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SymptoDx: An AI Based Diseases Prediction Using Symptoms and Hospital Recommendation Model

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Abstract - *Healthcare accessibility and early diagnosis remain major challenges in modern medicine. Patients often experience delays in receiving appropriate medical care due to the lack of reliable self-assessment tools. Traditional symptom checkers are usually rule-based, limited in scope, and incapable of guiding patients to the right healthcare facilities. To overcome these challenges, SymptoDx AI is developed as an intelligent, AI-driven healthcare support system. The proposed system utilizes machine learning models, specifically ensemble techniques such as Random Forest and XGBoost, to analyze patient-reported symptoms and predict possible diseases with improved accuracy.*

A key feature of SymptoDx AI is the integration of the Google Maps API, which provides real-time hospital recommendations based on the predicted condition and the patient's location, ensuring timely access to specialized care. Furthermore, the system incorporates an explainable AI layer using techniques like SHAP or LIME to provide transparency in predictions, thereby increasing patient trust and usability. The system is designed with a user-friendly interface to make healthcare insights accessible to patients, hospitals, and telemedicine platforms.

Key Words: Symptom Analysis, Disease Prediction, Machine Learning, Explainable AI, Healthcare Technology, Hospital Recommendation System

I. INTRODUCTION

Healthcare is one of the most critical sectors where timely access to accurate information can significantly impact patient outcomes. In many cases, patients delay seeking medical attention because they are uncertain about the severity of their symptoms or do not know which healthcare facility to approach. Traditional symptom checkers available online are often rule-based, limited in scope, and fail to reliable or personalized guidance. This gap creates the need for a more intelligent, user-friendly, and transparent solution that can empower patients to make informed healthcare decisions.

SymptoDx AI is designed as an innovative system that addresses this challenge by combining the power of machine learning, explainable AI, and location-based services. The system allows users to input their symptoms, which are then analyzed by advanced ensemble models such as Random Forest and XGBoost to predict potential diseases. Unlike conventional systems, SymptoDx AI does not stop at prediction—it goes a step further by recommending nearby hospitals with the relevant specialties, using the integration of the Google Maps API. This ensures that patients are not only made aware of possible health conditions but are also guided toward appropriate medical care promptly.

A key strength of SymptoDx AI is its explainability feature. By leveraging interpretability techniques such as SHAP or LIME, the system provides a clear explanation of how a prediction was made, highlighting the relationship between symptoms and possible diseases. This transparency enhances trust and ensures that patients and healthcare providers can use the tool confidently. Additionally, the user-friendly interface is designed to be accessible to patients from diverse backgrounds, making the system practical for both urban and rural healthcare settings.

Overall, SymptoDx AI offers a comprehensive, patient-centered approach to digital healthcare. By integrating disease prediction, hospital recommendation, and explainability, the project aims to reduce diagnostic delays, enhance patient awareness, and strengthen the bridge between individuals and healthcare providers. This project not only demonstrates the potential of AI in healthcare but also highlights the importance of making such technologies reliable, transparent, and accessible for widespread adoption.

The system is designed with a user-friendly interface to ensure accessibility for people from diverse backgrounds, including those with minimal technical expertise. Its applicability extends beyond individual patients—it can serve as a digital triage tool in hospitals, support telemedicine platforms, and even assist public health authorities in monitoring symptom trends for early detection of outbreaks.

II. LITERATURE SURVEY

Recent advancements in artificial intelligence (AI) have shown significant potential in improving healthcare navigation, disease prediction, and patient support systems. However, a review of existing studies reveals certain limitations that highlight the need for more comprehensive solutions such as *SymptoDx AI*.[1]

In 2024, research on AI-Driven Healthcare Navigation using Multimodal Inputs demonstrated the effectiveness of combining multiple data sources for improving healthcare access. While this approach enhanced prediction accuracy, the system lacked integration with local hospital databases and real-time updates, thereby limiting its practical usability in emergency and general healthcare scenarios.[2]

Similarly, Smart Healthcare: AI-Driven Symptom Checker for Disease Prediction by Chen et al. (2023) focused on improving disease prediction accuracy using advanced algorithms. Although effective in identifying possible conditions, the study did not extend its scope to hospital recommendation or patient navigation, restricting its value to symptom-to-disease mapping alone.[3]

Another contribution was by Patel and Shah (2023), who developed a Healthcare Navigation System using Google Maps API and AI. This study provided an important step toward linking prediction with healthcare facility guidance. However, the system was limited in its intelligence, as it did not prioritize or recommend hospitals based on disease severity, urgency, or specialization.[4]

Beyond technical models, the WHO Report (2022) on Ethics and Governance of Artificial Intelligence for Health emphasized the importance of ethical frameworks and responsible AI adoption in healthcare. While it provided broad guidelines, it fell short of offering specific strategies for implementing AI-driven hospital recommendation systems in real-world contexts.[5]

Finally, Kumar and Bansal (2022) proposed an AI-powered Emergency Medical Assistant, designed primarily for urgent and emergency use cases. Although it provided timely recommendations during critical events, the system lacked support for handling chronic diseases or general patient conditions, thereby restricting its overall scope of application.[6]

Taken together, these studies demonstrate the steady progress in AI-driven healthcare solutions but also reveal significant gaps. Most existing systems focus either on prediction or navigation, with limited integration of both. Moreover, the absence of explainability, real-time hospital recommendations, and broader disease coverage remains a challenge. *SymptoDx AI* seeks to address these shortcomings by combining accurate disease prediction, explainable AI, and intelligent hospital recommendation in a single user-friendly platform, thereby offering a more holistic healthcare solution.

III.COMPARATIVE ANALYSIS & RESEARCH GAP :-

Table 1.1 Research gap

Study	Methodology	Key Features	Efficiency Improvement	Research Gaps
Chen et al. (2023)	Machine Learning–based symptom analysis using ensemble models	Focused on AI-driven symptom–disease prediction	Achieved high prediction accuracy	Did not include hospital recommendation or navigation system
Patel & Shah (2023)	Integration of AI with Google Maps API for healthcare navigation	Linked users to nearby hospitals using location data	Improved accessibility to healthcare facilities	No prioritization of hospitals based on specialization or urgency
Kumar & Bansal (2022)	AI-powered emergency medical assistant with geolocation	Provided instant recommendations during emergencies	Enhanced response time for critical conditions	Limited only to emergency use, not for general healthcare
Prakash & Choudhury (2021)	NLP and Random Forest–based disease prediction	Used text input for symptom analysis	Improved prediction from unstructured data	No explainability or hospital recommendation integration
Liu et al. (2021)	Medical Knowledge Graph (MedKG) using EHR data	Created relational mapping between diseases and symptoms	Provided structured medical knowledge	Did not involve user-level interaction or real-time data
Roy & Ghosh (2020)	Geolocation-based hospital recommender system	Matched hospitals by specialization and proximity	Increased hospital recommendation efficiency	Lacked AI-based disease prediction and explainable reasoning

IV.COMPARATIVE SUMMARY

A detailed comparative analysis of existing research reveals significant progress in the application of Artificial Intelligence within healthcare, particularly in disease prediction and medical navigation systems. However, these studies also highlight several persistent gaps that limit their real-world implementation.

Chen et al. (2023) focused on enhancing disease prediction accuracy using advanced machine learning algorithms, successfully achieving precise results but lacking hospital recommendation and patient navigation capabilities. Similarly, Patel and Shah (2023) integrated AI with Google Maps API to improve hospital accessibility; however, their model did not consider hospital specialization or disease urgency, reducing its practical usefulness in critical healthcare scenarios.

Kumar and Bansal (2022) developed an AI-powered emergency assistant for rapid medical response, which proved efficient in emergency conditions but was not suitable for general or chronic disease management. The WHO Report (2022) emphasized ethical and governance principles for responsible AI usage in healthcare but did not provide specific implementation strategies for intelligent, patient-oriented systems.

Further, Prakash and Choudhury (2021) used NLP with Random Forest for disease prediction from textual symptom data, achieving good accuracy but without any explainable AI or hospital linkage features. Liu et al. (2021) introduced *MedKG*, a medical knowledge graph connecting symptoms and diseases, which enhanced structured healthcare data understanding but lacked live patient interaction and location-based functionality. Roy and Ghosh (2020) proposed a geolocation-based hospital recommender model that effectively suggested nearby hospitals but did not integrate AI-driven disease prediction or explainability.

The proposed system, **SymptoDx AI (2025)**, overcomes these limitations by combining ensemble learning models (Random Forest, XGBoost) with Explainable AI techniques (SHAP, LIME) and Google Maps API integration. It not only predicts diseases with high accuracy but also recommends nearby hospitals specialized in treating those conditions, while maintaining transparency and user trust. This integrated framework bridges the major research gaps identified in previous studies by offering a holistic, intelligent, and patient-centric healthcare solution. Future work can focus on extending its capabilities to include multilingual interfaces, wearable sensor integration, and Electronic Health Record (EHR) connectivity for enhanced predictive performance.

V.METHODOLOGY

The proposed system, SymptoDx AI, is designed to bridge the gap between patient-reported symptoms and accurate, timely healthcare services. The methodology integrates Machine Learning (ML), Explainable Artificial Intelligence (XAI), and Geospatial Mapping Technologies to predict diseases and recommend specialized hospitals in real-time.

A. User Input Module

The process begins with the user entering symptoms through a simple and interactive interface. Users can input symptoms in text form or select from predefined options. This module is responsible for collecting raw health-related information, which serves as the foundation for disease prediction.

B. Data Preprocessing

Once the symptoms are entered, they undergo data preprocessing to improve quality and ensure compatibility with the machine learning models. This includes:

Removing irrelevant or duplicate data

Standardizing symptom terminology

Converting text-based input into numerical form using Natural Language Processing (NLP) techniques

Tokenization and vectorization for model input

This step ensures that the dataset is clean, structured, and ready for analysis.

C. Machine Learning Model for Disease Prediction

The preprocessed data is passed to the disease prediction model, which employs ensemble learning algorithms such as Random Forest and XGBoost. These algorithms analyze symptom patterns and identify possible diseases based on training from large medical datasets.
The model generates:

- A list of possible diseases
- The probability or confidence level of each prediction

This ensures high accuracy and reliability in identifying potential health conditions.

D. Explainable AI (XAI) Integration

To build trust and transparency in the system, Explainable AI techniques such as SHAP (SHapley Additive exPlanations) and LIME (Local Interpretable Model-

Agnostic Explanations) are used. These methods explain how each symptom contributes to the predicted disease, allowing users and healthcare professionals to understand the reasoning behind the AI's decision. This feature enhances credibility and user confidence in the system's output.

E. Geospatial Hospital Recommendation System

Once the disease prediction is completed, the system integrates with the Google Maps API to identify nearby hospitals or healthcare centers specializing in the predicted condition. Hospitals are ranked and recommended based on:

Specialization and treatment facilities

Proximity to the user's location

User reviews and hospital ratings

This ensures that patients receive immediate, location-specific healthcare recommendations.

F. Feedback and Continuous Learning

A feedback loop is implemented where users and healthcare professionals can provide responses about prediction accuracy or hospital recommendations. This feedback is stored and used to retrain and fine-tune the ML model, thereby continuously improving prediction accuracy and system performance.

G. Doctor/Healthcare Integration

The final output, including predicted diseases and hospital recommendations, can be shared with healthcare professionals through digital reports or APIs. This helps doctors in preliminary diagnosis and supports telemedicine platforms in providing faster and more informed consultations.

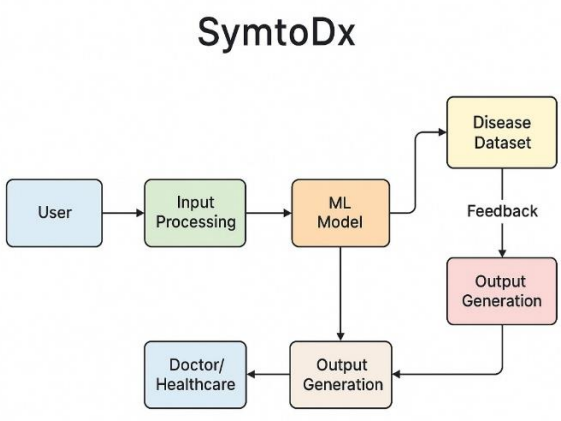

FIG 1.1. ARCHITECTURE OVERVIEW

VI. PROJECTED OUTCOMD AND FUTURE SCOPE

The proposed system, SymptoDx AI, is expected to emerge as an intelligent, accurate, and transparent healthcare support platform that effectively bridges the gap between symptom recognition and access to timely medical care. By combining machine learning algorithms, explainable AI techniques, and geospatial technologies, the system aims to deliver reliable disease predictions and recommend nearby specialized hospitals in real time. The ensemble learning models such as Random Forest and XGBoost are projected to provide highly accurate predictions based on user-reported symptoms, thereby reducing diagnostic uncertainty and delays. The integration of Explainable AI tools like SHAP and LIME will make the prediction process transparent and interpretable, allowing patients and healthcare professionals to understand the reasoning behind each diagnosis. Furthermore, the inclusion of Google Maps API will enable dynamic hospital recommendations based on location, specialization, and availability, improving accessibility and patient response time. As a result, SymptoDx AI is anticipated to enhance patient awareness, assist healthcare providers in early assessment, and contribute to the development of data-driven decision-making in digital healthcare systems. The system's user-friendly interface ensures that even individuals with limited technical knowledge can utilize it effectively, promoting inclusive healthcare access for both urban and rural users.

Looking ahead, SymptoDx AI holds immense potential for further expansion and integration into the broader healthcare ecosystem. In the future, the system can be enhanced through integration with wearable health monitoring devices such as smartwatches and IoT-based sensors to enable continuous tracking of patient health data. Incorporating Electronic Health Records (EHRs) could provide personalized predictions and continuity of care based on individual medical history. Another promising direction involves developing a multilingual interface to cater to users from diverse linguistic backgrounds, particularly in rural and regional areas. Additionally, implementing voice-based symptom input and AI-powered chatbots can make the system more accessible to elderly and differently-abled individuals. Cloud-based deployment will ensure scalability, real-time updates, and seamless integration with telemedicine platforms. Finally, aggregated and anonymized symptom data can be utilized for public health analytics, helping authorities predict regional disease trends and detect potential outbreaks at an early stage.

In conclusion, the projected outcomes and future scope of SymptoDx AI signify a transformative step toward smarter, preventive, and inclusive healthcare. By integrating advanced AI techniques, explainability, and geolocation-based recommendations, the system can evolve into a

holistic digital health companion that empowers patients, supports doctors, and strengthens the overall healthcare infrastructure.

VII. CONCLUSION

The proposed system, SymptoDx AI, is expected to make a significant contribution to the advancement of intelligent healthcare systems by providing an efficient, transparent, and patient-centric disease prediction platform. The study concludes that the integration of machine learning algorithms, explainable artificial intelligence, and geospatial mapping technologies can greatly enhance the accuracy, reliability, and accessibility of early disease diagnosis. By allowing users to input their symptoms and receive instant predictions along with real-time hospital recommendations, SymptoDx AI effectively bridges the existing gap between self-assessment and professional healthcare consultation. The system's use of ensemble models such as Random Forest and XGBoost ensures precise and data-driven predictions, while Explainable AI (XAI) methods like SHAP and LIME provide transparency and interpretability, thus increasing trust among users and healthcare professionals. The integration of Google Maps API further strengthens the system's practical usability by helping patients locate nearby hospitals specialized in treating the predicted conditions. Overall, SymptoDx AI is expected to improve healthcare accessibility, promote early intervention, and support data-driven decision-making in the medical field.

Although the system demonstrates strong potential, several opportunities for future research remain open to enhance its scope and effectiveness. Future studies can explore the incorporation of deep learning architectures such as recurrent or transformer-based neural networks to capture complex symptom-disease relationships more accurately. Integration with Electronic Health Records (EHRs) and wearable IoT devices could enable real-time, personalized health monitoring and prediction. Expanding the platform to support multilingual and voice-based interaction will make it more inclusive and beneficial for users from diverse linguistic and demographic backgrounds. Further research can also focus on developing cloud-based frameworks for scalability and interoperability with telemedicine systems. Additionally, the collection and analysis of anonymized user data can be utilized for epidemiological forecasting, helping governments and health organizations predict and manage potential disease outbreaks.

In summary, SymptoDx AI lays the foundation for an intelligent, explainable, and globally accessible healthcare ecosystem. With continued research and innovation, it can evolve into a comprehensive preventive healthcare platform capable of transforming how individuals interact with medical technology and how healthcare systems respond to emerging challenges.

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