

Natural Language Processing based Human Assistive Health Conversational Agent for Multi-Users

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Abstract—Background: Most of the people are not medically qualified for studying or understanding the extremity of their diseases or symptoms. This is the place where natural language processing plays a vital role in healthcare. These chatbots collect patients' health data and depending on the data, these chatbot give more relevant data to patients regarding their body conditions and recommending further steps also. **Purposes:** In the medical field, AI powered healthcare chatbots are beneficial for assisting patients and guiding them in getting the most relevant assistance. Chatbots are more useful for online search that users or patients go through when patients want to know for their health symptoms. **Methods:** In this study, the health assistant system was developed using Dialogflow application programming interface (API) which is a Google's Natural language processing powered algorithm and the same is deployed on google assistant, telegram, slack, Facebook messenger, and website and mobile app. With this web application, a user can make health requests/queries via text message and might also get relevant health suggestions/recommendations through it. **Results:** This chatbot acts like an informative and conversational chatbot. This chatbot provides medical knowledge such as disease symptoms and treatments. Storing patients personal and medical information in a database for further analysis of the patients and patients get real time suggestions from doctors. **Conclusion:** In

the healthcare sector AI-powered applications have seen a remarkable spike in recent days. This covid crisis changed the whole healthcare system upside down. So this NLP powered chatbot system reduced office waiting, saving money, time and energy. Patients might be getting medical knowledge and assisting ourselves within their own time and place.

Keywords: Natural language processing, Chatbots, Conversational AI, Dialogflow api, Artificial intelligence, Machine learning, Medical Chatbots.

I. INTRODUCTION

Health care is one of the evolving sectors worldwide even though millions of people lack access to medical care at the right time. Ensuring good health is one of the sustainable development goals of the United Nations. According to World Health Organization (WHO) norms, there should be one doctor for each 1000 population and its importance is realized evidently in the covid-19 situation. In India, the doctor's population is contradictory to the ratio of people, especially in the northern part of India. Because of the lack of qualified doctors, the basic medical needs fail to increase day by day. The new and advanced high-end technological solution is the

key to achieve this enormous target. Here conversational agents play a vital role in the medical and healthcare industry. The proposed conversational agent is built on Natural language processing. Natural Language processing helps humans to automate medical things such as appointment booking, storing patients personal and medical information and providing medical related knowledge to patients .

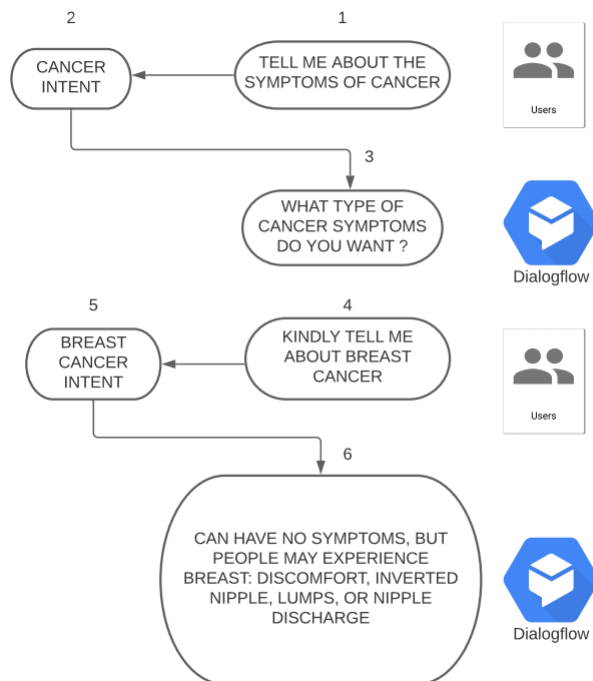


Fig.1. Understanding User Intention

Natural language processing is mainly designed to teach computers to talk in their computer language to talk to humans naturally like humans. Natural language processing used for understanding user texts, voices, any audio or video notes and then finally converted into a structured data format. In Healthcare information technology, natural language processing has many web applications, android applications, and many other online tools available. Natural language processing with built-in voice recognition eliminates the task of physicians and clinicians to provide a manual prescription. And the physician can also be in any far away location serving the patients in a remote location. During this process, the back-end system identifies any error that happened in the front-end system before giving it to human proofing.

This research project work aims to achieve and give medical knowledge and health consciousness to all people. It is achieved by providing Medical and Health knowledge on time with the help of our conversational agent. It also provides real-time suggestions to the user in need. The proposed conversational agent is built with natural language processing which is a branch of artificial intelligence and machine learning algorithms. We have achieved it by using Dialogflow

Api which is powered by google's natural language understanding algorithms.

II. RELATED WORK

Sayed Ehsanullah, [1] developed a chatbot that interfaces with a telegram platform to provide useful information at the time of disasters. This application can suggest information about the evacuation place and also provides real-time disaster information about the users' current place. In addition to this, it made people share the disaster-related picture which makes it easier for the authorized agency to help them during the disaster. Belfin R V, [2] designed a chatbot specifically for cancer patients. This chatbot is well trained with Artificial Intelligence (AI) powered algorithms to give facts about cancer and help the subject to understand the cancer types, facts, symptoms, treatment procedures and it will give feedback to the users by analyzing the user's sentiment.

Kyungyong, [3] described mobile-based health services that are implemented to check patient continuous health and give real-time health feedback to users via chatting platform. The AI-powered algorithms are implemented to ask intelligent questions to the user and extract useful medical information from the user. Jeremy Beaudry, et.al [4] have briefed out the designing of a chatbot for monitoring adolescent transition care. It is mainly designed for an adolescent to monitor their healthcare on a weekly basis due to lack of transition care. Adolescents face many difficulties in their transition stage, this bot will send the message on a particular day and interact with the patient. Based on their reply it gives the output with related websites and tips.

Chien-Hao Kao, [5] proposed a system to monitor mental health through real-time virtual conversation with a multi-modal emotional recognition system which is a part of natural language processing and it will generate several natural responses. This system extracts the information from text messages and voice clips for the recognition of the user's mental health and provides a suggestion. Surya Rocaa, [6] presents a chatbot architecture for supporting a patient with chronic disease. In this work, automation has been incorporated by converting Fast Healthcare Interoperability Resources (FHIR) to Artificial Intelligence Mark-up Language (AIML) files that help the system to collect the data of personal and medical information and store it in the patient health record.

Ben Sheehan, [7] studied the connection between miscommunication and adoption for customer support chatbots. Anthropomorphism is examined as an account of the connection. The results recommend that unresolved mistakes are enough to lessen anthropomorphism and adoption intent. However, there is no perceptual distinction between an error-unfastened chatbot and one that seeks rationalization. Farhana Sharmin, [8] developed an automatic gadget "Doly Bengali Chatbot" which offers a response to a consumer question on behalf of a human for the education in the Bengali language. This is an AI chatbot that uses a machine-learning algorithm and Bengali Natural Language Processing (BNLP). V.Selvi, [9] introduces a machine learning algorithm for training the bot and helping the bot to perform in the right way. Yixuan

Chai, [10] worked on a censorship gadget that can learn from a conversation from the real user and also helps in self-purifying the chatbots when they generate offensive or inappropriate responses. Moreover, it utilizes the long short-term memory (LSTM) model to forget the learned offensive response.

Eun Goa, [11] design humanizing chatbots that don't interact with the user like a machine. In this study, they have used three cues: anthropomorphic visual cue, message interactivity, and identity cue. Sen-Tamg Lai, [12] developed a banking chatbot that analyses the safety techniques of e-commerce and combines them with AI protection to provide security to the customers. Such banking chatbots reduce the security risk and provide full customer security and privacy. William Vasquez Parada, [13] developed a chatbot based on the Model-Driven Development for Facebook Messaging platform and utilized metamodel for defining the chatbot. This chatbot was tested in two different scenarios, the first one is by collecting the information from customers and trying to satisfy the customers from the available options. The second scenario is by utilizing various sensors and the Internet of Things (IoT).

Pavel Smutny, [14] has done a study on educational chatbots and their effectiveness. In this study, they have incorporated Facebook messenger for learning support. They have observed that educational platforms vary from sending messages personally to guiding them for a recommendation of learning content. Evert Van den Broeck, [15] explains about the cinebot, a Facebook chatbot that helps to book the ticket for movies. The main aim of this work is to study the usefulness of this app and to study the purchase and recommendation for this product by the customers. Ramya Ravi, [16] defines online websites. There are many internet analytics gear to be able to supply us with overall performance reports. However, it's tedious and time-consuming to grasp the gear depart by oneself to derive insights to apprehend the enterprise impacts. To overcome these challenges an AI ML pushed chatbot is proposed to fuel with analytics uncooked data, to be able to permit bot-customers to get enterprise insights via means of simply typing in the query.

Rupesh Singh, [17] developed a chatbot that can analyze the context of the conversation by using Tensorflow and NLP. It may be utilized in small industries or commercial enterprises for automating patron care as consumer queries will be dealt with via way of means of chatbots. This reduces the need for manpower and expenditure. Chin-Yuan Huang, [18] designed a chatbot for people with greater risk of obesity and overweight for self-monitoring. It is developed by the energy balance equation and gives feedback for physical activity and diet. The bot provides interactive feedback along with the healthcare professional's suggestions. Kyo-Joong Oh, [19] designed a chatbot which is used to order tickets by interfacing with social media applications such as Facebook. This technology can be used in our health bot for the reservation of appointments in nearby hospitals. It requires extensive data for the recognition. Chandimal Jayawardena, [20] described the chatbot, which is used in social assistance. The bot is designed by multidisciplinary experts using robot behavior descriptions for special assistance for older people

with a lack of care. It is customized according to the user by including features like falls detection, a reminder for medication by real-time monitoring.

From the study on related works of literature, this research work has been proposed and implemented to evaluate the feasibility of natural language processing chatbots to understand user's medical concerns and give real-time medical suggestions to user and make user to analysis our own body conditions and get suggestion from a conversational agent or to make an medical appointment for nearby hospitals and give medical knowledge to patients. Physicians or doctors also refer to disease treatments and clinical procedures which are suitable for patients. The aim of our system can be achieved by using Dialogflow api and action on Google platform powered by google's machine learning algorithms.

III. PROPOSED METHODOLOGY

A. Introduction

Incredibly the Chatbot/health-bot reduces the physician/Health professional workload by reducing hospital visits and eliminates unnecessary travel and burden to the patients. Thereby it also importantly reduces the hospital's unwanted admissions and readmission so that patients who require immediate admission may be given priority. This health bot provides accurate results about their health concerns based on authorized medical professionals via messaging or telephonic platforms. Users have a lot of advantages by using this health bot and a few of them are listed below

- Waiting at the doorstep of the doctor's consultation office is reduced
- Avoid unnecessary medical expenses. Know medical treatment and medications before buying medical products or treatments.
- To get the basic knowledge about their Health concerns before visiting a doctor for consultation.
- Users get access to doctors within a single click.

We develop our Health-bot by Natural language processing powered algorithm. So this health-bot understands the user's utterances and provides real-time health suggestions/recommendations according to user queries. We did our Health-bot architecture by using a lot of web applications and each category explicated Health-bot methodology and workflow.

B. Dialogflow

Dialogflow is a platform that develops virtual agent/chatbot powered by natural language processing algorithms. Dialogflow handles the Conversation of the user and understands the nuances of utterances and gives the user a response accordingly. Dialogflow supports text messaging and telephonic conversation. During the Conversation with users either text or telephonic the Dialogflow converts unstructured data into structured data format in the app service. This back-end system is powered by NLP and Machine Learning (ML) algorithm so that this health-bot can extract user intention and

connect exact user intent and give an appropriate response to the user.

Fig.1, describes the working of Dialogflow. When the user triggers the bot to tell about the symptoms of cancer, the input matches with the cancer intent and asks about what kind of information the user needs. According to the user reply the conversational agent matches with the intent to provide health suggestions. This is exactly the functionality of the health bot. The proposed health bot matches the user's intention and gives appropriate responses and health recommendations to the user. It supports either text messaging or telephonic conversation. In addition to this, it grabs the information from the user and provides a rich response within a second of time.

C. Google Cloud Platform

Google Cloud Platform (GCP) has so many scalable web applications to power the Dialogflow health-bot. In the medical field appointment booking and storing electronic health records (EHR) is an essential thing in every hospital and healthcare sector. So that using GCP we integrate Google Calendar API for an appointment booking in a hospital or particular doctors and Google firebase API for storing electronic health records in a properly structured format in the cloud. So that an authorized person can easily access and manage EHR data. Fig.2 shows the demo for appointment booking with the nearby hospitals by integrating Google calendar for a better experience. The major advantage of this calendar integration is that when the user makes an appointment with hospitals without human intervention the appointment is made in the hospital's Google calendar instantly.

D. Action on Google

Action on Google is a developer platform that extends the functionality of Google Assistant. Google Assistant is an AI-powered web application available on Android, iPhone, windows, mac, and Linux operating systems. Google Assistant functionality extends to more than 600+ million devices like phones, laptops, smart TV, smart speaker, smart cars and smartwatch, etc. The proposed health bot architecture was built by using this action on Google to extend its functionality which makes it possible to reach over more than 600+ million devices and gadgets.

E. Integration

The final workflow of this health-bot is an integration session. The most popular web applications like Google Assistant, Telegram, Slack, Facebook messenger, Google hangouts are integrated which helps this health-bot reach most people. Ultimately this health bot assists most people's health concerns and gives an appropriate response to the user.

F. Block Diagram

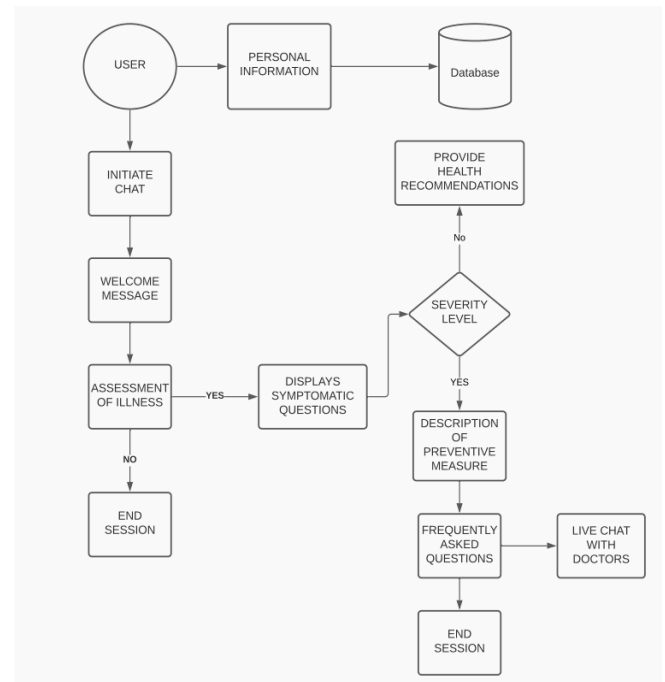


Fig. 2. Block Diagram

The workflow of the proposed system is shown in Fig.3. The user initiates the chat session after the welcome message. This chatbot stores the patient's personal and medical information. That personal information contains name, age, phone number and other personal details of the patient's medical information contains previous health illness, details about the medication, surgery details and previous prescription details which are all stored in the database. That database can be accessed only by doctors and authorized health professionals. The doctors can view patient's data in the database according to the patients' data doctors can make manual prescriptions to patients and give health related suggestions. The chatbot asking to user about current health concern depends on the patients input the chatbot separate patients to normal and abnormal. This chatbot identify patients normal and abnormal by asking symptomatic questions to patients. If the patient's condition is normal, the chatbot gives health recommendations based on the patient's concern. But if the patient's condition is abnormal the chat session redirects to live consultation to doctors and trained physicians.

G. Flowchart

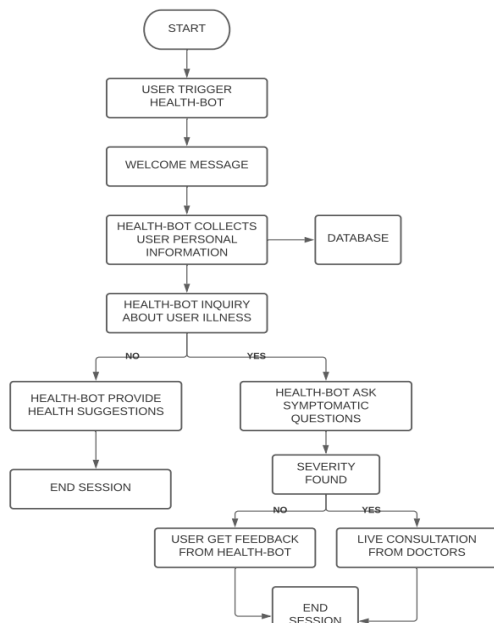


Fig. 3. Flowchart

Fig.4.describes the working of the proposed system. When the user triggers the conversational agent, a welcome message will pop up on the screen. Then user's personal and medical information (e.g. name, sex, etc.) will be collected and stored in a database like the hospitals. After that, the application will ask the present illness of the user. Based upon the user's reply to the proposed conversational agent will provide health suggestions or it may make an appointment for a live consultation with the doctors.

IV. RESULTS AND DISCUSSION

By using the proposed conversational agent, the user will get real-time health suggestions or make appointments with the doctors based on the severity level of the patients. The proposed system describes the feasibility of interfacing the natural language processing and web applications for providing medical suggestions. In Fig. 4, collecting the personal information of the patient is described as like in the hospitals whereas in Fig. 5 the patient's medical information like history of the present illness, past illness is recorded. Scheduled medical appointments are recorded in Fig.6. Patients get an acknowledgement of the medical appointments and live doctor's meeting credentials via google gmail.

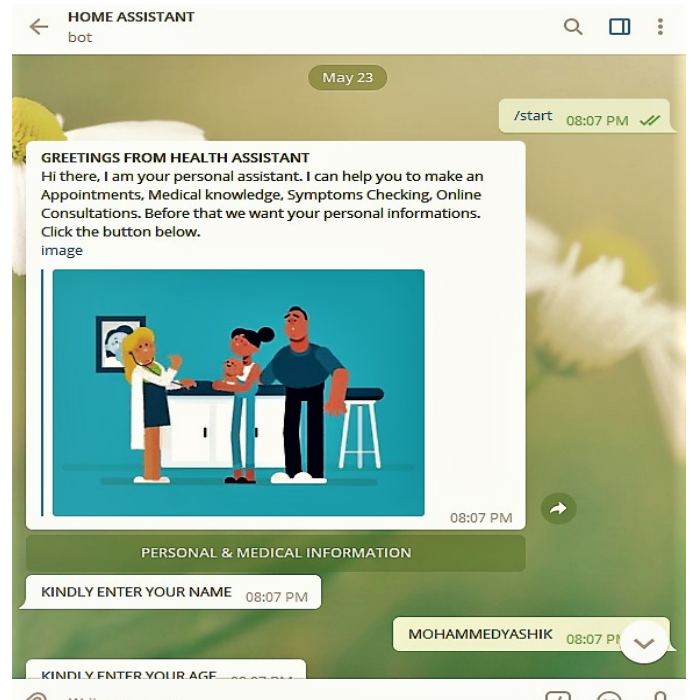


Fig. 4. Personal & medical Information Collection

Fig. 5. Represents the chatbot architecture deployed in telegram web application. One of the prominent features of this chatbot is collecting patients' personal and medical information. Because of storing these data doctors or physicians can make better decisions for patients.

TELEGRAM GOOGLE SHEETS INTEGRATION ☆

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3	Bashheer sahib	55	9486123539	C/74 pandian nagar	Business	Male	Fever	Noo	Nooo
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Fig. 5. Patients Information Database

Fig.5.Shows that collection of patients personal and medical information. Benefits of this data is diagnosing patients by their data and providing manual prescriptions based on patient's health records. This data can be accessed only by doctors.

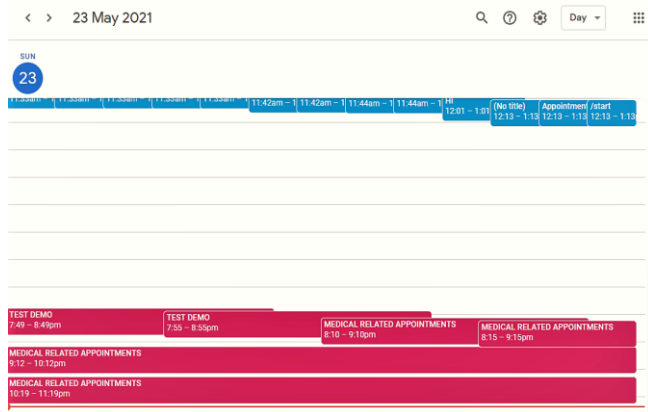


Fig. 6. Scheduling Medical Appointments

Fig.6. shows patients appointments recorded in google calendar. According to a survey, healthcare loses billions of dollars because of missed appointments. Another prominent advantage of this chatbot is this appointment made in doctor and patients google calendar. So missed appointments may be reduced.



Fig. 7. Automation

Fig.7.Representing automation work for this chatbot. This is the backend functionality to power this chatbot. This automation work contains electronic health data storing, scheduling medical appointments. For strengthening medical appointments, the patients will get a zoom meeting URL along with password and google calendar shareable link to view their appointments via google gmail.

V. CONCLUSION

This study has developed a conversational agent that provides real-time health suggestions for the end-user those who cannot afford or access the medical care at the right time especially during the pandemic situation. Millions of people search medical keywords every day in Google and other browsers. This chatbot system plays a vital role in the healthcare sector. Users get an immediate response about their health conditions through these web application platforms. In the future, we

wish to add health parameters to add with our conversational agent and to set up in rural areas to provide health assistance.

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