengthens platform security.

The user interface of the platform is developed with React.js and Vite to deliver a fast, dynamic, and responsive web experience. Modern frontend technologies including Tailwind CSS, Framer Motion, Recharts, and Lucide React are integrated to enhance the overall design, animations, and data visualization features of the application. The interface follows responsive design techniques, allowing users to operate the system efficiently across various devices and screen sizes.

The server-side functionality of MR. CONNECT is implemented using the Flask REST API framework, which controls the major operations of the platform. The backend is responsible for processes such as user verification, access control, medicine data handling, visit record maintenance, feedback management, and dashboard-related services. Communication between the client side and server side is performed through RESTful APIs for smooth data exchange. To strengthen system security, JWT-based authentication and Bcrypt encryption methods are used for protecting user credentials and sensitive information.

The project utilizes MongoDB Atlas as a cloud-supported NoSQL database system for efficient data storage and manage-ment. The database maintains records associated with users, medicine details, doctor visit information, feedback entries, and analytical reports. Due to its flexible document- oriented structure, scalability, and fast data processing capabilities, MongoDB is well suited for handling healthcare- related applications and large volumes of information.

One of the key functionalities of MR. CONNECT is the implementation of Artificial Intelligence and Machine Learn-ing techniques to enhance system intelligence. The platform contains a sentiment analysis component that examines doctor feedback and classifies responses into categories such as positive, negative, or neutral. For this analysis, NLP tools including Text Blob and VADER are utilized. In addition, the system features a recommendation module that provides medicine suggestions based on user behavior and preferences using TF-IDF and cosine similarity methods. The platform also emphasizes analytical reporting and visual representation of information. Interactive dashboards display important details such as doctor visit records, feedback evaluation, and medicine-related analytics in a simplified manner. These visualization features assist both doctors and medical representatives in understanding data more effectively and making informed decisions.

MR. CONNECT is designed to minimize manual processes, strengthen communication efficiency, improve digital data handling, and support smarter healthcare management us-ing advanced technologies. Through the integration of full-stack development, cloud services, cyber security mechanisms, and Artificial Intelligence/Machine Learning techniques, the project highlights the role of digital innovation in modernizing conventional healthcare and pharmaceutical management systems.

Overall, MR. CONNECT functions as a reliable, expandable, and smart healthcare communication system that promotes a digitally connected environment for doctors and medical representatives through the effective use of modern technologies.

II. LITERATURE REVIEW

The healthcare and pharmaceutical sectors are rapidly adopting digital technologies with the advancement of web applications, cloud-based services, and Artificial Intelligence. Researchers and technology organizations are continuously working on solutions that enhance communication among healthcare professionals, improve medical data handling, and support smarter decision-making processes. The development of MR. CONNECT is inspired by various research works and modern technologies associated with healthcare management platforms, pharmaceutical interaction systems, intelligent rec commendation techniques, sentiment analysis methods, and secure web-based applications.

Conventional healthcare communication practices mostly rely on direct meetings, paper-based documentation, and man-ually maintained records. Previous studies have pointed out that such traditional methods can lead to communication delays, repeated data entries, difficulties in record organization, slow feedback handling, and poor centralized data manage-ment. These drawbacks have motivated the creation of digital healthcare platforms that can automate operational activities and enhance collaboration among healthcare professionals.

Many healthcare management applications have been in-traduced to convert patient information, appointment man-agreement, and communication processes into digital formats. Research related to healthcare information technology shows that centralized digital systems improve the storage, retrieval, and organization of healthcare data in a more efficient manner. Cloud-supported healthcare platforms have gained significant importance because they offer better scalability, easier ac-accessibility, and secure data management. Technologies like MongoDB Atlas and modern cloud computing services are commonly used for handling large volumes of data through flexible and efficient database architectures.

Continuous improvements in web development technologies have greatly supported the growth of modern healthcare ap-plications. Frameworks like React.js are frequently used for creating fast, flexible, and interactive user interfaces because of their modular design approach and strong performance capabilities. Studies in interface design suggest that responsive layouts and interactive dashboards help users navigate systems more easily and improve accessibility. Furthermore, advanced UI frameworks such as Tailwind CSS and animation libraries are useful for designing attractive and user-friendly applications that enhance the overall digital experience.

Backend frameworks are essential for managing application processes and enabling communication between users, servers, and databases. Flask REST API is widely used in healthcare-related applications because of its lightweight structure, support for RESTful services, and ability to handle APIs efficiently while maintaining scalability. Research studies indicate that REST-based APIs improve coordination between frontend and backend components by allowing organized and high-speed data exchange.

Data security is considered a critical factor in healthcare technology systems because these platforms handle confidential personal and medical information. To maintain privacy and system protection, strong authentication and access management techniques are required. Various research studies suggest using JWT-based authentication methods along with secure password encryption techniques like Bcrypt hashing to safeguard user credentials and reduce the risk of unauthorized access. In addition, role-based permission management is commonly adopted to ensure that users are allowed to access only the functionalities associated with their specific roles and responsibilities within the system.

Recommendation systems have become an important re- search topic in the field of healthcare technology because they help provide personalized suggestions to users. Many modern applications apply machine learning techniques to recommend medicines, healthcare products, or services by analyzing user interests and previously available data. Algorithms such as TF-IDF and cosine similarity are frequently utilized to measure relationships between text-based records and generate relevant recommendations. Research findings show that intelligent recommendation mechanisms support faster decision-making and improve access to useful and personalized information.

The analysis of existing healthcare technologies shows that many current applications are mainly designed for individual functions such as patient record management, appointment scheduling, or medicine recommendation services. Only a limited number of systems offer a unified platform that combines communication management, visit monitoring, feed-back evaluation, intelligent recommendation features, analytics, and secure role-based access within a single system. MR. CONNECT is developed to overcome this limitation by integrating multiple advanced technologies and smart services into one centralized healthcare communication platform focused on improving interaction between doctors and medical representatives.

The literature findings further indicate that the combination of modern web technologies, cloud-based databases, cyber security practices, Artificial Intelligence, Machine Learn-ing, and analytical tools can significantly improve health-care systems. Inspired by these technological advancements, MR. CONNECT is designed as a secure, scalable, and Intelli-gent platform that supports efficient healthcare communication and contributes toward the digital modernization of the pharmaceutical sector.

III. METHODOLOGY

The development process of MR. CONNECT is based on a structured and technology-oriented methodology aimed at building a secure, scalable, and intelligent communication platform for doctors and medical representatives. The ap-proach involves combining frontend development, backend processing, database services, security features, and Artificial Intelligence modules within a unified web application. A mod-ular architecture is adopted in the system so that each module can independently handle its responsibilities while maintaining effective interaction with the remaining components of the platform.

The methodology used for the project is organized into multiple phases such as requirement gathering and analysis, system architecture planning, frontend implementation, back-end development, database configuration, AI/ML integration, security setup, system testing, and final deployment.

A. Requirement Analysis

The initial phase of the project methodology focuses on studying the limitations of conventional pharmaceutical com-munication practices and identifying the needs of system users.

Traditional processes followed by doctors and medical representatives were examined to recognize common operational challenges, including poor record maintenance, disconnected communication methods, manual handling of feedback, inefficient recommendation procedures, lack of proper analytical support, and issues related to security and data organization.

After analyzing these challenges, the necessary system requirements were gathered to develop a digital solution that could enhance communication, automate routine activities, and support efficient decision-making within the healthcare and pharmaceutical environment.

The major functional requirements defined for the platform include: Secure user login and access management, Dashboard access based on user roles, Digital medicine information management, Doctor visit recording and monitoring, Feedback submission and evaluation, Intelligent recommendation functionality, Analytics visualization and report generation.

Along with functional requirements, several non-functional aspects were also considered during the system planning pro-cess. These include scalability, responsive design, data security, user-friendly operation, reliability, and overall system performance to ensure efficient and smooth platform functionality.

B. System Design and Architecture

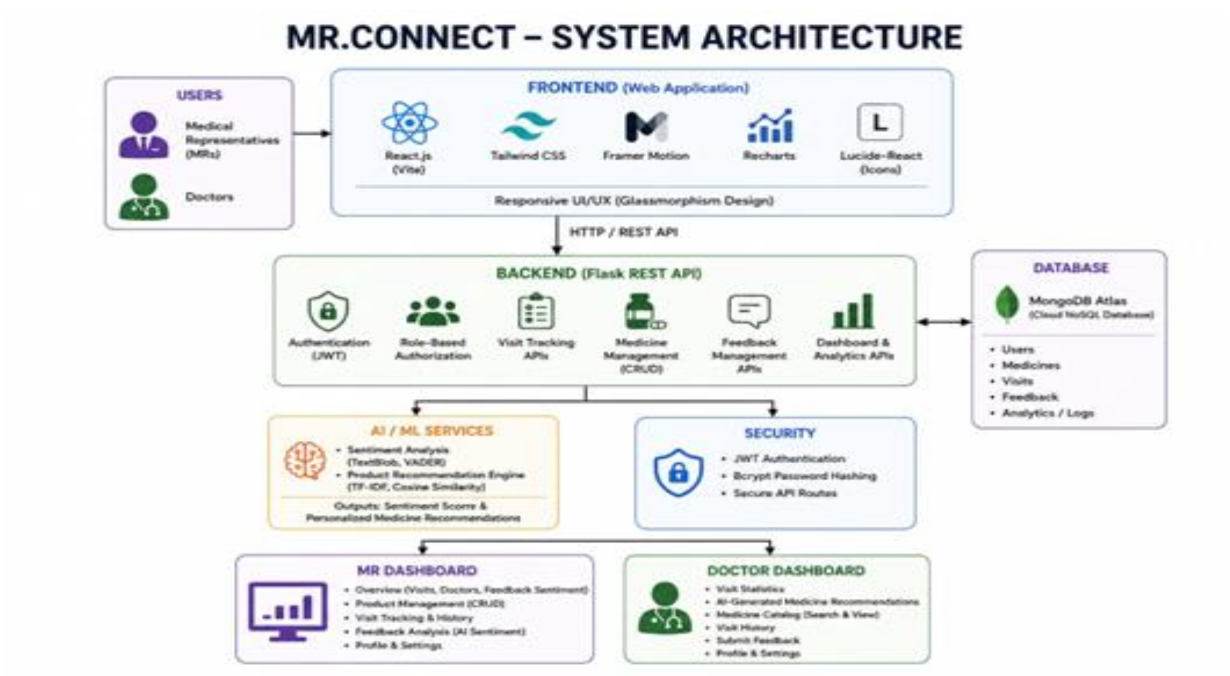

Fig. 1. System Architecture

Following the requirement analysis phase, the complete structure of the platform was planned using a layered architectural model.

This design strategy helps organize different functionalities into separate modules, making the system easier to manage, maintain, and expand in the future.

a) User Layer: The application is mainly designed for two categories of users: Doctors and Medical Representatives (MRs). Both users are provided with dedicated dashboards and functionalities according to their responsibilities within the system.

b) Frontend Layer: The frontend section manages user interaction and controls the visual appearance of the application. The interface is designed with a strong focus on responsiveness, smooth navigation, and improved user experience across different devices.

c) Backend Layer: The backend component is responsible for executing core system operations such as business logic implementation, API management, user authentication, request processing, and communication with the database layer.

d) Database Layer: The database module stores and manages all essential application data, including user details, medicine records, doctor visits, feedback information, and analytical data generated within the system.

e) AI/ML Service Layer: This layer handles intelligent functionalities within the platform. It is responsible for processing sentiment analysis and generating personalized recommendations using Machine Learning and Natural Language Processing techniques.

The layered architecture was selected to improve system organization, simplify maintenance, and support future scala-bility and feature enhancement.

B. Frontend Development

The frontend section of MR. CONNECT was implemented using React.js along with to create a fast and efficient web application environment. React.js was chosen due to its reusable component structure, high rendering performance, and suitability for developing modern responsive interfaces. The frontend development process involved multiple stages such as: Building responsive web pages, creating reusable UI components, Developing separate dashboards for doctors and medical representatives, implementing forms, menus, and nav-igation features, Integrating frontend modules with backend API services.

C. Backend Development

The backend functionality of MR. CONNECT was implemented using the Flask REST API framework. Flask was preferred for the project because of its lightweight architecture, flexibility, and effectiveness in developing API- driven web applications. The backend development process involved several important operations, including: Creating and manag-ing API endpoints, Processing client requests and responses, implementing user authentication mechanisms, performing data validation procedures, managing user roles and permissions, Handling CRUD functionalities for medicines and visit records, Processing doctor feedback information, Generating analytical and reporting data

D. Database Integration

MongoDB Atlas was utilized as the cloud-supported NoSQL database solution for storing and managing the project data. The database design methodology was focused on handling healthcare-related information efficiently while supporting flexibility and scalability for future expansion. Separate database collections were organized for managing different types of information, including: User account details, Medicine-related records, Doctor visit information, Feedback and response data, Analytics and activity logs.

MongoDB was chosen for the project due to several advantages, such as: Support for flexible document-oriented data structures, Ability to scale according to system requirements, Efficient and high-speed query execution, Easy accessibility through cloud-based services.

E. AIML Implementation

a) Sentiment Analysis Module: A sentiment analysis feature was integrated into the system to examine doctor feedback and identify the overall opinion or emotional response expressed in the text data. The implementation process involved several stages, including: Gathering textual feedback submitted by users, Cleaning and preprocessing the collected text data, Applying Natural Language Processing (NLP) meth-ods, Utilizing TextBlob and VADER libraries for sentiment evaluation, producing sentiment scores along with categorized feedback results. Based on the analysis results, the feedback responses are grouped into three categories: Positive, Negative, Neutral.

b) Recommendation System: A recommendation module was developed to provide medicine suggestions based on user interests, interaction patterns, and previously available data within the system. The implementation approach for the recommendation engine involved the following steps: Gathering medicine-related information from the database, transforming textual content into numerical representations using the TF-IDF technique, calculating similarities between records through cosine similarity methods, Producing cus-tomized medicine recommendations for users.

F. Security Implementations

a) JWT-Based Authentication: JSON Web Tokens (JWT) were implemented to manage secure user login sessions and verify authenticated users during system access.
b) Password Protection: User passwords are secured using Bcrypt encryption techniques before being stored in the database, reducing the risk of unauthorized password exposure.
c) Role-Oriented Access Management: Different access permissions were defined for doctors and medical representatives so that users can only utilize functionalities related to their assigned roles.
d) Protected API Communication: Secure API endpoints were developed to support safe communication and protected data exchange between the frontend interface and backend services.

G. Dashboard and Analytics Development

The development process for the analytics module involved: Retrieving analytical information from the database, Pro-cessing and organizing statistical data, Visualizing reports through charts and graphical components using Recharts. The dashboard section provides visual reports related to: Doctor visit statistics, Feedback evaluation and sentiment results, Medicine-related analytical reports, User activity and system usage data.

H. Testing and Validation

The testing approach covered multiple levels, including: Functional testing to verify that each feature operated as intended, API testing to ensure correct communication be-tween services, User interface testing to check usability and responsiveness, Database testing to validate data accuracy and integrity, Security testing to identify and fix potential vulnerabilities.

I. Deployment and Maintenance

After completing all testing phases successfully, the system was moved toward deployment. It was developed with a cloud-compatible architecture to ensure smooth deployment and easy scaling in the future. The maintenance plan focuses on continuous improvement and system stability, which includes: Regular updates to the database to keep information accurate and up to date, Continuous monitoring to ensure system security and detect issues early, Adding new features based on user needs and feedback, optimizing performance to maintain speed and efficiency over time.

J. System Workflow

Step 1: The process begins when the user interacts with the frontend interface.
Step 2: Frontend sends API request to Flask backend.
Step 3: Backend validates requests and communicates with
MongoDB database.
Step 4: AIML modules process feedback and generate recommendations.
Step 5: Processed data and responses are sent back to the frontend.
Step 6: Frontend displays dashboards, charts, reports to user.

IV. RESULT AND ANALYSIS

a) User Authentication and Security: Results - The sys-tem successfully provided secure user registration and login functionality. Password encryption techniques strengthened the protection of user credentials and sensitive information.

Analysis: The use of JWT-based authentication improved session security and enabled safe communication between front-end and backend components. Password encryption through Bcrypt increased the security level by ensuring that user passwords were not stored in plain text within the database.

b) Frontend Performance and User Interface: Results - The application interface functioned smoothly on different de-vices and screen sizes. Users were able to navigate dashboards easily through a simple and organized interface.

Analysis: The implementation of React.js contributed to faster rendering performance and supported the development of reusable interface components. Tailwind CSS helped in creating responsive layouts while maintaining a consistent visual design across the platform.

c) Backend Functionality: Results - RESTful APIs handled client requests and responses effectively. CRUD functionalities related to medicines, doctor visits, and feedback management operated successfully.

Analysis: The Flask-based backend structure improved the modular organization and future scalability of the application. REST APIs supported organized communication between different system layers and simplified integration with frontend modules. Validation techniques implemented at the backend level helped minimize invalid data entries and increased the overall reliability and consistency of the platform.

d) Database Management: Results - Information related to users, medicines, doctor visits, and feedback was stored successfully within the database. Data retrieval and query execution were performed quickly and efficiently.

Analysis: MongoDB Atlas supported scalable storage and efficient handling of healthcare-related information. Its NoSQL architecture allowed flexible schema management and improved the processing of dynamic data structures.

e) Medicine Management Module: Results - Medicine records were successfully created, modified, displayed, and removed within the system. Medicine-related information appeared accurately on the dashboards and interface pages.

Analysis: The medicine management module minimized the need for manual record maintenance and improved access to pharmaceutical information. Centralized storage and management of medicine data simplified data handling processes and increased operational efficiency for system users.

f) Feedback and Sentiment Analysis: Results - The system successfully processed and evaluated doctor feedback data. Feedback responses were categorized into positive, neg-ative, and neutral sentiment groups.

Analysis: The sentiment analysis feature improved the interpretation of doctor opinions and response patterns. ap-plying AI-based feedback evaluation techniques, the system enhanced understanding of user reactions and assisted medical representatives in developing more effective communication approaches.

g) Recommendation System: Results - The system gener-ated medicine suggestions based on user activities and interac-tion history. Recommendation quality and accuracy improved as more data became available in the platform.

Analysis: The recommendation module demonstrated the effective use of Machine Learning methods within healthcare communication systems. Customized medicine suggestions helped doctors access more suitable and relevant information, which supported better understanding and improved decision-making processes.

h) Dashboard and Analytics: Results - Doctor visit statistics were presented successfully using visual reports and charts. Feedback patterns and trends were displayed clearly through graphical representations.

Analysis: The analytics module enhanced the understanding of healthcare communication data by presenting information in a visual format. Graphical dashboards made statistical interpretation easier and supported users in making more informed and efficient decisions based on analytical insights.

V. DISCUSSION

The MR. CONNECT project was created to overcome com-munication and operational difficulties frequently observed in the healthcare and pharmaceutical industry. Conventional interaction methods between doctors and medical representatives generally depend on manual activities such as paper-based documentation, handwritten medicine records, and traditional feedback handling without digital evaluation. These outdated practices can lead to reduced efficiency, higher workload, and challenges in managing data effectively. The project discussion highlights how the proposed system addresses these issues through the integration of modern web technologies, cloud-based services, Artificial Intelligence, and secure system architecture.

One of the key discussion areas of the project is the growing importance of digital transformation within healthcare communication systems. The healthcare sector is continuously adopt-ing automated and technology-oriented solutions to improve operational efficiency, accessibility, and decision-making ca-pabilities. MR. CONNECT supports this transformation by offering a centralized digital platform that enables doctors and medical representatives to communicate, maintain records, and access healthcare information in an organized and systematic way. By replacing manual documentation with cloud-based data management, the platform helps reduce paperwork and improves data accessibility.

The project also highlights the significance of full-stack web technologies in developing scalable healthcare applications. The frontend implementation using React.js delivers a responsive and interactive interface that enhances usability and accessibility for users. Technologies such as Tailwind CSS, animation libraries, and graphical dashboards contribute to creating a modern and visually efficient user environment that simplifies navigation throughout the application.

Another important discussion point is the backend architecture and API-based communication model used in the system. Flask REST API was implemented to handle server-side functionalities and data processing tasks. The RESTful communication structure enables organized interaction be-tween frontend modules and backend services through API requests and responses. The modular backend design improves maintainability and supports future scalability of the platform. The discussion suggests that lightweight backend frameworks like Flask are highly suitable for healthcare applications that require secure, reliable, and efficient data communication.

Overall, the discussion of MR. CONNECT emphasizes the growing importance of digital healthcare technologies in enhancing communication, information management, and intel-ligent decision-making within the pharmaceutical industry. The project illustrates how modern technologies including full-stack web development, cloud services, cybersecurity practices, Artificial Intelligence, and data analytics can work together to build a secure, scalable, and efficient healthcare communication system. The successful development of the platform demonstrates that technology- oriented healthcare solutions can minimize manual work, improve operational pro-ductivity, and contribute to the continuous digital advancement of healthcare and pharmaceutical management processes.

VI. FUTURE WORK

1) Mobile Application Development: At present, MR. CONNECT functions as a web-based platform. In future versions, the system can be expanded into a dedicated mobile application for Android and iOS devices to provide greater flexibility and portability for users.
2) Integration with Hospital and Healthcare Systems: Future developments of the project may include connectivity with external healthcare applications and hospital management systems to improve interoperability and data sharing capabilities.
3) Real –Time Communication System: The existing plat-form is primarily focused on managing records, analytics, and healthcare-related information. In future versions, the system can be enhanced by adding live communication features to strengthen interaction between doctors and medical representatives.
4) Multi-Language Support: The present version of the plat-form may provide support for only a limited set of languages. Future enhancements can include multilingual functionality to make the system more accessible to users from different regions and language backgrounds.
5) Automated Reporting and Documentation: Future up-grades of the platform can focus on automating documenta-tion and report preparation processes to reduce administrative workload and improve efficiency.
6) Advanced Cybersecurity Enhancements: Healthcare plat-forms require continuous improvement in security mechanisms to protect confidential user and medical information from evolving cyber threats.

VII. CONCLUSION

MR. CONNECT is an intelligent and secure healthcare com-munication system developed to improve digital interaction between doctors and medical representatives. The project reduces dependence on traditional manual methods by intro-ducing an automated and centralized platform that enhances communication, record handling, and information accessibility within the pharmaceutical industry.

The platform combines advanced technologies such as Re-act.js, Flask REST API, MongoDB Atlas, Artificial Intelli-gence, Machine Learning, and cloud-based services to build a comprehensive web-based healthcare management application. Dedicated dashboards are provided for doctors and medical representatives, enabling users to perform tasks efficiently according to their specific roles and responsibilities. Func-tonalities including medicine management, visit monitoring, feedback handling, analytics visualization, and recommendation services help streamline routine operations and increase overall efficiency.

The integration of AI-driven sentiment analysis and rec-commendation modules adds intelligent capabilities to the system by assisting users in understanding feedback trends and receiving customized medicine suggestions. These intel-ligent features highlight the practical application of modern AI technologies in improving communication and supporting decision-making within healthcare and pharmaceutical environments.

A strong emphasis was placed on security throughout the system development process. Authentication techniques, encrypted password protection, and role-based access manage-ment were implemented to preserve data privacy and safeguard sensitive user information from unauthorized access. In addition, the use of a cloud-based database structure improved system scalability, flexibility, and centralized data handling capabilities.

The project outcomes indicate that MR. CONNECT can successfully minimize manual effort, enhance communication efficiency within healthcare environments, and support organized digital management of pharmaceutical activities.

The inclusion of interactive dashboards and analytical re-porting tools also enables users to monitor information more effectively and make decisions based on data insights. Fur-thermoses, the modular design of the platform creates opportunities for future upgrades and technological enhancements. Upcoming improvements such as mobile application integra-tion, advanced AI functionalities, real-time communication features, and smart healthcare system connectivity can further strengthen the platform in future versions.

Overall, MR. CONNECT serves as a practical demonstration of how modern web technologies, cloud computing, cybersecurity practices, and Artificial Intelligence can work together to build a smart and efficient healthcare communication plat-form. The project supports the ongoing digital transformation of the healthcare and pharmaceutical sector by delivering a scalable, user-friendly, and technology- oriented solution for professional healthcare communication and management.

REFERENCES

[1] S. Hamza-Cherif, L. Kazi Tani, and N. Settouti, “AI-based emotion classification techniques for healthcare communication analysis,” 2024.

[2] “Utilization of AI-generated responses for patient–provider communication management,” *npj Digital Medicine*, 2025.

[3] M. Atta, A. Ragab, M. A. Salam, and M. Mahmoud, “Artificial intelligence integration in hospital medication management systems,” *International Journal of Advances in Signal and Image Sciences*, 2026.

[4] D. Hu, Y. Guo, Y. Zhou, and K. Zheng, “A systematic review of generative AI applications for patient communication systems,” *npj Health Systems*, 2025.

[5] C. Mhlanga and B. Ndlovu, “Sentiment analysis approaches in electronic healthcare records: A systematic review,” 2026.

[6] “AI-enhanced decision-making methods for pharmaceutical and healthcare management systems,” *ScienceDirect*, 2025.

[7] Shifa, G. Ali, and R. Foulger, “Large language model applications for electronic medical record communication systems,” 2025.

[8] “Sentiment analysis of clinical narratives and healthcare communication data,” *Journal of Biomedical Informatics*, 2023.

[9] Y. Ge, L. Dai, B. Huang, and R. Khan, “Ensemble learning approaches for sentiment analysis in doctor–patient communication,” 2025.

[10] G. Sun and Y. Zhou, “Artificial intelligence in healthcare communication: Opportunities and challenges,” *PubMed*, 2023.

[11] Li, Y. Yang, C. Mao, and Y. Wang, “Aspect-

based sentiment analysis using large language models in healthcare systems," *Journal of Medical Internet Research*, 2025.

[12] "HELIOT: Clinical decision support system for adverse drug reaction management using AI techniques," *Knowledge-Based Systems*, 2025.

[13] B. Nair, D. T. Jaison, and V. S. Anoop, "Machine learning techniques for sentiment analysis of healthcare and drug reviews," 2024.

[14] G. P. Basyal, B. P. Rimal, and D. Zeng, "Natural language processing applications for healthcare knowledge management systems," 2020.

[15] P. K. Nag, A. Bhagat, and D. Khare, "Deep learning and NLP techniques for healthcare text analysis," 2024.

[16] S. Garg, "Machine learning-based drug recommendation systems using sentiment analysis techniques," 2021.

[17] *Reuters Health*, "Artificial intelligence applications in healthcare reporting and medical documentation," 2025.

[18] React.js Official Documentation

[19] Flask REST API Documentation

[20] MongoDB Atlas Documentation

[21] Tailwind CSS Documentation

[22] JWT Authentication Documentation

[23] TextBlob Documentation

[24] VADER Sentiment Analysis Documentation

[25] Recharts Documentation