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VitaAssist – Medical Enquiry System and Data Analysis

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Abstract - VitaAssist is an innovative mobile healthcare application designed to provide users with accurate, AI-powered medical support. The application is built using React Native and integrates a medical chatbot powered by the Gemini large language model (LLM) to address medical queries. Additionally, VitaAssist incorporates a predictive model based on Convolutional Neural Networks (CNN) and Transfer Learning to diagnose lung cancer from CT scans. The app further enhances personalized healthcare by enabling Electronic Health Record (EHR) analysis, providing users with comprehensive health insights and tailored medical recommendations. This paper presents the design, implementation, and evaluation of VitaAssist, demonstrating its potential to improve early diagnosis, patient support, and overall healthcare outcomes.

***Key Words*:** Electronic Health Record, Chatbot, Convolution Neural Network

1.INTRODUCTION

The rapid advancement in artificial intelligence (AI) and machine learning (ML) has transformed the healthcare landscape, offering unprecedented improvements in diagnostic accuracy, patient outcomes, and personalized care. Lung cancer, being the leading cause of cancer-related deaths globally, poses a significant challenge to healthcare providers due to its often late-stage detection and complex treatment pathways. Early detection and timely intervention are critical in improving survival rates and patient quality of life. Traditional diagnostic methods, such as tissue biopsy and imaging, though reliable, are resource-intensive and not always accessible, especially in resource-limited settings. VitaAssist addresses this critical healthcare gap by leveraging cutting-edge AI and ML technologies to provide a mobile-first, user-centric solution for lung cancer prediction and medical consultation. By integrating a Gemini LLM-based chatbot for precise medical interactions, a CNN-based predictive model for accurate lung cancer diagnosis, and an EHR analysis tool for personalized healthcare insights, VitaAssist aims to empower patients and healthcare providers with real-time, data-driven support. This paper explores the design, methodology, and performance of VitaAssist, demonstrating its potential to enhance patient engagement, streamline clinical decision-making, and improve overall healthcare outcomes.

2. METHODOLOGY

VitaAssist employs a multi-tiered approach to deliver comprehensive healthcare support:

Medical Chatbot (Gemini LLM)
Trained to handle only medical-related queries, ensuring precise and context-aware responses. It leverages the Gemini LLM's extensive medical knowledge base, enabling it to address complex medical questions with high accuracy.

EHR Analysis
This component allows users to input their medical history, including symptoms, past diagnoses, and current medications. The data is processed using natural language understanding (NLU) techniques, enabling the chatbot to generate personalized summaries and provide context-specific medical advice. The analysis focuses on identifying risk factors, comorbidities, and potential complications based on the entered data, providing users with actionable health insights.

Lung Cancer Prediction Model
The lung cancer prediction feature is built using a convolutional neural network (CNN) with transfer learning. This model is trained on a diverse dataset of lung CT scans, capable of differentiating between adenocarcinoma, large cell carcinoma, and squamous cell carcinoma. The CNN architecture includes multiple convolutional and pooling layers to capture spatial hierarchies in the CT images. Transfer learning from a pre-trained model (e.g., ResNet or VGG) significantly reduces training time and improves accuracy by leveraging previously learned visual features.

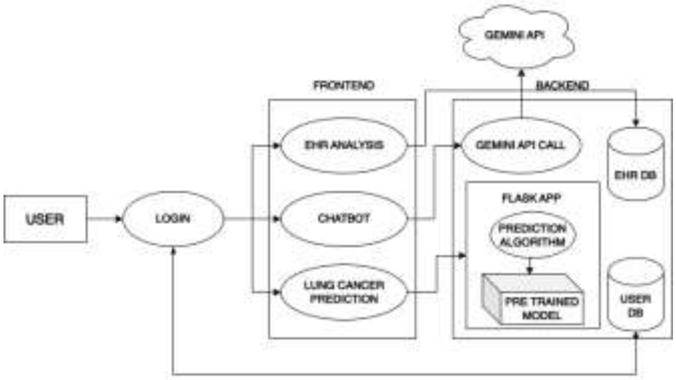

Fig -1: Architecture Design

3. TECHNOLOGY USED

The project utilizes a modern tech stack for seamless performance:

Frontend: The frontend layer is built with React Native along with a streamlining framework called Expo. To process styling React Native's Nativewind is used. To ensure proper typing, Typescript is used

Backend: The backend later is built with NestJS which provides secure and scalable APIs. To interact with entities an Object Relational Mapper is used called TypeORM

Database: For Database, PostgreSQL was used as it provides relational database which is fast and easy to use

AI/ML: For prediction, TensorFlow, Scikit-learn for predictive analytics (e.g., lung cancer prediction). The final model and running file are bundled in a flask app.

Algorithms: The application integrates multiple components powered by machine learning and large language models. A chatbot, based on the Gemini API, is configured to respond to health-related queries, ensuring domain relevance. For Electronic Health Records (EHR), user-entered diagnosis data is formatted as JSON and analyzed. Additionally, a lung cancer prediction module employs a Convolutional Neural Network (CNN) with transfer learning. This model processes CT scan images to predict both the stage and type of lung cancer, leveraging pre-trained image recognition layers for efficient and accurate classification.

4. RESULTS AND DISCUSSION

A. Chatbot Response

As shown in Figure 2, the chatbot responds accurately to user-submitted health-related questions. The system prompt within the Gemini API confines responses strictly to health topics, effectively filtering out irrelevant inputs. This constraint ensures focused interaction and improves user trust in medical contexts. The responses demonstrate coherence, context awareness, and appropriate medical terminology, making the chatbot a valuable first-line tool for general health inquiries.

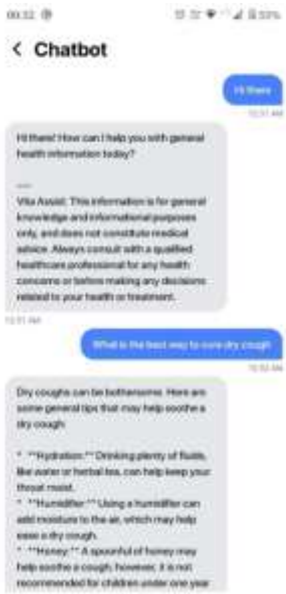

Fig -2: Chatbot Page

B. EHR Analysis

Figure 3 illustrates the EHR analysis feature. Users can input structured diagnosis data, which is then summarized using the same language model backend. The generated summaries provide clear, concise interpretations of the data, making it easier for patients and non-clinicians to understand complex medical information. This approach simplifies data communication and can aid in patient education and decision-making.

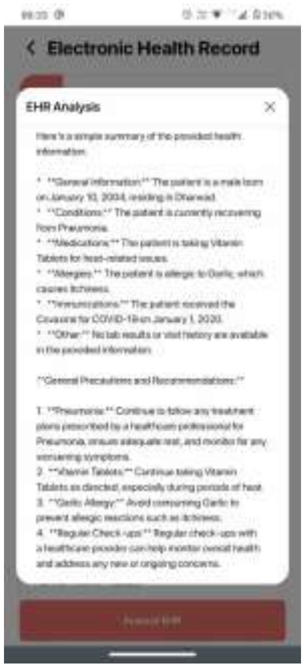

Fig -3: EHR Analysis

C. Lung Cancer Prediction

The lung cancer prediction module processes CT scan images to classify both cancer stage and type using a Convolutional Neural Network (CNN) with transfer learning. As seen in Figure 4, the model provides interpretable predictions, supporting early diagnosis efforts. While initial results are encouraging, further validation on diverse image datasets is necessary to ensure clinical robustness and minimize bias in predictions.

Fig -4: Lung Cancer Prediction

5. CONCLUSIONS

VitaAssist presents a significant step towards democratizing access to advanced medical diagnostics and personalized healthcare. By integrating state-of-the-art machine learning models and conversational AI, the app aims to empower patients with timely insights and proactive health management, ultimately reducing diagnostic delays and improving patient outcomes. Future work will focus on expanding the app's predictive capabilities and incorporating real-time data analytics to further enhance its clinical utility. Additionally, integrating more diverse medical datasets and real-world clinical validations will be essential to ensure broader applicability. With ongoing improvements, VitaAssist has the potential to become a vital tool in the early detection and management of critical illnesses, significantly impacting patient lives.

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