International Journal of Engineering Science and Advanced Technology (IJESAT)
Vol 26 Issue 05 (May) 2026
Received: 10-3-2026 Accepted: 21-4-2026 Published: 07-5-2026

HEALTHCARE SYMPTOM MONITORING USING A HYBRID RAG-BASED CONVERSATIONAL AI

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ABSTRACT

SYMPTOTRACKAI: Hybrid RAG Chatbot for Symptom Monitoring is an intelligent healthcare support system designed to assist users in tracking, analyzing, and understanding their health symptoms through conversational interaction. The system leverages a Hybrid Retrieval-Augmented Generation (RAG) approach, combining large language models with external medical knowledge bases to provide accurate, context-aware, and up-to-date responses. It collects user-reported symptoms through a chatbot interface and processes them using natural language processing (NLP) techniques to identify possible conditions and recommend appropriate actions. The hybrid architecture integrates both generative AI for conversational responses and retrieval mechanisms to access verified medical information, improving reliability and reducing misinformation. Additionally, the system supports continuous symptom monitoring, personalized insights, and early risk detection by analyzing user history over time. It can be integrated with healthcare platforms to assist doctors and patients in decision-making while maintaining user privacy and data security. Overall, the proposed system enhances digital healthcare services by providing accessible, real-time, and intelligent symptom monitoring and guidance.

KEYWORDS:

Hybrid RAG, Chatbot, Symptom Monitoring, Healthcare AI, Natural Language Processing, Retrieval-Augmented Generation, Medical Diagnosis Support, Machine Learning, Digital Health, Conversational AI

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I. INTRODUCTION

The rapid advancement of digital healthcare technologies has transformed the way individuals monitor and manage their health. With the increasing availability of online medical resources and mobile health applications, people are now more inclined to seek quick and accessible health information. However, many existing systems lack personalization, real-time interaction, and reliability, often leading to misinformation or delayed medical guidance. This highlights the need for intelligent systems that can provide accurate, timely, and user-friendly healthcare support.

In recent years, **Artificial Intelligence (AI)** and **Natural Language Processing (NLP)** have played a crucial role in developing smart healthcare applications, particularly conversational agents or chatbots. These systems enable users to describe their symptoms in natural language and receive instant responses. However, traditional chatbot systems rely heavily on pre-trained models and static datasets, which may not always provide updated or domain-specific medical knowledge.

To overcome these limitations, the concept of **Retrieval-Augmented Generation (RAG)** has emerged as a powerful approach that combines the strengths of information retrieval and generative models. In a hybrid RAG framework, the system retrieves relevant medical information from trusted knowledge bases and integrates it with generative AI to produce accurate and context-aware responses. This ensures that the chatbot delivers reliable and up-to-date health information while maintaining conversational quality.

The proposed system, **SYMPTOTRACKAI: Hybrid RAG Chatbot for Symptom Monitoring**, aims to provide continuous health monitoring and intelligent assistance through a conversational interface. The system collects user-reported symptoms, analyzes them using AI models, and provides personalized insights, possible condition predictions, and recommendations for further action. It also maintains a history of user interactions, enabling long-term symptom tracking and early detection of potential health risks.

II. LITERATURE REVIEW

Recent research in healthcare chatbots and symptom monitoring systems has focused on leveraging artificial intelligence and natural language processing to provide accessible and real-time medical assistance. Early systems were primarily rule-based chatbots that relied on predefined decision trees and medical guidelines to respond to user queries. While these systems were simple and interpretable,

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they lacked flexibility and were unable to handle complex or diverse user inputs effectively [1][2].

With the advancement of machine learning, researchers introduced data-driven approaches using classification algorithms such as decision trees, support vector machines (SVM), and naïve Bayes to predict diseases based on user symptoms. These models improved diagnostic accuracy but required structured input and lacked conversational capabilities, limiting user interaction [3].

The emergence of deep learning further enhanced healthcare chatbots, with models such as recurrent neural networks (RNNs) and long short-term memory (LSTM) networks being used to process sequential patient data and understand context in conversations. These approaches enabled more natural interactions and better symptom analysis compared to traditional methods [4].

Recent studies have explored the use of transformer-based models and large language models (LLMs) to build more advanced conversational agents. These models can understand complex queries, generate human-like responses, and provide more accurate medical suggestions. However, they often rely on static training data and may produce outdated or incorrect information if not properly guided [5].

To address these limitations, researchers have introduced **Retrieval-Augmented Generation (RAG)** frameworks, which combine information retrieval with generative models. In this approach, relevant medical knowledge is retrieved from trusted sources and incorporated into response generation, improving accuracy, reliability, and context-awareness in chatbot systems [6].

Several studies have also focused on hybrid systems that integrate RAG with continuous symptom monitoring and personalized health tracking. These systems analyze user history, detect patterns in symptoms over time, and provide early warnings for potential health risks. Additionally, they enhance decision-making support for both patients and healthcare professionals [7].

Recent research emphasizes the importance of data privacy, security, and ethical considerations in healthcare AI systems. Techniques such as secure data storage, anonymization, and federated learning are being explored to protect sensitive patient information while maintaining system performance [8].

Despite significant advancements, challenges such as handling ambiguous user inputs, ensuring medical accuracy, reducing bias, and achieving regulatory compliance remain. These limitations highlight the need for more robust, explainable, and trustworthy hybrid

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RAG-based chatbot systems for effective symptom monitoring and healthcare support [9].

III. EXISTING SYSTEM

Existing symptom monitoring and healthcare chatbot systems are primarily based on **rule-based models**, traditional machine learning approaches, or standalone conversational agents. Rule-based systems use predefined medical knowledge and decision trees to respond to user queries. While they are simple and easy to implement, they lack flexibility and cannot handle complex or varied user inputs effectively. These systems also struggle to adapt to new medical knowledge or evolving healthcare needs.

Many existing systems utilize **machine learning models** such as decision trees, naïve Bayes, and support vector machines (SVM) to predict diseases based on user-provided symptoms. Although these models improve prediction accuracy, they generally require structured input and do not support natural conversational interaction. This limits user engagement and reduces the usability of such systems for non-technical users.

With advancements in AI, **chatbot-based systems** using deep learning and large language models have been introduced. These systems provide more interactive and human-like responses. However, they often rely on pre-trained data and may generate inaccurate or outdated medical information due to the lack of access to real-time, verified knowledge sources. This raises concerns about reliability and trustworthiness in healthcare applications.

Another limitation of existing systems is the lack of **continuous symptom monitoring and personalization**. Most platforms provide one-time responses without tracking user history or analyzing symptom progression over time. As a result, they fail to detect early warning signs or provide long-term health insights.

Additionally, existing systems often do not effectively integrate **retrieval mechanisms** with generative models. Without retrieving verified medical information from trusted databases, the responses may lack factual accuracy and clinical relevance. Furthermore, issues related to **data privacy and security** are not always adequately addressed, especially when handling sensitive health data.

IV. PROPOSED SYSTEM

The proposed system, **SYMPTOTRACKAI: Hybrid RAG Chatbot for Symptom Monitoring**, is designed to provide an intelligent, reliable, and personalized healthcare assistance platform by combining conversational AI with real-time medical knowledge retrieval. The system adopts a **Hybrid Retrieval-Augmented Generation (RAG)** architecture to overcome the

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limitations of traditional chatbot systems and improve the accuracy and relevance of responses.

In this system, users interact with a chatbot interface by describing their symptoms in natural language. The input is processed using Natural Language Processing (NLP) techniques to extract key medical entities such as symptoms, duration, severity, and related conditions. This information is then used to query external medical knowledge bases, research articles, and clinical guidelines to retrieve relevant and verified information.

The retrieved data is combined with the capabilities of a generative AI model to produce context-aware, accurate, and human-like responses. This hybrid approach ensures that the chatbot not only understands user queries but also provides reliable medical insights based on up-to-date knowledge sources, reducing the risk of misinformation.

The system also includes a **symptom tracking module**, where user interactions are stored securely and analyzed over time. This enables continuous monitoring of health conditions, identification of symptom patterns, and early detection of potential risks. Personalized recommendations and alerts can be generated based on the user's historical data, enhancing preventive healthcare.

V. METHODOLOGY

The methodology of the proposed **SYMPTOTRACKAI: Hybrid RAG Chatbot for Symptom Monitoring** follows a structured pipeline that integrates natural language processing, information retrieval, and generative AI to deliver accurate and personalized healthcare assistance.

Initially, user input is collected through a conversational chatbot interface, where users describe their symptoms in natural language. The input is then processed using Natural Language Processing (NLP) techniques such as tokenization, stop-word removal, and named entity recognition (NER) to extract relevant medical entities including symptoms, duration, severity, and context. This step converts unstructured user input into a structured format suitable for further analysis.

Next, the extracted information is passed to the **retrieval module**, which searches for relevant medical knowledge from trusted sources such as medical databases, clinical guidelines, and research articles. The system uses semantic search and embedding techniques to identify the most relevant documents based on the user's query. This ensures that the retrieved information is accurate, up-to-date, and contextually relevant.

The retrieved knowledge is then combined with a **generative AI model** in the RAG framework. The generative model uses the

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retrieved content along with the user's input to generate a coherent, context-aware, and informative response. This hybrid approach improves the reliability of responses by grounding them in verified information while maintaining conversational quality.

In parallel, the system includes a **symptom analysis and prediction module**, where machine learning models analyze the extracted features to predict possible diseases or health conditions. Risk levels are assigned based on severity and symptom patterns, and appropriate recommendations are generated, such as self-care advice or suggestions to consult a healthcare professional.

The system also maintains a **user history database**, where previous interactions and symptom records are stored securely. This enables continuous monitoring and trend analysis, allowing the system to detect changes in health conditions over time and provide personalized insights.

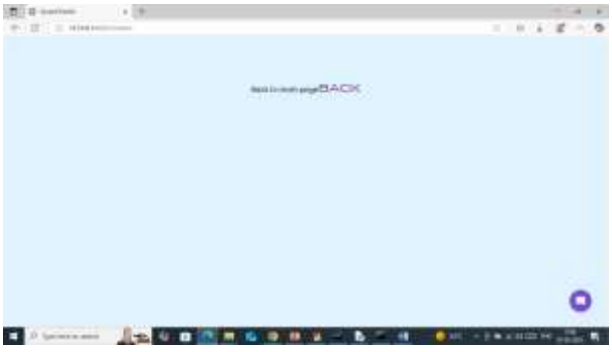
VI. SYSTEM MODEL

System Architecture

VII. RESULTS AND DISCUSSIONS

In above screen user is login and after login will get below page

In above screen click on 'Chatbot AI Based Symptoms Tracker' link to get below page



In above screen click on 'Blue' icon from bottom to activate Chatbot and then will get below page

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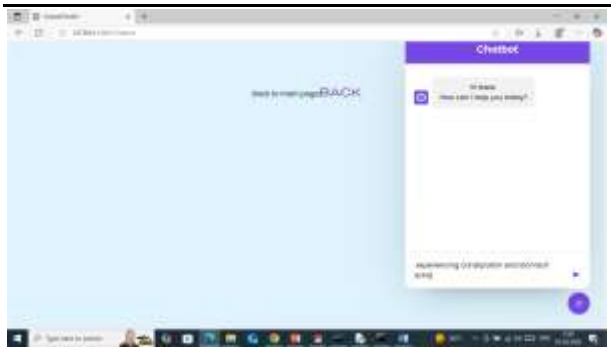
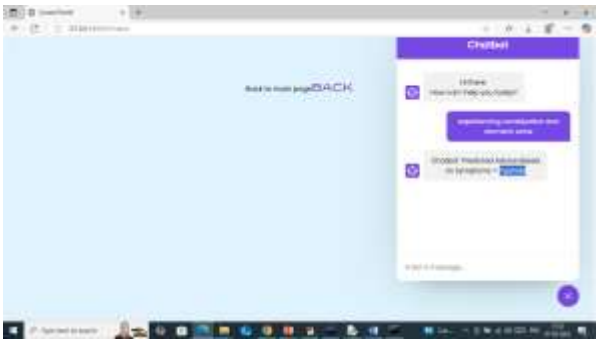
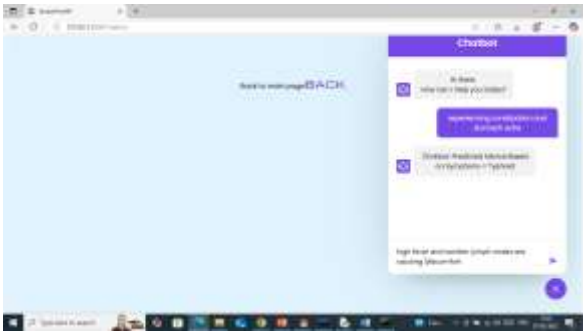


In above screen in bottom text field can enter input query and then press enter key to get below page



In above screen in blue text panel can see user query and then in white text panel Chatbot predicted disease of advice based on symptoms is 'Typhoid'. Similarly you can enter query and get response and below are some other response



In above screen given another query and below is the response

VIII. CONCLUSION

The proposed **SYMPTOTRACKAI: Hybrid RAG Chatbot for Symptom Monitoring** presents an advanced and reliable solution for modern digital healthcare by combining conversational AI with retrieval-based knowledge systems. By integrating a hybrid Retrieval-Augmented Generation (RAG) framework, the system overcomes the limitations of traditional chatbots and provides accurate, context-aware, and up-to-date medical responses.

The use of natural language processing enables users to interact with the system in a simple and intuitive manner, while the retrieval mechanism ensures that responses are grounded in verified medical information. Additionally, the incorporation of continuous symptom monitoring and personalized analysis allows the system to track user health over time and provide meaningful insights for early risk detection.

Compared to existing systems, the proposed approach enhances accuracy, reduces misinformation, and improves user engagement through intelligent and adaptive interactions. The system also emphasizes data privacy and security, making it suitable for handling sensitive healthcare information.

Overall, SYMPTOTRACKAI contributes to the advancement of digital health by offering a scalable, efficient, and user-friendly platform for symptom monitoring and preliminary

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health guidance. With further improvements and integration into healthcare ecosystems, it has the potential to support both patients and healthcare professionals in making informed decisions and improving overall health outcomes.

IX. FUTURE WORK:

The proposed **SYMPTOTRACKAI: Hybrid RAG Chatbot for Symptom Monitoring** can be further enhanced in several directions to improve its intelligence, reliability, and real-world applicability. Future work can focus on integrating more advanced large language models and domain-specific medical models to improve understanding of complex medical queries and provide more precise responses. Fine-tuning models on specialized healthcare datasets can further enhance accuracy and reduce ambiguity in symptom interpretation.

Another important direction is the incorporation of **multimodal data**, such as images (e.g., skin conditions), voice inputs, and wearable sensor data (e.g., heart rate, temperature). This would enable the system to provide more comprehensive health analysis by combining textual, visual, and physiological data.

The system can also be extended with **real-time health monitoring integration** using IoT devices and wearable technologies. Continuous data collection from smart devices can help in early detection of health anomalies and provide proactive healthcare recommendations.

Future enhancements may include implementing **explainable AI (XAI)** techniques to provide transparent reasoning behind predictions and recommendations. This will increase user trust and support healthcare professionals in validating the system's outputs.

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