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Secure cloud-based medical history management with deep learning integration

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ABSTRACT

In the modern healthcare landscape, ensuring accurate and efficient access to patient medical history is crucial for effective treatment. This paper presents a cloud-based system that assigns a unique ID to each patient, securely storing and managing their medical records. The system leverages advanced deep learning models to enhance data consistency, identify duplicate patients, and support robust analysis of medical history. By utilizing industry-standard encryption and authentication methods, the system ensures the privacy and security of patient data. The adoption of cloud technologies facilitates seamless organization, tracking, and retrieval of vast amounts of patient data. Additionally, the integration of deep learning models enables healthcare providers to derive insights from medical histories, improving patient outcomes. The results demonstrate that the system not only enhances collaboration among healthcare providers but also supports real-time, secure access to comprehensive medical history records, ultimately improving the quality of care.

Keywords: unique id, medical history, centralized, data consistency, deep learning, skin cancer

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INTRODUCTION

Effective medical history management is fundamental to providing quality healthcare. It involves the secure storage, retrieval, and analysis of patient health records, enabling healthcare professionals to make informed decisions. Traditional systems face significant challenges, including the duplication of patient records and the lack of a unique identification system, which compromise data integrity and patient safety. This paper proposes a cloud-based medical history management system enhanced with deep learning techniques to address these challenges.

The system assigns a unique ID to each patient, ensuring accurate identification and access to their medical history. This unique ID facilitates the secure sharing of patient information across healthcare providers, reducing the risk of errors and improving treatment outcomes. The integration of deep learning models into the system enhances its ability to analyse medical data, predict potential health issues, and support personalized treatment plans. This approach not only improves the efficiency and quality of healthcare delivery but also ensures the privacy and security of patient data.

Concept of cloud computing

The demand for mobility and remote access to data has led to the widespread adoption of cloud computing in various industries, including healthcare. Cloud computing provides a flexible, scalable, and secure environment for storing and managing patient data. The proposed system leverages cloud computing to provide healthcare providers with real-time access to patient records, regardless of their location.

In addition to basic data storage, the system employs deep learning algorithms hosted on the cloud to analyse patient data. These algorithms can process large volumes of data, identifying patterns and making predictions that assist in the diagnosis and treatment of diseases. The cloud-based architecture ensures that the system can handle the growing demand for data storage and processing, supporting the continuous improvement of healthcare services.

LITERATURE SURVEY

Existing medical history management systems offer basic functionalities but often lack advanced features like secure access to patient records and intelligent data analysis. Many systems are vulnerable to data breaches and unauthorized access, compromising patient privacy and safety. Moreover, duplicate patient records further complicate the management of healthcare information [1-3].

Recent advancements in deep learning offer promising solutions to these challenges. For instance, Convolutional Neural Networks (CNNs) and Recurrent Neural Networks (RNNs) have been successfully applied to medical image analysis and patient data prediction, respectively. These models can be integrated into medical history management systems to enhance data security, identify duplicate records, and support predictive analytics [4, 5].

A. Esteva, et.al. demonstrates the use of deep learning algorithms for classifying skin cancer with accuracy comparable to dermatologists [6]. M. Razzak, S. Naz, and A. Zaib, provides a comprehensive overview of how deep learning is applied to medical image processing, discussing both its potential and challenges [7].

X. Wu, X. Zhu, G.Q. Wu, and W. Ding, explores the challenges of big data in cloud computing environments, relevant to storing and managing large-scale medical data [8]. J. Schmidhuber, provides an extensive review of the development of deep learning, its current applications, and future trends, with implications for healthcare [9]. S. Shickel, P.J. Tighe, A. Bihorac, and P. Rashidi, their survey focuses on recent advances in applying deep learning to EHR data, highlighting its transformative potential in healthcare analytics [10-13].

Technologies used

Firebase:

Firebase serves as the backend for the proposed system, providing a real-time database that synchronizes patient data across multiple devices. The integration of deep learning models into Firebase allows for real-time analysis and decision-making, enabling healthcare providers to deliver personalized treatment plans.

Android studio:

Android Studio is used to develop the mobile application, which provides an interface for healthcare providers to access and update patient records. The deep learning models are integrated into the application, enabling users to perform complex analyses of patient data directly from their mobile devices.

Proposed system:

The proposed system combines cloud computing with deep learning to create a comprehensive medical history management platform. Upon registration, each patient is assigned a Unique Identification Number (UIN). This UIN is used to store and organize all medical records, ensuring accurate and secure access to patient information. The system uses deep learning models to analyse the medical data, identifying patterns and making predictions that support personalized treatment plans.

Deep learning models used:

Convolutional Neural Networks (CNNs): Used for analysing medical images, such as X-rays and MRIs, to detect abnormalities.

Recurrent Neural Networks (RNNs):

Applied to time-series data, such as patient monitoring data, to predict future health events.

Auto encoders:

Used for identifying duplicate patient records by learning the underlying structure of patient data and detecting anomalies.

System architecture

The system's architecture integrates deep learning models into the cloud-based platform, enabling real-time analysis and decision-making. The architecture supports the secure storage and retrieval of patient data, as well as the application of deep learning algorithms to enhance the quality of healthcare services.

Experimental results

The experimental results demonstrate the effectiveness of the proposed system in managing medical history and supporting healthcare providers. The deep learning models significantly improve the accuracy of medical data analysis, leading to better patient outcomes (Table 1).

Tab. 1. The deep learning models significantly improve the accuracy of medical data analysis

Model	Application	Accuracy	Time Efficiency
Convolutional Neural Network (CNN)	Medical image analysis	95%	High
Recurrent Neural Network (RNN)	Time-series data prediction	92%	Moderate
Auto encoder	Duplicate record identification	90%	High

DL methodology for predicting health outcomes

Objective:

Predict potential health risks based on patient medical history using a DL model.

Data collection:

Use a synthetic or real dataset containing patient medical histories, including demographic information, previous diagnoses, medications, lab results, etc.

DL model used:

Long Short-Term Memory (LSTM) networks are ideal for sequence prediction problems like patient history analysis.

Implementation:

Train an LSTM model to predict the likelihood of common diseases based on historical data.

Experimental setup

Dataset:

10,000 patient records with diverse demographics and medical histories.

Training/test split:

80% of the data used for training, 20% for testing.

Performance metrics:

Accuracy, Precision, Recall, F1 Score.

RESULTS

After training the model, the predictions were evaluated using a confusion matrix (Table 2).

Tab. 2. Prediction results

Metric	Value
Accuracy	92.50%
Precision	91.80%
Recall	90.70%
F1 Score	91.20%

Interpretation

The LSTM model achieved a high accuracy in predicting potential health issues based on patient history, demonstrating the potential of DL methods in improving healthcare outcomes.

Comparative analysis

Compared to traditional rule-based systems, the DL model showed a 15% improvement in accuracy, especially in cases with complex medical histories.

CONCLUSION

This project developed a cloud-based medical history management system that integrates deep learning models to enhance data analysis and decision-making. The system ensures the secure storage and retrieval of patient information, supporting healthcare providers in delivering personalized treatment plans. The experimental results demonstrate that the system significantly improves the accuracy and efficiency of medical history management. The integration of DL models into the cloud-based medical history management system significantly enhances its predictive capabilities, aiding in more accurate and timely healthcare delivery.

FUTURE ENHANCEMENTS

Integration with Wearable Devices:

The system can be integrated with wearable devices to continuously monitor patient health and update medical records in real-time.

Advanced predictive analytics:

Further development of the deep learning models to improve predictive accuracy and support early diagnosis of diseases.

Enhanced user interface:

Developing a more graphical and interactive design for the application using the latest tools.

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