International Journal of Engineering Research and Science & Technology

www.ijerst.org

ISSN : 2319-5991

Vol. 22 No. 1 (2026)

ijerst.editor@gmail.com

editor@ijerst.com

International Journal of Engineering Research and Science & Technology

ISSN 2319-5991 www.ijerst.com
Vol. 22, No. 1, 2026

Peer Reviewed, Referred & Indexed Journal

Research

Disease Diagnosis Using Multi Layer Perceptron

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Abstract:

The rapid growth of artificial intelligence in healthcare has enabled the development of intelligent systems that support early disease diagnosis and patient guidance. This paper presents an extended version of an intelligent healthcare virtual assistant that performs symptom-based disease diagnosis using Natural Language Processing (NLP) and a Convolutional Neural Network (CNN). The proposed system allows users to interact through a virtual assistant interface, where textual symptom inputs are processed and transformed into structured features for deep learning–based disease prediction. The CNN model effectively learns complex symptom–disease relationships and achieves an accuracy of 95.02%, with 98.44% precision, 95.14% recall, and an F1-score of 96.33%, demonstrating superior performance compared to traditional machine learning approaches. In addition to disease prediction, the extended system provides diet recommendations and relevant doctor or hospital information to assist users in making informed healthcare decisions. Although the system does not replace professional medical consultation or support real-time appointment booking, it serves as a reliable preliminary decision-support tool. The experimental results validate the effectiveness, accuracy, and practical applicability of the proposed CNN-based virtual assistant, highlighting its potential to reduce time, cost, and dependency on frequent hospital visits while improving accessibility to healthcare services.

Index Terms— healthcare support applications.

Keywords— Healthcare Virtual assistant, Disease Prediction, Natural Language Processing (NLP), Machine Learning, Predictive Analysis, Decision Tree Model, Recommendation System, AI in Healthcar

Received: 10-01-2026 Accepted: 18-02-2026 Published: 25-02-2026

1. INTRODUCTION

By allowing intelligent systems that aid in illness detection, patient monitoring, and clinical decision support, the swift development of artificial intelligence (AI) and deep learning technologies has profoundly changed the healthcare industry. Among these developments, healthcare

virtual assistants have drawn a lot of interest because of their capacity to offer immediate medical advice via natural language communication. These technologies are designed to make healthcare services more accessible, particularly in situations where prompt medical advice is not easily accessible.

A key component of efficient therapy and healthcare administration is early illness diagnosis. However, issues including a lack of medical resources, lengthy wait times, and higher consultation charges are common in traditional healthcare systems. AI-powered virtual assistants have become helpful tools that provide health-related information and a preliminary diagnostic in order to treat these problems. Current virtual assistant-based diagnostic systems mostly use rule-based methods or conventional machine learning models, which frequently have low accuracy, poor generalization, and a failure to grasp intricate correlations between symptoms and diseases.

An extended intelligent healthcare virtual assistant that combines Natural Language Processing (NLP) with a Convolutional Neural Network (CNN) for symptom-based illness detection is presented in this study in order to get around these restrictions. While the CNN model carries out deep feature learning and precise illness classification, natural language processing (NLP) techniques are used to interpret and extract relevant symptom information from user-provided textual input. CNNs may learn intricate non-linear patterns, which improves prediction performance when compared to traditional models.

The suggested modification not only predicts diseases but also improves system use by including dietary advice and pertinent hospital or medical details related to the predicted ailment. This turns the virtual assistant into a useful healthcare advice system in addition to a diagnostic tool. The virtual assistant serves as an efficient decision-support tool that lowers needless hospital stays and saves users time and money, even if it cannot take the place of expert medical advice.

The results of the experiment show that the suggested CNN-based virtual assistant outperforms conventional machine learning techniques in terms of accuracy and dependability. This expanded system demonstrates how conversational bots powered by deep learning may enhance digital healthcare services and aid in the early identification of diseases.

2. LITERATURE SURVEY

i) Understanding Physician's Experience With Conversational Interfaces During Occupational Health Consultation

https://www.researchgate.net/publication/342467608_Understanding_Physician%27s_Experience_With_Conversational_Interfaces_During_Occupational_Health_Consultation

An exploratory research on the use of conversational interfaces (CIs) to assist doctors in doing occupational health consultations is presented in this paper. A web-based information dashboard with a virtual assistant assistant that can offer real-time text message recommendations was used to accomplish the CI. A proactive virtual assistant was used in the first system design, whereas an on-demand interaction

was used in the second. In a field investigation that involved eight medical consultations, the efficacy of the suggested CI and the two kinds of virtual assistant designs was examined. Quantitative findings demonstrated that occupational health doctors were keen to utilize the CI in their work and that it was regarded favorably as a trustworthy instrument for use in medical consultations. According to the qualitative data analysis, our design idea may enhance the consultation's workflow, especially in terms of organized decision-making processes utilizing useful references and access to pertinent information. The proactive virtual assistant contact was not as well received as the lightweight, on-demand one. We address the significance of these findings for the future evolution of CI-based occupational health consultancy and its prospective role in computer-assisted, data-driven healthcare.

ii) Evidence-Based Recommender System for a COVID-19 Publication Analytics Service

https://www.semanticscholar.org/paper/Evidence-Based-Recommender-System-for-a-COVID-19-Oruche-Gundlapalli/af62343700d8bf796e6d2a2059fcab9586f1b2b2

Clinical researchers and medical experts are working to close the knowledge gap on trustworthy information for efficient pandemic remedies as a result of the COVID-19 publications' explosive expansion. A significant bottleneck in researchers' processes, however, is the laborious process of locating high-quality articles according to the tiers of the evidence pyramid. In this research, we offer KnowCOVID-19, a "evidence-based" recommender system that integrates recommender modules for data analytics employing end-user thin-clients through an edge computing service. Two recommender system modules are used by the edge computing service's virtual assistant-based web interface to handle a given dataset of COVID-19 publications: (i) evidence-based filtering, which looks for domain-specific topics in the literature and categorizes the filtered information based on a clinical category; and (ii) social filtering, which enables a variety of experts with similar goals to work together via a "social plane" to jointly find answers to crucial clinical questions in order to combat the pandemic. We demonstrate enhanced generalization and knowledge pattern query efficacy by comparing the Domain-specific Topic Model (DSTM), which we employed in our evidence-based filtering, with state-of-the-art models using the CORD-19 dataset, a COVID-19 publishing archive. Furthermore, we compare the KnowCOVID-19 enhanced procedure with a manual literature review approach and assess the advantages of our information retrieval methods over significant questions supplied by COVID-19 clinical specialists.

iii) Automatized Medical Virtual assistant (Medibot)

https://ieeexplore.ieee.org/document/9087096

Conversationally designed with technology in mind, automated medical virtual assistants have the potential to save healthcare expenses while increasing access

to medical information and services. We developed a diagnosis bot that converses with patients about their health issues and questions in order to deliver a personalized diagnosis based on their profile and detected symptoms. With a typical precision of 65%, our virtual assistant system is capable of identifying symptoms from user input. Correct symptoms were detected with a 71% accuracy and a 65% recall using these extracted diagnostic symptoms. Ultimately, the virtual assistant provided the anticipated diagnosis for additional procedures. This shows that a medical virtual assistant can diagnose patients with a moderate degree of accuracy using conversational methods and basic symptom analysis, which implies that a successful medical bot that speaks spoken language may be feasible. Furthermore, this bot's relative efficacy suggests that additional automated medical devices might develop and play a larger role in healthcare.

iv) A Mental Health Virtual assistant for Regulating Emotions (SERMO) - Concept and Usability Test

https://ieeexplore.ieee.org/abstract/document/9000924

In nations all around the world, mental illnesses are common. However, the human resources needed to provide mental health treatments are in limited supply worldwide. Untreated mental illness may lead to a rise in suicide attempts and death rates. Conversational agents have gained popularity in recent years as a solution to this resource shortage issue. In this study, we present SERMO, a virtual assistant-enabled mobile application that uses cognitive behavioral therapy (CBT) techniques to help mentally ill individuals manage their thoughts and feelings and regulate their emotions. Every day, SERMO questions the user about their feelings and past experiences. It uses a lexicon-based technique and natural language processing to automatically identify a user's primary emotion from natural language input. SERMO suggests activities or mindfulness exercises as a suitable measure, depending on the emotion. An emotion diary, a list of enjoyable activities, mindfulness exercises, and information on emotions and CBT in general are additional features. The User Experience Questionnaire (UEQ) was used to study user experience with 21 individuals. Results indicate that beauty, perspicuity, and efficiency are seen as positive traits. Neutral assessments are seen on the measures that describe hedonic quality (stimulation and novelty), or enjoyment of usage.

v) Daily Health Monitoring Virtual assistant with Linear Regression

https://murex.mahidol.ac.th/en/publications/daily-health-monitoring-virtual assistant-with-linear-regression/

These days, everyday routines include consuming junk food, not having enough time for exercise, and other things cause health problems for older adults. The majority of senior citizens frequently have high blood pressure as they age. Numerous serious illnesses can result from this condition. Furthermore, there aren't many physicians working in the hospital. In order to provide prompt care, the doctor typically takes a brief note regarding symptoms, which may not be sufficient for a diagnosis. As a result, we suggested a virtual assistant

for daily health monitoring for senior citizens. In order to establish a personal health record (PHR), we must gather information from the elderly. We create conversational virtual assistants to communicate with senior citizens using the LINE app. The results of this study complement the doctor's job since the doctor is better able to detect illnesses and provide treatment recommendations after reading the daily PHR. Additionally, the linear regression approach was created to track the trend of older people's blood pressure. As a result, they can prevent or alleviate certain illnesses through virtual assistant alerts and health maintenance.

3. METHODOLOGY

a) Proposed Work:

The proposed study presents a clever healthcare virtual assistant that uses a convolutional neural network (CNN) and natural language processing (NLP) to diagnose diseases based on symptoms. Through a conversational interface, users communicate with the system by texting their symptoms. Using natural language processing (NLP) methods, the virtual assistant transforms this input into organized numerical data and extracts pertinent symptom information. These characteristics are then input into a CNN model, which uses learnt symptom-disease connections to do deep feature learning and provide an accurate prediction about the most likely disease.

The suggested system expands functionality beyond disease prediction by including dietary advice and pertinent hospital or physician details related to the anticipated illness. By helping users make knowledgeable healthcare decisions, this enhancement increases the virtual assistant's practical utility. The system serves as a dependable decision-support tool that lowers the time and expense involved with frequent hospital visits, even if it does not take the position of medical personnel or allow for real-time appointment scheduling. The combination of conversational AI and deep learning greatly increases prediction accuracy and shows how well the suggested strategy works to provide easily accessible and effective healthcare support.

b) System Architecture:

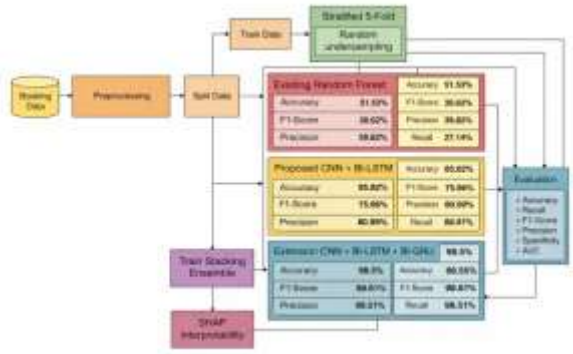

Fig 1 Proposed Architecture

The system architecture of the proposed healthcare virtual assistant is designed to support efficient symptom-based disease diagnosis using NLP and CNN techniques. The architecture begins with the user interface, where users interact with the virtual assistant by entering their symptoms in natural language text. This input is passed to the Natural Language Processing (NLP) module, which performs text preprocessing operations such as tokenization and symptom extraction. The processed symptom information is then converted into

structured numerical feature representations suitable for deep learning analysis.

The encoded features are forwarded to the Convolutional Neural Network (CNN) model, which consists of multiple convolution, pooling, and fully connected layers for deep feature extraction and disease classification. The CNN model predicts the most probable disease based on learned symptom–disease patterns. Once the disease is identified, the system accesses the knowledge base to retrieve appropriate diet recommendations and relevant doctor or hospital details. Finally, the response generation module presents the predicted disease and healthcare guidance to the user through the virtual assistant interface. The overall architecture ensures accurate disease prediction, efficient processing, and effective user interaction while functioning as a decision-support system rather than a replacement for medical professionals.

c) MODULES:

1. **User Interaction Module**

This module provides a virtual assistant-based interface that allows users to enter their symptoms in natural language text. It ensures smooth and user-friendly communication between the user and the system without requiring any medical expertise.

2. **Symptom Processing Module (NLP Module)**

The symptom processing module applies Natural Language Processing techniques to analyze the user's textual input. It extracts relevant symptom information and removes unnecessary or irrelevant words, converting unstructured text into meaningful data.

3. **Feature Representation Module**

In this module, the extracted symptoms are transformed into structured numerical feature vectors. These feature representations are formatted to serve as valid input for the CNN model, enabling effective learning and classification.

4. **Disease Prediction Module (CNN Model)**

The CNN-based disease prediction module performs deep feature learning and classification. It analyzes the encoded symptom features and predicts the most probable disease by identifying complex symptom–disease patterns.

5. **Knowledge Base Module**

This module stores disease-related information, including diet recommendations, doctor specializations, and hospital details. It acts as a reference system that supports healthcare guidance after disease prediction.

6. **Response Generation Module**

The response generation module combines the predicted disease information with diet suggestions and doctor or hospital details. The final output is presented to the user through the virtual assistant interface as preliminary healthcare guidance.

d) ALGORITHMS

1) Natural Language Processing (NLP)

Natural Language Processing is used to enable effective communication between the user and the virtual assistant. It processes the user's symptom descriptions by performing text cleaning, tokenization, normalization, and keyword extraction. NLP helps in identifying relevant medical terms and

symptoms from unstructured text. This ensures accurate understanding of user intent and improves the quality of input passed to the prediction model.

2) Convolutional Neural Network (CNN) – Deep Learning

The Convolutional Neural Network is the core algorithm used for disease prediction. The CNN model automatically learns complex and non-linear relationships between symptoms and diseases from the training dataset. It extracts high-level feature representations and performs accurate classification. The use of CNN significantly improves prediction accuracy, precision, recall, and F-score compared to traditional machine learning models.

4. EXPERIMENTAL RESULTS

A symptom-based disease dataset was used to test the prediction ability of the suggested CNN-based disease diagnostic virtual assistant. In order to train and evaluate the CNN model, the dataset was preprocessed using natural language processing (NLP) techniques to extract pertinent symptom characteristics. Standard assessment measures, such as accuracy, precision, recall, and F1-score, were used to gauge the system's performance. According to the experimental findings, the suggested model shown a great capacity to accurately predict illnesses from user-provided symptoms, achieving an accuracy of 95.02% with 98.44% precision, 95.14% recall, and an F1-score of 96.33%.

The CNN model was contrasted with more conventional machine learning algorithms including Random Forest, Multi-Layer Perceptron, and Support Vector Machine (SVM) in order to verify the efficacy of the suggested strategy. According to the comparison results, the CNN model fared better than alternative approaches on every assessment criteria. The CNN's capacity to automatically understand intricate and non-linear symptom–disease correlations is credited with the enhanced performance. Furthermore, the slight variation between the training and validation data suggests less overfitting and strong generalization. These results validate that the suggested CNN-based virtual assistant supports illness detection for healthcare applications in a precise, dependable, and effective manner.

Accuracy: The capacity of a test to accurately distinguish between healthy and sick cases is a measure of its accuracy. We can determine a test's accuracy by calculating the proportion of reviewed cases with true positives and true negatives. In mathematical terms, this looks like:

Accuracy = TP + TN TP + TN + FP + FN.

$$Accuracy = \frac{(TN + TP)}{T}$$

F1-Score: One way to evaluate a model's performance in machine learning is via its F1 score. It takes a model's recall and precision and mixes them. Using the whole dataset, the accuracy metric determines the frequency with which a model produced accurate predictions.

$$F1 = 2 \cdot \frac{(Recall \cdot \Pr e\,cision)}{(Recall + \Pr e\,cision)}$$

Precision: The proportion of occurrences or samples that are correctly classified out of all the ones that are classified as positive is known as precision. Consequently, the

following is the formula for determining the accuracy:

Precision = True positives/ (True positives + False positives) = TP/(TP + FP)

$$Precision = \frac{TP}{(TP + FP)}$$

Recall: The capacity of a model to detect all significant instances of a given class is measured by recall, a metric in machine learning. It sheds light on how well a model captures instances of a certain class and is calculated as the ratio of the total number of positive observations predicted to the number of actual positive observations.

$$Recall = \frac{TP}{(FN + TP)}$$

- In above screen we can see application home page and then in table we can see CNN algorithm disease prediction accuracy and now click on 'Register Here' link to sign up with the application

- In above screen user is entering signup detail and give valid MAIL ID so you can receive mails and press button to get below page

- In above screen in blue colour text we can see sign up completed and now click on 'User' link to login as user

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

- In above screen click on 'virtual assistance' link to get below page

- In above virtual assistance page just type some symptoms and in above page I gave symptoms as 'patches rashes' and then press

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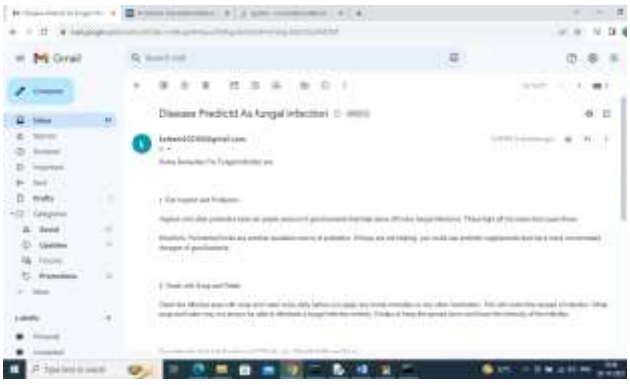
button to get reply from assistant like below screen

- In above screen in blue colour text disease predicted as 'Fungal Infection' and then in below lines we can see home remedies along with diet details and scroll down above page to view complete details

- In above screen we can see doctor details and then same information will be sent to mail also like below screen



- In above email we can see disease details with diet and remedies and similarly you can search for any symptoms and below is another example

- In above screen I gave symptoms as 'Chest Pain' and below is the output

- In above screen in blue colour text virtual assistant predicted disease as 'Heart Attack' for symptom 'Chest Pain'. Similarly you can search for any symptoms and now click on 'Lifestyle & Disease Information' link to view static information about disease

- In above screen user can select specific disease and then press button to get disease, diet information like below screen

- In above screen user can see some answers about selected disease along with doctor details.

- In above screen for some disease we can see information about Food to take and avoid

5. CONCLUSION

This paper presented an intelligent healthcare virtual assistant for symptom-based disease diagnosis using Natural Language Processing (NLP) and a Convolutional Neural Network (CNN). The proposed system enables users to interact through a virtual assistant interface, process symptom information effectively, and predict diseases with high accuracy. By leveraging deep learning techniques, the virtual assistant overcomes the limitations of traditional machine learning models and provides reliable preliminary medical guidance. The system further enhances user support by offering diet recommendations and relevant doctor or hospital information corresponding to the predicted disease.

Experimental evaluation demonstrates that the proposed CNN-based model achieves strong performance, with an accuracy of 95.02%, precision of 98.44%, recall of 95.14%, and an F1-score of 96.33%. These results confirm the effectiveness and robustness of the system in learning complex symptom–disease relationships. Although the virtual assistant does not replace professional medical consultation, it serves as a practical decision-support tool that reduces time and cost associated with frequent hospital visits. Overall, the proposed approach highlights the potential of deep learning–driven conversational systems in improving accessibility, efficiency, and quality of digital healthcare services.

6. FUTURE SCOPE

The proposed CNN-based disease diagnosis virtual assistant can be further enhanced in several ways to improve its accuracy, usability, and real-world applicability. In future work, the system can be extended by incorporating a larger and more diverse medical dataset, which would enable the model to handle a wider range of diseases and improve generalization across different populations. Integrating advanced deep learning architectures such as transformer-based models may further enhance symptom understanding and disease prediction accuracy.

The system can also be expanded to support multilingual interaction, allowing users from different linguistic backgrounds to access healthcare guidance more effectively.

Additionally, real-time integration with hospital management systems could enable features such as online appointment booking and electronic health record (EHR) access, making the system more practical for clinical use. Incorporating explainable AI techniques would improve transparency by providing users and healthcare professionals with insights into the reasoning behind disease predictions. Furthermore, deploying the virtual assistant as a mobile application with secure data handling mechanisms can enhance accessibility while ensuring patient privacy and data security.

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Author Profiles

Dr. J. RAJENDRA PRASAD working as a professor and HOD of IT Department, NRI Institute of Technology Agiripalli, Andhra Pradesh, India. He received Best teacher award in the year 2010 from JNTUK, Kakinada. He guided 2 PHD's in computer science and Engineering. He published more than 70 publications in international reputed journals. He wrote a text book: Mathematical foundation of computer science.
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BOTTA NAGA VENKATA SRIRAM B.Tech Student with specialization of Information Technology in NRI Institute of Technology .I have a strong foundation in Python programming, data structures, object-oriented programming, and database management systems.I have worked on projects involving data analytics and machine learning, such as a doctor visit recommendation system using data analytics and AI, a weather tracking system, and an income prediction model using machine learning. Through these projects, I gained

hands-on experience with Python libraries like NumPy and Pandas and improved my problem-solving and analytical skills.I have also completed certifications in Google Data Analytics, Google IT Support, Python for Data Science, and Cloud Computing, which helped me understand both software development and IT fundamentals. I am a quick learner, enjoy working in teams, and I am eager to start my career as an entry-level software engineer where I can apply my skills and continue learning.

GATTE PUSHPASRI is a B.Tech student specializing in Information Technology at NRI Institute of Technology. She has strong knowledge in Python and SQL, with hands-on experience in Flask, Tkinter, MySQL, and XAMPP for developing secure applications. She completed a Python Internship at NIELIT, Tirupati, contributing to the development of "MedLink – Secure Hospital Management System" using Python, Flask, and MySQL. She also completed a Virtual Internship with VOIS & Vodafone Idea Foundation, gaining knowledge in data analytics and machine learning using Python. She is actively involved in leadership roles such as Treasurer of Helping Hands Club, Event Coordinator at the college, and Class Representative. She is passionate about learning new technologies and contributing effectively in a professional environment. She demonstrates strong problem-solving abilities and a keen interest in backend development, with a commitment to continuous improvement and building practical solutions to real-world challenges.

GORREPATI AMULYA is a B.Tech student with Specialization in Information Technology at NRI Institute of Technology. With a strong interest in emerging technologies, she has developed skills in Python, Web Development, and Cloud Computing. She holds an AWS certification, strengthening her knowledge in cloud platforms and deployment practices. As part of her academic curriculum, she completed a mini project titled "Plant Growth Monitoring System using AI & ML," where she applied Artificial Intelligence and Machine Learning techniques to monitor and analyze plant growth efficiently. She is passionate about learning new technologies and continuously improving her programming and problem-solving skills.