SMART HEALTH ASSISTANT: ARTIFICIAL INTELLIGENCE DRIVEN SELF-DIAGNOSIS ANDDISEASE FORECASTING

[1]Beesa Sujith Kumar, [2]Chimchimgari Vamsi Krishna
[1,2]UG Student, [1,2]Department of Computer Science & Engineering, Geethanjali Institute of Science and Technology, Gangavaram, Andhra Pradesh, India

ABSTRACT

Healthcare sector is shifting focus on improving services by adopting new technological approaches. This project proposes the development of an around-the- clock healthcare chatbot system designed to assist the general public with primary medical care needs. By providing accessible self-diagnosis and medical advisory capabilities, the chatbot aims to alleviate the workload on frontline healthcare professionals, especially during times of high demand or resource constraints. With the increase in need of medical services and lack of availability of the resources, Healthcare Chatbot is an attempt to assist common people with primary health care by reducing the burden on medical frontline workers.

The objective of this project work is to design a 24/7 available chatbot thatanswers common medical queries, predicts disease based on the symptoms and radiology images provided, aids with medication precautionary measures that are tobe followed. A chatbot can provide a customized one on one interaction through textto voice interface and gives reply. Leveraging artificial intelligence and machine learning techniques, the chatbot delivers personalized responses by employing natural language processing to comprehend user inputs containing specific keywords. It responds differently to message containing certain keywords and uses Machine Learning to adapt their responses to fit the situation.

The healthcare chatbot handles a large number of requested queries at a time making it reliable to use. The chatbot responds to medical queries only to the best of its knowledge database. While not intended to replace professional medical consultations, the chatbot serves as a self-diagnostic tool, potentially reducing the strain on healthcare resources, a particularly valuable asset during pandemics when access to in-person care is limited.

INTRODUCTION

In recent years, there has been a surge in the adoption of technological solutions within the healthcare sector to improve service delivery and accessibility. One such innovative approach is the development of intelligent chatbots, which leverage artificial intelligence (AI) and machine learning (ML) techniques to provide personalized and interactive medical assistance.

The primary objective of this project is to develop a 24/7 available healthcarechatbot system designed to assist the general public with primary medical care needs. By offering self-diagnosis capabilities, answering common medical queries, and providing relevant information on diseases, medications, and precautionary measures, the chatbot aims to alleviate the workload on frontline healthcare professionals, particularly during times of high demand or resource constraints.

Chatbots are available in many domains including Healthcare that abate the complications faced by the end-user. From our extensive research, we found that a fully developed web application with an integrated chatbot that replaces a manual ofa medical physicians. A virtual assistant in the form of a chatbot eliminates the needto contact the customer care personnel for trivial issues and focuses on bettering the patient care and diagnosis.

Cognitive chatbots that can perform sentiment analysis on the user to track their mood and promote better emotional health have been developed. Apart from these, chatbots have been developed with the expertise of doctors to track the symptoms of the users and arrive at a diagnosis. The proposed Health Bot is developed using a Python framework called Rasa, a contextual assistant that employsMachine Learning.

MOTIVATION

The healthcare industry faces numerous challenges in providing timely, accessible, and affordable medical services to the general population. The growing demand for healthcare, shortage of medical professionals, and the need for efficient resource allocation have necessitated the exploration of innovative technological solutions.

One of the primary motivations behind this project is to address the increasingburden on frontline healthcare workers, especially during times of high demand or resource constraints, such as pandemics or public health emergencies. By developing a self-service chatbot system, we aim to alleviate the workload on medical professionals, enabling them to focus their efforts on more critical cases and improving overall patient care.

Furthermore, the project is driven by the need to enhance access to primary medical care for individuals who may face geographical, financial, or mobility- related barriers. The chatbot system provides a convenient, cost-effective, and accessible platform for individuals to seek medical advice, obtain self-diagnosis recommendations, and receive guidance on appropriate next steps, without the need for immediate in-person consultations.

Literature Review

Artificial intelligence and internet of thing enabled disease diagnosis modelfor smart healthcare system

"Sandhiyogha Lakshmi V, Nisha Evangelin L(2023)"

An artificial intelligence and Internet of Things (AIoT) enabled disease diagnosis model revolutionizes smart healthcare systems by amalgamating advanced technologies for efficient patient care. Integrates algorithms with IoT devices to gather real-time health data and analyse it for accurate diagnosis and timely intervention. Through AI's machine learning capabilities, the system can recognize patterns in patient data, identify anomalies, and predict potential health issues. IoT devices such as wearable sensors, smart medical devices, and health monitoring gadgets continuously collect vital signs, activity levels, and other relevant data, providing a comprehensive health profile.

This amalgamation enhances disease detection by enabling early symptom recognition, facilitating proactive healthcare interventions, and optimizing treatment plans tailored to individual patient needs. Additionally, it fosters remote patientmonitoring, allowing healthcare professionals to remotely track patient health status, intervene when necessary, and offer timely advice or adjustments to treatment plans. By leveraging AIoT, healthcare systems can achieve heightened efficiency, reduce diagnostic errors, and enhance patient outcomes, ultimately ushering in a newera of personalized and proactive healthcare delivery.

Disease Symptom Analysis Based Department Selection Using MachineLearning for Medical Treatment

"Md. Latifur Rahman, Rahad Arman Nabid, Md. Farhad Hossain (2020)"

Most of the patients today who face health problems, initially take advicefrom unprofessional or people with no knowledge that makes them more vulnerable.

In many occasions, doctors also get confused with identifying actual disease. This might happen as they usually identify disease based on their limited experience. Moreover, general patient selects doctor according to thei r will and with no knowledge about the disease that may need specialist doctor. But some disease cannot be confirmed without a specialized doctor. Therefore, this paper proposes a MachineLearning based disease symptom analysis technique for assisting the patients seekingproper treatment by selecting accurate medical department using the symptom that they can easily recognize. Proposed framework will use machine learning technique to select a medical department based on the joint consideration of various disease symptoms of the patient. We investigate our proposed framework by using 9 different supervised machine learning techniques. Performance of framework for identifying appropriate medical department under the machine learning techniques is thoroughly investigated and compared. This framework can be used for telemedicine platform or in automated hospital management sector. This may create a path of enormous development in health care sector.

Lung cancer disease prediction with CT scan and histopathological imagesfeature analysis using deep learning techniques

"Vani Rajasekar, M.P. Vaishnnave, S. Premkumar, Velliangiri Sarveshwaran, and V. Rangaraaj (2023)"

Lung cancer is characterized by the uncontrollable growth of cells in the lung tissues. Early diagnosis of malignant cells in the lungs, which provide oxygen to the human body and excrete carbon dioxide because of important processes, is critical. Because of its potential importance in patient diagnosis and treatment, the use of deep learning for the identification of lymph node involvement on histopathological slides has attracted widespread attention. The existing algorithm performs considerably less in recognition accuracy, precision, sensitivity, F-Score, Specificity, etc. The proposed methodology shows enhanced performance in the metrics with six different deep learning algorithms like Convolution Neural Network (CNN), CNN Gradient Descent (CNN GD), VGG-16, VGG-19, Inception V3 and Resnet-50. The proposed algorithm is analyzed based on CT scan images and histopathological images. The result analysis shows that the detection accuracy is better when histopathological tissues are considered for analysis.

Classification of COVID-19 in chest X-ray images using DeTraC deepconvolutional neural network

"Asmaa Abbas, Mohammed M. Abdelsamea, Mohamed Medhat Gaber(2021)"

Chest X-ray is the first imaging technique that plays an important role in the diagnosis of COVID-19 disease. Due to the high availability of large-scale annotated image datasets, great success has been achieved using convolutional neural networks(CNN s) for image recognition and classification. However, due to the limited availability of annotated medical images, the classification of medical images remains the biggest challenge in medical diagnosis. Thanks to transfer learning, an effective mechanism that can provide a promising solution by transferring knowledge from generic object recognition tasks to domain-specific tasks. In this paper, we validate and a deep CNN, called Decompose, Transfer, and Compose (DeTraC), for the classification of COVID-19 chest X-ray images. DeTraC can deal with any irregularities in the image dataset by investigating its class boundaries using a class decomposition mechanism. The experimental results showed the capability of DeTraC in the detection of COVID-19 cases from a comprehensive image dataset collected from several hospitals around the world. High accuracy of 93.1% (with a sensitivity of 100%) was achieved by DeTraC in the detection of COVID-19 X-ray images from normal, and severe acute respiratory syndrome cases.

AI-powered cloud for COVID-19 and other infectious disease diagnosis

"Fadi Al-Turjman (2021)"

An AI-powered cloud for COVID-19 and other infectious disease diagnosis integrates machine learning algorithms with cloud computing infrastructure to enhance disease detection and diagnosis. These systems utilize vast datasets of medical images, patient records, and clinical data to train algorithms capable of accurately identifying signs of infection in radiological scans, blood tests, and symptom profiles. By leveraging the scalability and accessibility of cloud computing, these AI systems can rapidly process large volumes of data from diverse sources, enabling quick and accurate diagnoses. Furthermore, they facilitate real-time collaboration among healthcare professionals by providing centralized access to diagnostic tools and patient information, improving coordination and decision- making.

The AI algorithms continually learn from new data, enabling them to adapt to evolving disease patterns and improve diagnostic accuracy over time. Additionally, these systems can aid in early detection and monitoring of outbreaks by analyzing epidemiological data and identifying emerging hotspots.Overall, an AI-powered cloud for infectious disease diagnosis holds immense potential to revolutionize healthcare delivery, offering faster, more accurate diagnoses, improving patient outcomes, and enhancing public health surveillance efforts.

Real-time healthcare monitoring using smart systems

"Vaidik Bhatt, Samyadip Chakraborty (2021)"

Real-time healthcare monitoring powered by smart systems represents a monumental leap in healthcare service orchestration. These innovative technologies integrate advanced sensors, data analytics, and connectivity to deliver unparalleled insights into patients' health statuses. By continuously collecting and analyzing vital signs, medication adherence, and other relevant data points, smart systems enable healthcare providers to remotely monitor patients' well-being in real-time.

Moreover, these systems can detect anomalies or deviations from baseline metrics promptly, allowing for proactive interventions and timely adjustments to treatment plans. This proactive approach not only enhances patient outcomes but also reduces healthcare costs by preventing complications and hospital readmissions.
Through secure digital platforms, they enable efficient exchange of information, remote consultations, and personalized care delivery.
In essence, the integration of smart systems into healthcare represents a transformative shift towards patient-centric, data-driven, and efficient healthcare delivery. As these technologies continue to evolve, they hold immense potential to revolutionize how healthcare services are orchestrated and delivered, ultimatelyleading to improved quality of care and better health outcomes for individuals and populations alike.

Medical diagnostic systems using artificial intelligence (ai) algorithms

"Pratima Kadam (2023)"

Medical diagnostic systems leveraging artificial intelligence (AI) algorithms have emerged as powerful tools in healthcare, revolutionizing the way diseases are detected and treated. These systems harness the capabilities of AI, including machinelearning and deep learning, to analyze complex medical data and assist healthcare professionals in making accurate diagnoses. By training on vast amounts of patient data, AI algorithms can recognize patterns, correlations, and subtle indicators that may not be readily apparent to human observers. This enables them to identify disease markers, predict outcomes, and even suggest personalized treatment plans based on individual patient characteristics.
Furthermore, AI-driven diagnostic systems can operate with remarkable speed and efficiency, processing large volumes of data in a fraction of thetime it would take for a human expert to do so. This rapid analysis can lead to earlier detection of diseases, allowing for timely interventions and improved patient outcomes. Moreover, these systems have the potential to reduce diagnostic errors and variability in interpretation, enhancing the overall quality and consistency of healthcare delivery. They can serve as valuable decision support tools for healthcareproviders, augmenting their expertise and improving diagnostic accuracy.
As AI continues to advance, medical diagnostic systems will play an increasingly vital role in healthcare, empowering clinicians with actionable insights and transforming the landscape of medical diagnosis and treatment. By leveraging the power of AI, these systems hold promise for more precise, efficient, and personalized healthcare delivery, ultimately benefiting patients and healthcare systems worldwide.

Intelligent Health Monitoring System for detection of symptomatic /asymptomatic COVID-19 patient

"Sudarshan Nandy, Mainak Adhikari (2021)"

An intelligent health monitoring system for the detection of symptomatic and asymptomatic COVID-19 patients represents a critical tool in the ongoing battleagainst the pandemic. Leveraging a combination of AI, IoT devices, and data analytics, such a system can offer real-time monitoring and early detection of potential cases, thereby aiding in the containment and mitigation of the virus's spread.This system can utilize wearable devices equipped with sensors to continuously monitor vital signs such as body temperature, heart rate, and respiratory rate. AI algorithms can analyze the data collected from these devices to detect anomalies or patterns indicative of COVID-19 symptoms, even in asymptomatic individuals.
Furthermore, the integration of data from various sources, including self-reported symptoms, travel history, and contact tracing data, can enhance the system's accuracy in identifying potential cases. By employing machine learning techniques, the system can adapt and improve its predictive capabilities over time based on new data and emerging trends. Moreover, such a system can enable timely interventions by alerting healthcare providers and individuals to seek testing or self-isolate if necessary. By facilitating early detection and containment of COVID-19 cases, it can help reduce transmission rates and alleviate the burden on healthcare systems. Overall, an intelligent health monitoring system for COVID-19 detection holds significant promise in supporting public health efforts to control the pandemic.

EXISTING SYSTEM

The current healthcare paradigm predominantly relies on traditional, in-person interactions between patients and healthcare providers. However, to optimize accessibility and operational efficacy, a proposed healthcare

chatbot endeavours to serve as a conduit between patients and medical experts through digital interfaces. Harnessing cutting-edge AI and machine learning methodologies, this chatbot aims to deliver tailored medical guidance, symptom assessment, and preliminary diagnostic insights based on user input. Additionally, its implementation will be underpinned by a sophisticated rule-based framework, ensuring precision in responses and alignment with established medical protocols. Integrated seamlessly within existing healthcare frameworks, this solution facilitates patients' effortless engagement with healthcare professionals for further consultation, heralding a paradigm shift toward comprehensive healthcare delivery that amalgamates the convenience of digital platforms with the expertise of seasoned medical practitioners.

PROPOSED SYSTEM

In our proposed methodology, we present a pioneering healthcare chatbotsystem meticulously crafted on the robust foundation of the Rasa framework. This innovation marks a departure from conventional methods, eschewing the arduous task of constructing chatbots from scratch with deep learning and machine learning frameworks like TensorFlow. Instead, our strategy harnesses Rasa's pre-built modules for seamless model training, enabling efficient intent extraction and bespoke output generation. This chatbot facilitates structured dialogues, adeptly extracting crucial medical data, including symptoms, medical history, and concerns, while also accommodating user-submitted radiology images. Leveraging advanced image analysis techniques, it extends its capabilities to disease prediction and diagnosis, transcending conventional healthcare approaches.

SYSTEM ARCHITECTURE

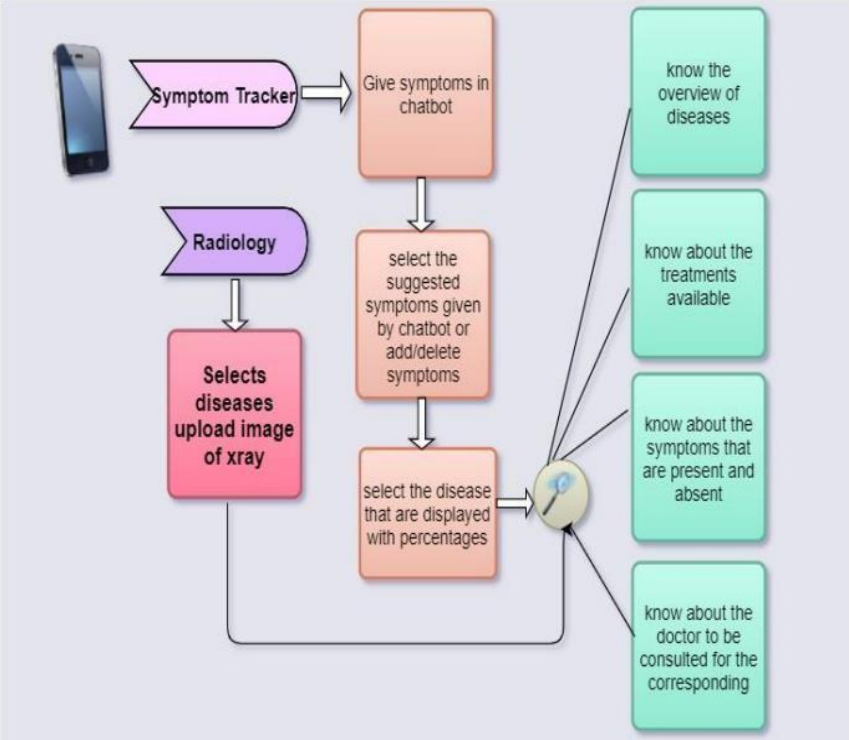

Fig.1. Chatbot Architecture

Distinguished by its intuitive interface and natural language interaction capabilities, our chatbot streamlines the healthcare journey, empowering users with tailored recommendations and guidance. By optimizing both time and effort, it facilitates informed healthcare decisions, all while ensuring scalability and adaptability to meet evolving user needs and integrate with external medical data sources. Through this pioneering approach, we endeavor to redefine patient engagement in healthcare, offering a personalized and efficient means of accessing medical assistance and guidance, including groundbreaking disease prediction through radiology image analysis.

ADVANTAGES

1. **Accuracy and Reliability**: Advanced AI algorithms enhance accuracy in diagnosis and forecasting, aiding in timely and precise healthcare decisions.
2. **Privacy and Security**: Robust encryption and access controls ensure the protection of sensitive health data, fostering trust and compliance with privacy regulations.
3. **Accessibility:** User-friendly interfaces and multilingual support make the system accessible to diverse populations, promoting inclusivity and equitable healthcare access.
4. **Bias Mitigation:** Incorporation of bias mitigation techniques addresses disparities in diagnosis and treatment recommendations, promoting fairness acrossdemographic groups.
5. **Ethical Compliance:** Clear protocols for informed consent and algorithmictransparency uphold ethical standards, fostering trust between users and the healthcare system.
6. **Healthcare Provider Collaboration**: Integration with healthcare professionals facilitates collaboration and augments clinical decision-making, improving patientoutcomes.
7. **Continuous Improvement:** Ongoing monitoring, evaluation, and user feedback drive system enhancements, ensuring its effectiveness and relevance over time.

CONVOLUTIONAL NEURAL NETWORK (CNN)

Convolutional Neural Networks (CNNs) are a class of deep learning models specifically designed for processing structured grid-like data, such as images. They are inspired by the organization of the animal visual cortex and are highly effective for tasks like image classification, object detection, and segmentation.

SYSTEM IMPLEMENTATION

RASA

Rasa is an open-source conversational AI framework that enables developersto build, customize, and deploy chatbots and virtual assistants. It provides tools and libraries for natural language understanding (NLU), dialogue management, and integration with messaging platforms

NATURAL LANGUAGE UNDERSTANDING (NLU) :

Natural Language Understanding (NLU) in Rasa involves processing user messages to extract intents and entities, which are essential for understanding user input and generating appropriate responses. Here's how NLU works in Rasa:

Intent Recognition: The first step in NLU is to recognize the intent behind the user message. An intent represents the purpose or goal of the user's message.

Entity Extraction: In addition to intents, NLU also extracts entities from the user message. Entities are pieces of information relevant to the intent.

Training Data: To train the NLU model, you need to provide labelled training data that contains examples of user messages along with their corresponding intents and entities. This data is used to train machine learning models that can recognize patternsand relationships between words and their meanings.

Pipeline Configuration: In Rasa, you define an NLU pipeline that specifies the sequence of components used to process user messages. A typical NLU pipeline might include tokenization, featurization, intent classification, and entity extraction components.

Model Training: Once you have labeled training data and defined an NLU pipeline,you can train the NLU model using the Rasa training command. During training, the model learns to recognize patterns and associations between words, intents, and entities in the training data.

Intent Classification: During inference, the trained NLU model takes a user messageas input and predicts the most likely intent(s) associated with the message. Rasa uses machine learning algorithms such as support vector machines (SVM), recurrent neural networks (RNNs), or transformer-based models for intent classification.

Entity Extraction: In addition to intent classification, the NLU model also extracts entities from the user message using techniques such as conditional random fields (CRF) or bidirectional long short-term memory

networks (BiLSTMs).

RASA MODULES

A raw chatbot build on top of deep learning and machine learning techniques basically uses any of the frameworks like tensor flow etc. They need to be modelled from scratch. But using Rasa we simply use the modules provided by rasa to train the inbuild model with the input data where the intent from the user can be get and also customizing the output for the user intent.

Results

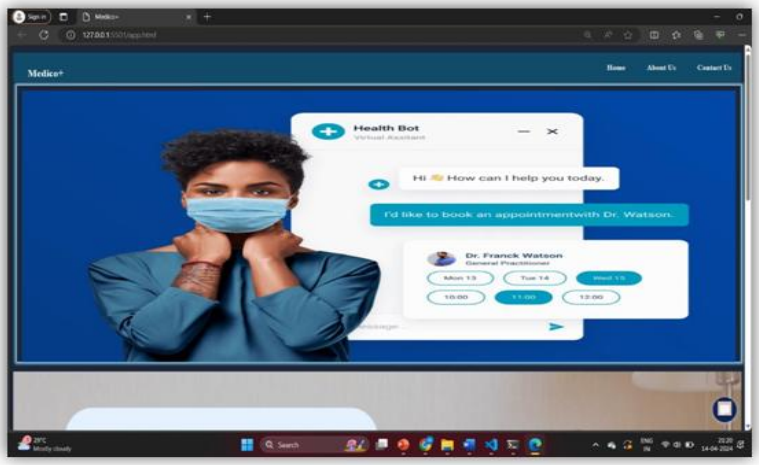

Fig.2. WebSite of Healthcare Chatbot

Fig.3. Starting interaction with Chatbot

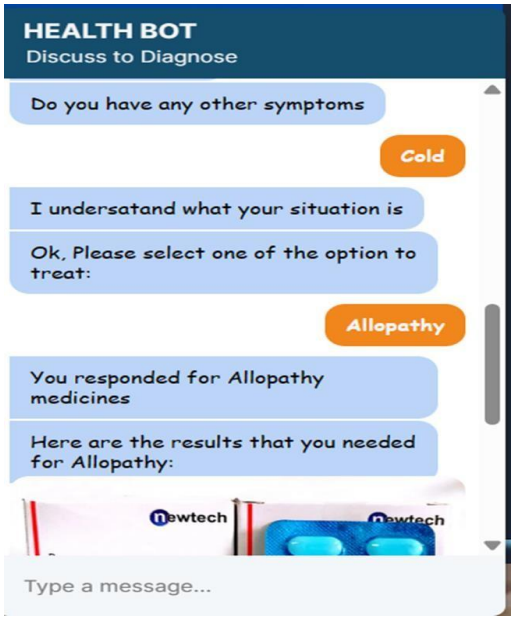

Fig.4. Client and Bot Responses

Fig.5. Providing Medication to Client

CONCLUSION

Here we have successfully created a Chatbot using Rasa. Rasa is an essentialtool or Framework to build a Chatbot. The main advantage of Rasa chatbot is basically the easiness and customization of a chatbot without having in depth knowledge in deep neural networks and machine learning. In conclusion, the development of a smart health assistant with AI-driven self-diagnosis and disease forecasting capabilities is a complex but highly valuable endeavor in the realm of healthcare innovation. Through a combination of sophisticated algorithms, comprehensive testing methodologies, and user-centered design principles, such a system holds the potential to revolutionize the way individuals manage their health and well-being.

By harnessing the power of artificial intelligence, this smart health assistant can accurately interpret user

symptoms, analyze medical data, and provide personalized recommendations for self-diagnosis and disease forecasting. Whether it's identifying potential health risks, suggesting preventive measures, or offering guidance on treatment options, the AI-driven capabilities of this system can empowerusers to make informed decisions about their health with greater confidence and efficiency.

Throughout the development process, rigorous testing is paramount to ensure the reliability, accuracy, and safety of the smart health assistant. By employing both black box and white box testing methodologies, developers can thoroughly evaluate the system's functionality, performance, and usability across a wide range of scenarios and use cases. This includes validating input handling, assessing boundary conditions,stress testing under high load conditions, and soliciting user feedback through acceptance testing.

FUTURE SCOPE

Looking forward, the future scope of the healthcare chatbot system lies in its integration with wearable devices and telemedicine platforms, heralding a transformative era in personalized healthcare. By seamlessly connecting with wearable health devices, the chatbot gains access to real-time health data, enabling users to continuously monitor vital signs and activity levels. This integration not onlyenhances the accuracy of self-diagnosis but also empowers individuals to proactivelymanage their health by receiving timely insights and alerts tailored to their unique health parameters.

Simultaneously, the chatbot's integration with telemedicine platforms revolutionizes access to healthcare services, allowing users to effortlessly schedule virtual consultations with healthcare professionals directly through the chatbot. This advancement transcends geographical barriers and time constraints, offering users convenient and timely access to medical expertise from the comfort of their own homes. Together, these innovations mark a significant step towards preventive and personalized healthcare, empowering individuals to take control of their well-being with the support of intelligent digital health assistants.

References

1. D S. Shaikh, J. Gala, A. Jain, S. Advani, S. Jaidhara and M. Roja Edinburgh, Analysis and Prediction of COVID-19 using Regression Models and Time Series Forecasting,Confluence,2021.
2. R. Kumari et al., Analysis and predictions of spread, recovery, and death caused byCOVID-19 in India, in Big Data Mining and Analytics.
3. R. Lee and C. Chitnis, Improving Health-Care Systems by Disease Prediction, CSCI, 2018.
4. H. Q. Yu, Experimental Disease Prediction Research on Combining Natural Language Processing and Machine Learning, ICCSNT, 2019.
5. Asmaa Abbas, Mohammed M. Abdelsamea, Mohamed Medhat Gaber , Classification of COVID-19 in chest X-ray images using DeTraC deep convolutionalneural network ,2021.
6. Md. Latifur Rahman, Rahad Arman Nabid, Md. Farhad Hossain, Disease Symptom Analysis Based Department Selection Using Machine Learning for Medical Treatment, IEEE,2020.
7. Vani Rajasekar, M.P. Vaishnnave, S. Premkumar, Velliangiri Sarveshwaran, and V. Rangaraaj , Lung cancer disease prediction with CT scan and histopathological imagesfeature analysis using deep learning techniques, 2023.
8. R. Pradeep, S. Praveen Kumar, S. Sasikumar, P. Valarmathie, and P. V. Gopirajan,Artificial Intelligence-Based Automation System for Health Care Applications: Medbot, 2022.
9. Sandhiyogha Lakshmi V, Nisha Evangelin L , Artificial intelligence and internet ofthing enabled disease diagnosis model for smart healthcare system ,2023.
10. Vaidik Bhatt, Samyadip Chakraborty ,Real-time healthcare monitoring usingsmart systems, 2021.