HEALTHCARE DATA MANAGEMENT

MediTwin: Digital Health Companion

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Abstract

MediTwin is a secure and personalized digital health platform designed to help users manage their medical information in one centralized system. It enables users to store and organize medical records, maintain a health timeline, track medications and appointments, and visualize health trends. The system also supports automated medical-document organization and personalized assistance based on the user's stored health information. Secure access control allows users to selectively share their records with authorized healthcare professionals, improving accessibility, privacy, and continuity of personal healthcare management.

Keywords: Digital Health; medical records; personal health record; health monitoring; secure data sharing; health analytics

1 Introduction

Healthcare institutions generate a large volume of patient information through hospitals, diagnostic laboratories, clinics, prescriptions, medical reports, imaging records, and other clinical services. In many healthcare environments, particularly government hospitals, patient information may still be maintained through paper-based records or distributed across different departments and healthcare facilities. The absence of a unified system for organizing these records can make it difficult to maintain a patient's complete medical history and retrieve relevant information when required. This can result in difficulties in record management, repeated documentation, and delays in accessing previous medical information.

The increasing adoption of digital healthcare systems provides an opportunity to transform traditionally maintained medical records into structured and accessible digital information. However, digitizing medical records alone is not sufficient. A healthcare information system must also provide a reliable mechanism for identifying patients and associating their medical records across different healthcare interactions. To address this issue, this paper proposes MediTwin, a centralized healthcare information management framework.

In the proposed system, each patient is associated with a unique identification number through which medical information can be linked to the corresponding patient. Medical reports generated during hospital visits, diagnostic tests, consultations, prescriptions, and other healthcare services can be uploaded and associated with the patient's digital record. This enables the patient's medical information to be maintained as a structured and continuously updated digital profile rather than as isolated physical documents. The proposed framework is primarily intended to support government hospitals, where centralized access to properly organized patient records can assist in maintaining continuity of healthcare information.

Security and controlled access are also important considerations in the proposed framework because medical records contain sensitive personal information. Instead of requiring patients to directly manage technical access-control mechanisms, MediTwin proposes an intermediary-based access model. In this model, an authorized intermediary is responsible for managing access requests between healthcare institutions and patient records. The patient is informed about or acknowledges the healthcare provider with whom their information is being shared, while the intermediary manages the authorization and access process. This approach is intended to reduce the technical burden on patients while maintaining controlled access to medical information.

The proposed MediTwin framework therefore aims to provide a centralized and structured approach to healthcare record management by combining unique patient identification, digital medical-record maintenance, controlled information sharing, and intermediary-based access management. The system is designed as a proposed framework for improving the organization and accessibility of patient information within government healthcare institutions while considering privacy and security requirements.

This paper presents the proposed MediTwin architecture, its patient identification mechanism, medical-record management process, intermediary-based access control model, and data visualization approach. The paper also discusses the potential benefits, limitations, and future scope of the proposed framework.

2 Problem statement and objectives

2.1 Problem statement

Medical records are frequently scattered across hospitals, diagnostic centres, laboratories, and personal documents. Maintaining these records manually can be time-consuming and may make it difficult to retrieve previous reports, identify changes over time, track medication information, and share relevant documents during consultations. A centralized platform is therefore needed to organize personal medical information and provide a structured view of an individual's recorded health history.

2.2 Objectives

The objectives of MediTwin are:

1. To provide a centralized profile for storing and organizing personal medical records.
2. To arrange health events and reports in chronological order.
3. To help users maintain medication and appointment information.
4. To visualize available health measurements and their changes over time.
5. To support convenient retrieval and organization of medical documents.
6. To enable selective sharing of relevant records with authorized healthcare professionals.
7. To establish a foundation for future AI-assisted document processing and personalized health information access.

3 Literature survey

Sahal et al. explored personal digital twins as a potential approach to personalized healthcare and discussed the integration of digital representations with technologies such as artificial intelligence and data analysis [1]. Their work highlights the importance of maintaining an individualized representation using relevant health information.

Armeni et al. reviewed digital twins in healthcare and discussed their potential applications in personalized medicine, clinical trials, and healthcare operations [2]. Their review also identifies technical, ethical, and regulatory challenges that must be addressed before widespread adoption.

Bruynseels et al. examined the ethical implications of digital twins in healthcare, emphasizing privacy, autonomy, and responsibility when personal data are used to support healthcare decisions [3]. These concerns are relevant to any system that stores and shares sensitive medical information.

The reviewed literature provides a foundation for understanding digital health platforms and patient-centred data management. MediTwin focuses on organizing personal health records, presenting a chronological health history, tracking routine health information, and supporting controlled sharing. Its proposed value lies in bringing these functions together within a single user-oriented platform. The actual effectiveness of the system must be established through implementation and testing.

4 Proposed system

MediTwin is proposed as a web-based digital health companion that organizes medical information into a centralized personal profile. The system is divided into functional modules to simplify record management, health-history review, visualization, and information sharing.

4.1 Personal health record management

This module provides a centralized location for organizing medical documents such as laboratory reports, prescriptions, diagnostic reports, and other relevant health records. Records can be categorized using available information, including document type and date, to make retrieval easier.

4.2 Health timeline

The health timeline organizes recorded medical events chronologically. It allows users to review previous reports and health-related events in sequence rather than searching through separate files. This chronological view is intended to improve the accessibility and continuity of personal health information.

4.3 Medication and appointment tracking

This module is intended to help users maintain medication details and appointment information in an organized format. It supports the review of recorded schedules and healthcare activities. The platform is intended to assist with organization and should not replace medication instructions or professional medical advice.

4.4 Health data visualization

The visualization module presents available structured health measurements as trends over time. Measurements should be displayed with their corresponding dates and units to support interpreta-

tion. The usefulness of these visualizations depends on the availability, accuracy, and completeness of the underlying data.

4.5 Personalized assistance and document organization

MediTwin aims to support convenient access to information available in a user's stored medical records. Future document-processing capabilities may use OCR to extract text from scanned documents, while AI and natural language processing may support information retrieval and summarization. These capabilities should be treated as planned extensions unless their implementation has been verified.

4.6 Secure medical data sharing

The proposed system emphasizes selective sharing of medical information with authorized healthcare professionals. Users should be able to choose the relevant records to share. A production implementation should provide appropriate authentication, authorization, consent management, access revocation, and audit logging to protect sensitive information.

5 System architecture and workflow

The proposed MediTwin architecture consists of a user interface, an application-processing layer, a medical-record storage component, and presentation modules for timelines, tracking, and visualization.

The user interface allows users to enter information and upload medical documents. The application layer processes requests and organizes the available information. The storage component maintains user profiles and associated records. The presentation modules display the organized information so that users can review their medical history and retrieve relevant details.

The intended system workflow is shown in Figure 1.

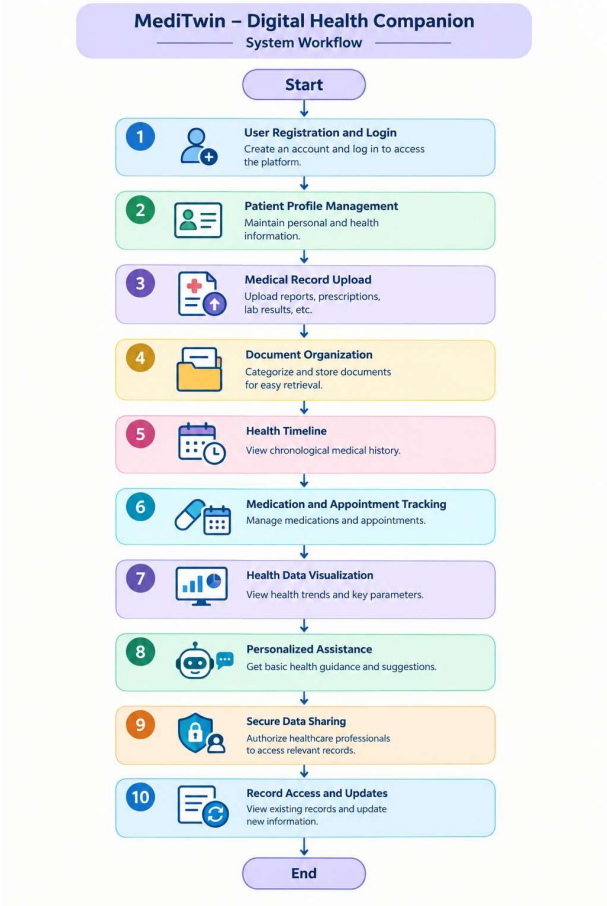


Figure 1. Workflow of the proposed MediTwin system.

Initially, the user provides or uploads available health information. The platform organizes the records and associates them with relevant dates and categories. The organized records are then presented through the health profile and timeline. Available structured measurements can be displayed through visualization components, while medication and appointment information can be reviewed separately. When required, selected records may be shared with an authorized healthcare professional.

6 Evaluation plan and discussion

A reliable evaluation is necessary to determine whether MediTwin performs its intended functions correctly. Since measured results, a test dataset and experimental observations are not yet available, this paper presents an evaluation plan rather than claiming completed experiments.

The proposed evaluation should examine the following aspects:

- **Record management:** Verify whether medical documents can be uploaded, categorized, retrieved, and displayed correctly.
- **Timeline accuracy:** Check whether health events appear in the correct chronological order with appropriate dates.
- **Tracking functionality:** Verify the correctness of stored medication and appointment information.

- **Visualization accuracy:** Compare displayed measurements with the corresponding source values, units, and timestamps.
- **Access control:** Test whether unauthorized users are prevented from accessing protected records.
- **Usability:** Evaluate whether intended users can complete common tasks efficiently and understand the displayed information.
- **Personalized assistance:** If implemented, assess whether generated summaries accurately reflect the source records and avoid unsupported claims. Testing should use synthetic data or appropriately authorized information. Results should report the test conditions, number of cases, observed errors, and limitations. Such evaluation can establish the technical reliability of the platform, but claims about clinical benefits would require additional evidence.

7 Future work

Several extensions are proposed to improve the functionality and usability of MediTwin. OCR-based document processing could help extract information from scanned medical reports and reduce manual data entry. Advanced AI and natural language processing could support information retrieval and personalized summaries, subject to accuracy and safety evaluation.

Stronger authentication and role-based access control could improve the protection of medical records. Secure cloud deployment could support access across locations, while integration with hospitals and diagnostic laboratories could reduce information fragmentation. Android and iOS applications could provide more convenient access to personal health information.

These extensions should be implemented in stages, with privacy, security, interoperability, and usability evaluated at each stage. Integration with real healthcare systems would also require appropriate authorization and technical compatibility.

8 Results

The proposed MediTwin system aims to provide a centralized digital platform for managing medical records, particularly in government hospitals. It is designed to help organize medical information, including laboratory reports, prescriptions, diagnostic results, and other clinical documents in one place. The system aims to improve access to medical information, reduce dependence on physical documents, and simplify the process of retrieving and sharing records. An intermediary-based access mechanism is proposed to manage access permissions, with patient acknowledgement before authorized healthcare professionals can access the records. This approach is intended to support secure information sharing and improve continuity of healthcare services across medical institutions. The login page and the dashboard interface of the prototype are shown in Figure 2 and Figure 3.

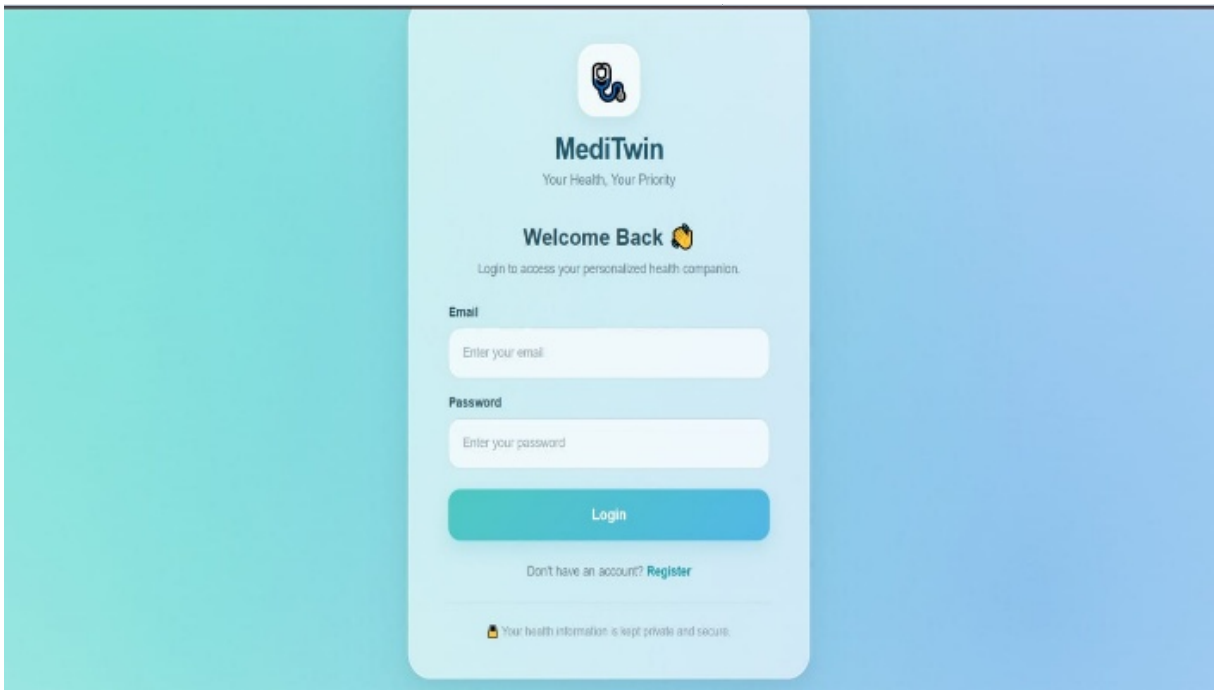


Figure 2. User login page.

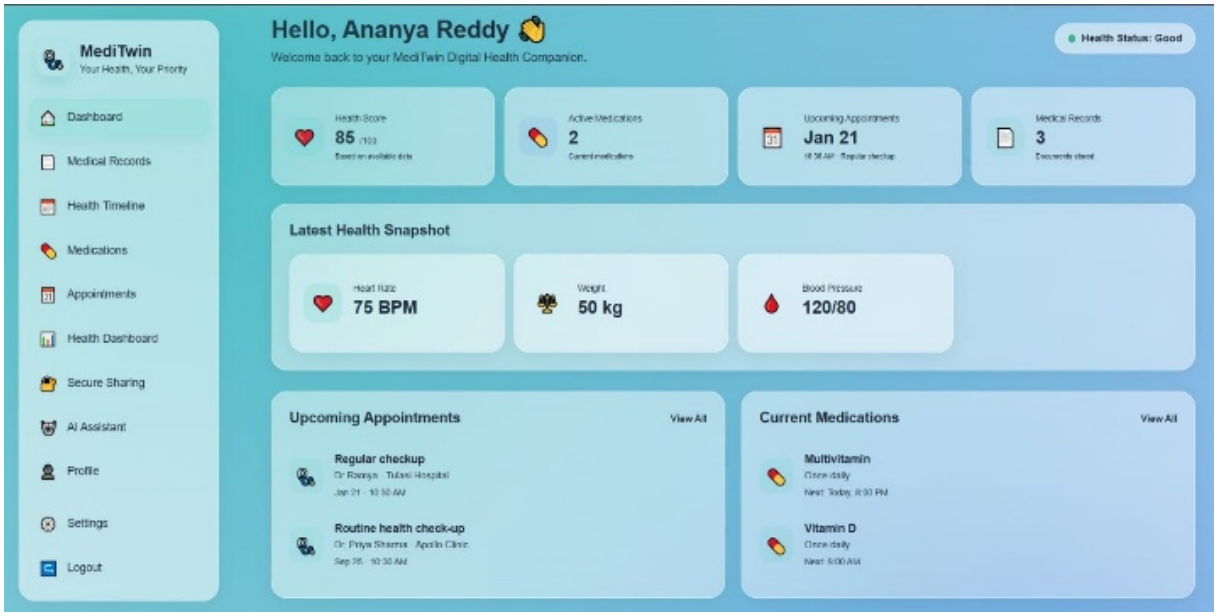


Figure 3. MediTwin dashboard interface.

9 Conclusion

MediTwin is proposed as a digital health companion to address the challenges associated with fragmented personal medical information. By bringing medical records, a chronological health timeline, medication and appointment tracking, health visualization, and selective sharing into a centralized platform, the system aims to make personal health information easier to organize and review. The proposed approach emphasizes user access, structured record management, and privacy-aware sharing. However, its reliability and practical value depend on the correct implementation of the proposed modules, accurate handling of health information, and effective security controls. Future work will focus on OCR-based document processing, advanced AI integration, stronger au-

thentication, cloud deployment, healthcare-system integration, and mobile applications. Systematic technical and usability evaluation is necessary before making claims about performance or clinical effectiveness.

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