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Self-Reliant Medical Chatbot Using Machine Learning for Smart Intent Classification

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Abstract: *The Self-Reliant Medical Chatbot is a web-based healthcare information system designed to improve accessibility to preliminary healthcare guidance through an interactive conversational interface. The proposed system uses Natural Language Processing (NLP) techniques to process user queries and identify their intended meaning. It employs text preprocessing, tokenization, Bag-of-Words (BoW) feature extraction, cosine similarity, and keyword-based matching to identify relevant healthcare intents. Based on the identified intent, the system provides preliminary symptom-related guidance, medicine information, health condition details, and hospital information. The application also incorporates user authentication, consultation history management, multilingual interaction, and administrator functionalities to support an organized healthcare information service. A fallback mechanism is used to handle queries that cannot be matched with the available intent patterns. The system is designed to improve access to basic healthcare information while maintaining the limitation that chatbot responses cannot replace professional medical diagnosis or treatment. The proposed approach demonstrates the practical application of NLP-based intent identification and rule-based response handling in a web-based healthcare assistance system.*

Key Word: *Medical Chatbot, Machine Learning, Intent Classification, Natural Language Processing, Healthcare Information System, Symptom Assessment, Bag-of-Words, Multilingual Support*

I. INTRODUCTION

Healthcare information plays an important role in helping individuals understand basic health concerns and make informed decisions about seeking medical assistance. With advancements in Artificial Intelligence (AI), Natural Language Processing (NLP), and Machine Learning (ML), medical chatbots have emerged as a convenient way to provide preliminary healthcare information through conversational interfaces.

However, users may face difficulties in finding relevant medical information, understanding health-related concerns, or communicating their symptoms in a language they are comfortable with. Traditional methods of accessing healthcare information may also require additional time and effort, particularly when immediate preliminary guidance is needed. These challenges highlight the need for an interactive and accessible system that can understand user queries and provide relevant healthcare information.

The proposed Self-Reliant Medical Chatbot Using Machine Learning for Smart Intent Classification addresses these challenges through a web-based conversational healthcare platform. The system uses Natural Language Processing techniques to process user queries and identify their intended purpose. Text preprocessing, tokenization, Bag-of-Words (BoW) feature extraction, cosine similarity, and keyword-based matching are used to identify relevant healthcare intents and select appropriate responses.

The proposed system provides preliminary symptom-related guidance, medicine information, and healthcare-related details. It also incorporates interactive symptom assessment, multilingual interaction, voice input, and location-based hospital information to improve accessibility. Additional features such as user authentication and consultation history support organized interaction with the platform.

The main contribution of this work is the integration of conversational query processing, intent identification, preliminary healthcare information, and hospital-related assistance within a unified web-based system. The chatbot is intended to support access to basic healthcare information and does not replace professional medical diagnosis, consultation, or treatment.

II. OBJECTIVES

The main objective of the proposed Self-Reliant Medical Chatbot is to provide accessible preliminary healthcare information through an interactive and user-friendly conversational interface. The specific objectives are:

1. To develop a web-based medical chatbot that uses Natural Language Processing (NLP) techniques and intent identification to understand user queries.
2. To implement text preprocessing, tokenization, Bag-of-Words (BoW) feature extraction, and similarity-based matching for identifying relevant healthcare intents.
3. To provide preliminary symptom-related guidance, medicine information, and healthcare details based on user queries.
4. To integrate multilingual interaction, voice input, consultation history, and location-based hospital information to improve accessibility and usability.

III. LITERATURE SURVEY

Several research studies have explored the application of Artificial Intelligence, Natural Language Processing, and conversational agents in healthcare. Valizadeh and Parde [1] reviewed task-oriented dialogue systems for healthcare applications and highlighted their role in supporting communication between users and healthcare platforms. Wang et al. [2] examined the applications of ChatGPT and other conversational Large Language Models in healthcare and discussed concerns related to accuracy, privacy, and reliability. Bedi et al. [3] studied testing and evaluation methods for healthcare applications of Large Language Models and emphasized the importance of accuracy, fairness, and safety. Grassini et al. [4] reviewed healthcare chatbots in the context of inclusive healthcare and highlighted the importance of accessibility and user-friendly interaction. Huo et al. [5] examined chatbot-based health advice and identified challenges related to evaluation methods, model reliability, and patient safety.

Although these studies demonstrate the potential of conversational AI in healthcare, challenges remain in understanding medical queries, identifying user intent, and providing relevant healthcare information. Addressing these challenges requires effective query processing and reliable response selection. The proposed Self-Reliant Medical Chatbot integrates NLP-based query processing, Bag-of-Words feature extraction, similarity-based intent identification, and predefined healthcare responses. It also incorporates symptom assessment, multilingual interaction, medicine information, consultation history, and hospital information within a unified web-based platform. The system aims to improve access to preliminary healthcare information while maintaining appropriate limitations on automated medical guidance.

IV. METHODOLOGY

The proposed Self-Reliant Medical Chatbot follows a structured methodology to process user queries, identify relevant healthcare intents, and generate appropriate preliminary responses. The methodology consists of user query input, text preprocessing, feature extraction, intent identification, healthcare information retrieval, and response generation.

1. **User Query Input**
   The user enters a medical query or describes symptoms through the chatbot interface. The system provides a conversational interface with multilingual interaction to improve accessibility.

2. **Text Preprocessing**
   The entered query is processed using Natural Language Processing (NLP) techniques. Tokenization divides the input text into smaller units, which are used for further processing and comparison with predefined intent patterns.

3. **Feature Extraction**
   The processed text is converted into numerical representations using the Bag-of-Words (BoW) technique. This approach represents the query based on the occurrence of words and enables comparison with predefined healthcare-related text patterns.

4. **Intent Identification**
   The system identifies the user's intended query category using similarity-based matching and keyword-based techniques. Cosine similarity is used to compare the processed query representation with available intent patterns. The most relevant matching intent is selected to determine the appropriate response category.

5. **Healthcare Information Retrieval**
   Based on the identified intent, the system retrieves relevant information from its predefined healthcare knowledge base. The information includes preliminary symptom-related guidance, general medical details, medicine information, and severity-related guidance.

6. **Response Generation**
   The chatbot generates a response based on the identified intent and available healthcare information. If the query cannot be matched with the available patterns, a fallback response is provided to handle unmatched or unclear inputs.

7. Consultation Management

The system maintains consultation history so that users can access their previous interactions. Additional features, including hospital information and emergency assistance, help users identify relevant healthcare services when required.

The overall methodology combines NLP-based text processing, Bag-of-Words feature extraction, similarity-based intent identification, and rule-based response handling. It is designed to provide preliminary healthcare information and does not replace professional medical diagnosis, consultation, or treatment.

V. SYSTEM DESIGN

The proposed Self-Reliant Medical Chatbot follows a client-server architecture consisting of a user interface, backend processing components, an NLP-based intent identification module, and a healthcare information knowledge base. The architecture enables users to submit healthcare-related queries and receive relevant preliminary information through a conversational interface.

1. User Interface Module

The user interface allows users to interact with the chatbot by entering medical queries or describing symptoms. It also provides access to features such as user authentication, multilingual interaction, voice input, and consultation history.

2. Backend Processing Module

The backend manages user requests and coordinates communication between the frontend, NLP processing components, and healthcare information resources. It processes incoming queries and forwards them to the intent identification component.

3. NLP and Intent Identification Module

This module processes user input through tokenization and Bag-of-Words feature extraction. It applies cosine similarity and keyword-based matching to identify the most relevant predefined healthcare intent.

4. Healthcare Information Module

This module retrieves relevant information from the available healthcare knowledge base based on the identified intent. It supports preliminary symptom-related guidance, medicine information, and general healthcare details.

5. Response Generation and Fallback Module

The response generation component selects an appropriate response based on the identified intent and available information. If the query is unclear or does not match the available intent patterns, a fallback response is provided.

6. Hospital Information and Consultation Management Module

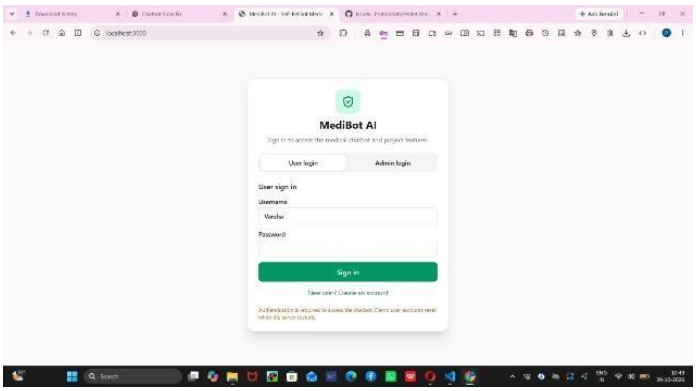
This module provides hospital-related information and supports access to consultation history. These features help users review previous interactions and locate relevant healthcare services when needed.

The integration of these modules provides a unified platform for preliminary healthcare information through conversational interaction. The system is designed to support information access and does not replace professional medical diagnosis or treatment.

VI. IMPLEMENTATION

The system is a web-based medical chatbot that provides preliminary healthcare information. It includes user authentication, symptom assessment, medical query processing, medicine and hospital information, consultation history, and administrator features for managing the knowledge base and intent classification model.

1. User Authentication Module

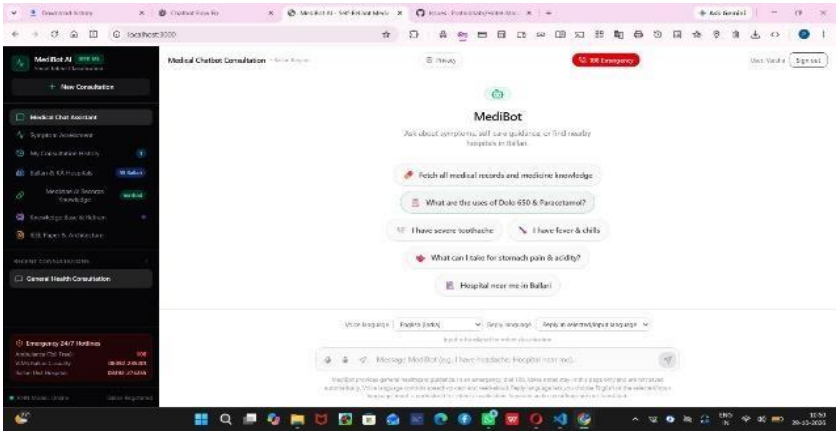


User and Admin Login Interface

The application provides separate login facilities for users and administrators. Users can sign in using their credentials to access chatbot functionalities, while administrators can access the administrative features for managing healthcare information and application content. This module helps organize access to different system functionalities.

2. Medical Chat Assistant Module

The Medical Chat Assistant provides a conversational interface through which users can enter healthcare-related queries. It also displays sample questions related to fever, headache, stomach pain, medicine information, and nearby hospitals. Based on the submitted query, the chatbot identifies the relevant intent and provides corresponding healthcare information.



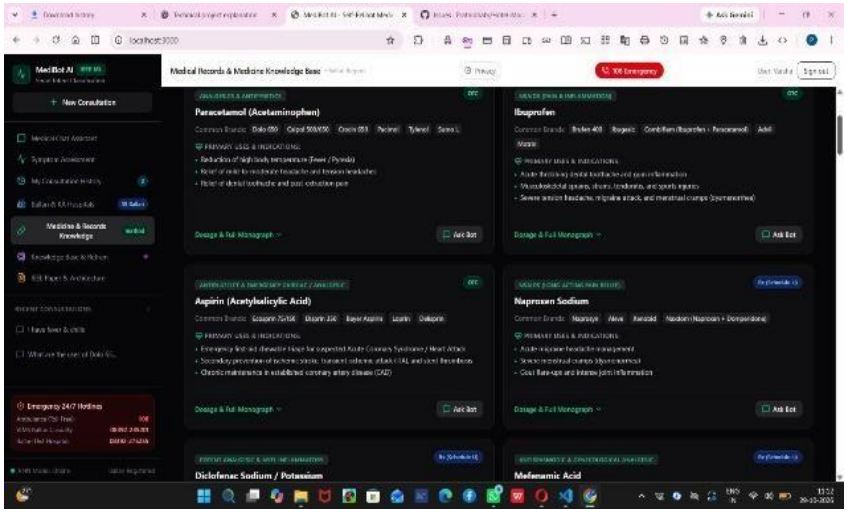
Medical Chat Assistant Interface

3. Smart Intent Classification Module

Intent identification is an important component of the proposed medical chatbot. When a user submits a medical query, the input text is processed using tokenization to divide it into smaller units. The processed text is converted into numerical representations using the Bag-of-Words (BoW) feature extraction technique. The system then applies cosine similarity and keyword-based matching to identify the most relevant predefined intent. The identified intent helps retrieve appropriate healthcare information and generate a relevant response.

4. Symptom Assessment Module

The Symptom Assessment module allows users to enter information about their symptoms and receive preliminary guidance based on the available healthcare information. This module supports users in understanding basic health-related concerns. However, the information provided is not intended to replace professional medical diagnosis.



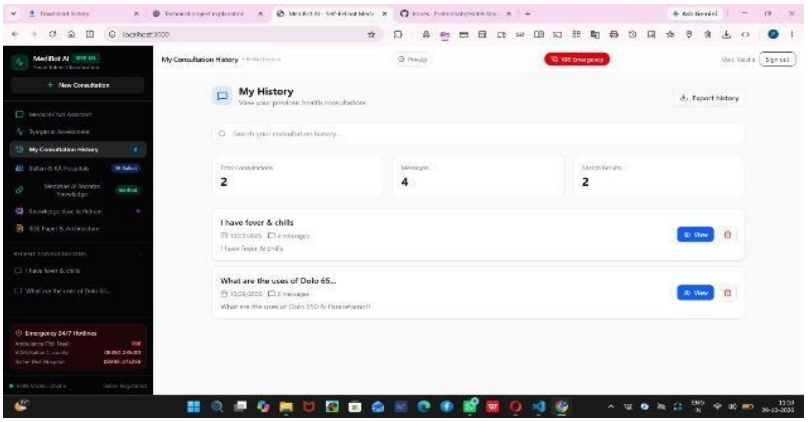
Symptom Assessment Interface

5. Multilingual Support Module

The application provides language selection options to support multilingual interaction. It enables users to interact with the chatbot using supported languages through the available input and response functionalities. This feature aims to improve accessibility for users with different language preferences.

6. Consultation History Module

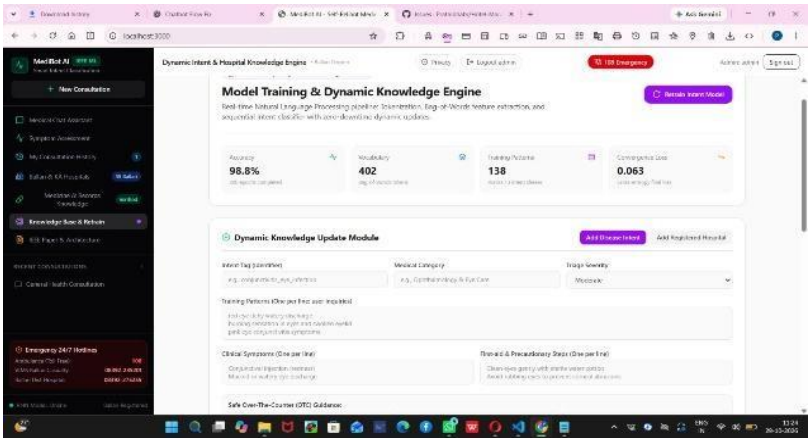
The consultation history module stores and displays previous user interactions. Users can search their consultation history, review earlier conversations, and delete individual records. The interface also provides an option to export consultation history for future reference.



Consultation History Interface

7. Medicine and Medical Records Knowledge Base

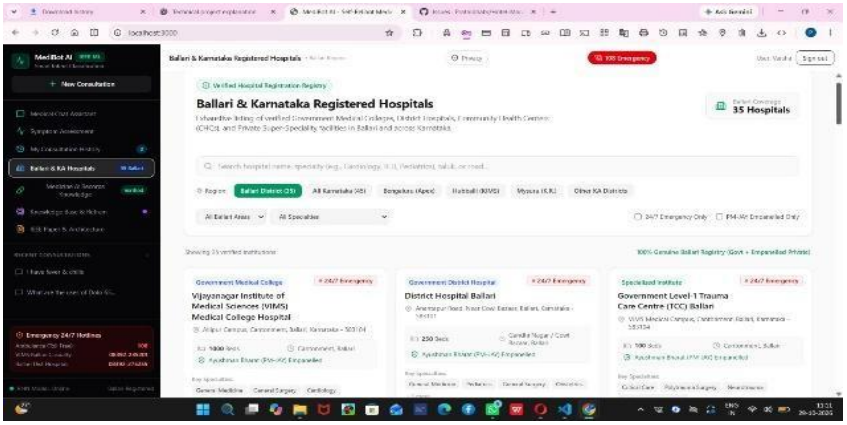
This module provides information about medicines, their general uses, and related healthcare details. The knowledge base includes medicine categories, common brand names, primary uses, and available dosage or monograph information. Users can also use the Ask Bot functionality to obtain additional information through the chatbot.



Medicine and Medical Records Knowledge Base

8. Hospital Information module

The hospital information module provides a searchable list of hospitals in Ballari and other regions of Karnataka. Users can explore hospital information based on region, location, specialty, and available facilities. The displayed details include hospital names, addresses, bed capacity, specialties, emergency availability, and registration-related information.

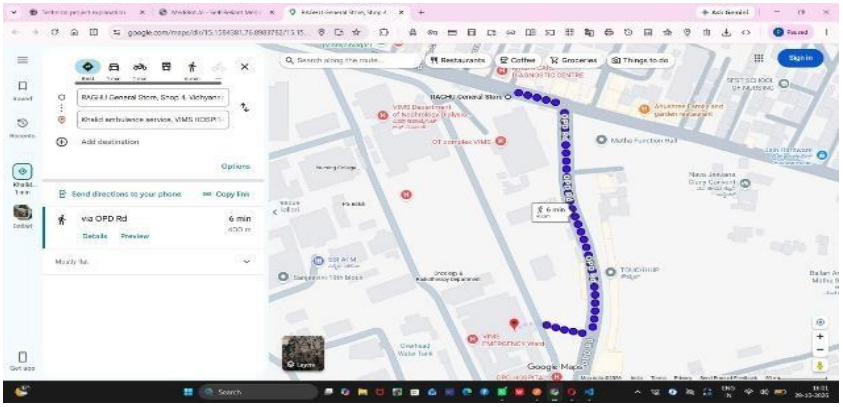


Hospital Information Interface

9. Hospital Information and Navigation Module

The system provides emergency contact information, including ambulance number 108, along with available hospital contact details. It also incorporates map-based navigation to help users identify hospital locations and obtain directions when required.

The implementation combines conversational query processing, intent identification, healthcare information retrieval, and supporting application features to provide a unified web-based healthcare information platform.



Hospital Navigation Interface

VII. TESTING AND RESULTS

7.1. Testing Procedure

Testing of the proposed Self-Reliant Medical Chatbot was carried out to verify the functionality of its major modules. Individual features were checked to ensure that they performed their intended operations. User and administrator login functionalities were tested through their respective interfaces. Medical query processing and intent identification were checked by submitting healthcare-related queries. Symptom assessment, language selection, hospital search, consultation history, and administrator management functionalities were also verified. The results were recorded based on the actual behaviour of each test case.

7.2. Functional Testing Results

Sl.No.	Test Case	Actual Result	Status
1	User Login	Login successful	Pass
2	Medical Query	Query processed	Pass
3	Intent Classification	Intent identified	Pass
4	Symptom Assessment	Guidance displayed	Pass
5	Language Selection	Language worked	Pass
6	Hospital Search	Details displayed	Pass
7	Consultation History	History displayed	Pass
8	Admin Management	Functions worked	Pass

Table I. Functional Test Case Results

The testing process included the following activities:

Functional Testing: Verified login, medical query processing, intent identification, symptom assessment, language selection, hospital search, consultation history, and administrator functions.

Module-Level Testing: Checked the individual chatbot, symptom assessment, medicine information, hospital information, and consultation history modules.

Usability Testing: Checked whether users could navigate the interface and access its main features.

Security-Related Testing: Checked login functionality and separation of user and administrator access.

The listed test cases produced the expected results during testing, indicating that the implemented modules performed their intended functions.

7.3. Response Handling and Evaluation

The chatbot processes user queries using text preprocessing, Bag-of-Words feature extraction, cosine similarity, and keyword-based matching to identify the most relevant intent. It retrieves an appropriate response from the available healthcare

information. A fallback response is provided for unclear or unmatched queries. However, response relevance depends on the available intent patterns and predefined information.

The current evaluation focuses mainly on functional testing. Quantitative performance measures such as accuracy, precision, recall, and F1-score require a separately labelled test dataset. Since verified numerical results are unavailable, these scores are not reported. The system is intended to provide preliminary healthcare information and does not replace professional medical advice.

7.4. Privacy and Security Considerations

The system provides user authentication and separate user and administrator access. Further improvements in secure data storage, privacy protection, and security testing are required to strengthen the handling of healthcare-related information.

VIII. CONCLUSION

The proposed Self-Reliant Medical Chatbot provides a web-based platform for accessing preliminary healthcare information through an interactive conversational interface. The system uses Natural Language Processing techniques, including text preprocessing, tokenization, Bag-of-Words feature extraction, cosine similarity, and keyword-based matching to identify user intents and provide relevant responses.

The chatbot integrates several features, including symptom assessment, medicine information, multilingual interaction, consultation history, and hospital search to improve accessibility and usability. Functional testing demonstrated that the implemented modules performed their intended operations.

Although the system supports preliminary healthcare information and query handling, its response quality depends on the available intent patterns and predefined healthcare information. It does not replace professional medical diagnosis, consultation, or treatment. Further improvements in classification performance, response reliability, and data security can enhance the system's effectiveness.

IX. FUTURE SCOPE

The proposed medical chatbot can be enhanced in several ways to improve its functionality, accuracy, and reliability. Future developments may include:

1. **Advanced Intent Classification:** Implementing and evaluating advanced machine learning and deep learning techniques to improve the identification of healthcare-related queries.
2. **Improved Symptom Assessment**: Enhancing symptom analysis to provide more relevant preliminary guidance while maintaining appropriate medical limitations.
3. **Expanded Healthcare Knowledge Base:** Regularly updating medical information and including additional healthcare resources.
4. **Enhanced Multilingual Support**: Supporting more regional languages to improve accessibility for users from different backgrounds.
5. **Healthcare Service Integration:** Integrating the chatbot with hospital services, appointment systems, and verified healthcare information sources.
6. **Improved Security and Privacy**: Introducing stronger data protection, secure storage, and privacy measures to protect user information.

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