Intelligent Chatbot for Medical Assistance in Rural Areas

V. Arulmangainayaki, M. Harini, M. Keerthiga, M. Deva Priya

Abstract: *In today's world, 918 million rural people are more easily connected to the internet than doctors. The rural part of India is still in crisis due to lack of doctors and gets only one-third of hospital facilities. 80% doctors are available only in urban areas. In this paper, an application is developed with a motive of connecting doctors and assisting medication primarily focusing on rural and urban areas. The main idea is to create a user-friendly virtual assistant which helps every citizen, mainly residing in the rural parts of India. There are few industrial bots for News, Weather, Trends and perhaps different day-after-day events that manifest themselves within the general class. The proposed application takes a prominent place in the medical field. The bot recommends the best medical practice to the patients in treating minor medical issues. In the future, this Medical Chatbot can be trained with doctors to treat some minor surgeries.*

Keywords: *Artificial Intelligence, Medical ChatBot, Dialogflow, Heroku, Firebase, Flask, Flutter*

I. INTRODUCTION

Man-made reasoning / Artificial Intelligence (AI) enables machines to act like people. Computer based intelligence empowers the machines to make choices based on accumulated information. Right now, India has some million allopathy specialists to treat its population in billions. The villages in India are still in great trouble as most of the villages do not have either hospitals or doctors to treat their illness at their place. 80% of science and medical experts are available only in town fields. The basic idea is to develop a user-friendly virtual assistant that would help every person even in the last mile. Chatbot is the most essential piece of application that acts as an interface between the client and the Application Programming Interfaces (APIs). A chatbot will not substitute medical care, but it can easily become a personal holistic self-care coach. It plays the job of an individual collaborator and consequently offers the following benefits: checking the accessibility of mentioned queries and giving answers to user's specific queries.

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The user can converse with the Chatbot using a regular language. The therapeutic Chatbots analyze the user's requests, recollect them and answer related queries. Various examinations have exhibited that Chatbots can support human administrations at low costs. There is amazingly a smaller number of Chatbots in the field of therapeutics.

In research, Chatbot and Bot find eminent places, though they have seen an increasingly gradual slowdown in recent years. This is due to the inherent difficulty in appropriately describing the evolution of a discussion, without making appropriate considerations and upstream reflections. The Chatbot application is enhanced by designing an efficient User Interface (UI) that gets the queries from patients and responds with appropriate results. The bot should be capable of utilizing the gathered user's information, examining the client's queries and answering to the related questions.

The proposed Bot provides useful information such as details of Physicians around, medications to be taken when queried of a particular diagnosis, exercises to be carried out for pain, women pregnancy, menstrual advice and nearby public toilets. This assistant might become the first contact point for the patient to gain medical information. If sufficient information is not available, then it redirects to a well-known physician for help. This assistant also provides useful information for general queries like news, How-to(s), disaster relief loans and government funds etc.

II. RELATED WORK

Many intelligent solutions are available in the literature for disease diagnosis [1-6]. Initially, cosmology of reference methodology was used. From this perception, one can comprehend how the meaning of the right reference philosophy is central to the correct working of Bot.

Comendador et al (2015) [7] have created a conversational Chatbot that is designed to prescribe and give suggestion about generic disease. They have presented a personal conversation application that acts as a drug specialist for the patients. The analysts use left and right parsing algorithms in their investigation to produce ideal results. In the future, designers may enhance the amount of information in terms of infections or illnesses that can be dealt by a Chatbot.

Versatile applications have become normal these days and something fundamental. WhatsApp is one of these kinds that stand apart with a large number of clients. Moreno et al (2015) [8] have proposed an extraordinary idea for converting the people's own language to make the conversation easier. They have shown the conversation of Brazilian people with the doctors.

Retrieval Number: F3083049620/2020©BEIESP
DOI: 10.35940/ijitee.F3083.049620
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24

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Kumar et al (2016) [9] have proposed a plan to code the medicinal record utilizing worldwide methodologies.

The essential point of this application is to connect between the wellbeing suppliers by demonstrating answers to the queries posted by patients. Local mining extracts the medical concepts from individual record and then maps them based on external authenticated vocabularies. Local Mining establishes a tri-stage framework to accomplish this task.

Dharwadkar & Deshpande (2016) [10] have created a medical bot. This therapeutic visit bot relies on Natural Language Processing (NLP) that takes the clients' queries. The user can ask any query related to human services to the talk Bot without physically accessing the clinic by using Google API for voice and voice-to-text transformation. The query is sent to the ChatBot that finds the related solution and shows the answer on the android application.

Mhatre et al (2016) [11] have developed a Chatbot called Donna, an individual partner. Donna's adequacy originates from the way that it employs Common Language Processing (CLP) to get data from messages. It employs Gmail and Calendar API for notifying about events that have been already stored. The information is exchanged through E-mail, whereas evaluation is performed through natural language procession and natural language generation.

Madhu et al (2017) [12] have proposed an application with man-made consciousness that can meet the necessities. AI can anticipate the infections dependent on the indications and can give them some remedies. The system can likewise give prescriptions and advise them to take the right treatment. Along these lines, people can have an idea related to their health and prevent major diseases. An effective execution of customized drugs would spare numerous lives and provide impeccable medicinal calling.

Versatile Instant Messaging (VIM) stages like WhatsApp are getting progressively popular. They have extended access to computerized content, sound, picture and video. Moreno et al (2017) [13] have endeavored to incorporate WhatsApp into Aggie, a web-based life for gathering and observing stage.

Rarhi et al (2017) [14] have designed a structure of a medicinal Chatbot that finds and cures based on the queries given to the application. The application has the option to measure the reality, and if necessary, it associates the client to a specialist accessible on the web.

Brixey et al (2017) [15] have presented the execution of a self-sufficient Chatbot, SHIH bot conveyed on Facebook. It is capable of answering a wide assortment of sexual well-being inquiries on HIV/AIDS. The Chabot's reaction database is gathered from proficient medicinal and open well-being assets so as to provide data to patients.

Mishra et al (2018) [16] have created Dr. Vdoc-a medicinal Chatbot that acts as a virtual specialist. Patients can pose query identified with illness to this virtual Chatbot. Dr. Vdoc offers response about few sorts of inquiry related to infection. It acts as a support to individuals dwelling in places inaccessible by specialists. Dr. Vdoc effectively responds to the inquiry posed by a patient with 80% precision.

Divya et al (2018) [17] have proposed the idea of developing a supportive Chatbot using AI that can examine the afflictions and give basic details of knowledge with respect to their symptoms. Certain Chatbots go about as a restorative reference book which enables the patient to find about their illness and improve their health. The user can achieve the real advantage of a Chatbot exactly when it can examine all kinds of diseases and give significant information. Pryss et al (2019) [18] have dealt with the fact that the appearance of Chabots have an impact on numerous treatment techniques in the psychological fields. Specifically, Chabots might be helpful much of the time when patients are back at home. For instance, while being in the planning period of a colonoscopy, a Chabot may understand the query more rapidly than a specialist. For instance, if another medicinal indication happens, a Chabot may fill in as the primary "master" to answer about a patient's condition. Accordingly, the current work proposes a design that acts as a reference to different and psychological situations. According to Maroengsit et al (2019) [19], Chatbots have been recognized by numerous enterprises that subsequently respond to clients' queries by means of talk interfaces. While it is simple to build a Chatbot application, the application itself is complex in nature.

III. IMPLEMENTATION OF THE PROPOSED CHATBOT

Nowadays, portable discussions become insights for making better decisions in the future. These discussions are extremely straightforward in nature and incorporate efficient method of correspondence. Chatbot is an effective on-the-off chance that follows effortless texting applications. They are generally message-driven with pictures and bound together gadgets which makes establishing connections simpler. To create a chat assistant, Python 3.x is used as the backend for co-operating with UI tools. By utilizing NLP strategies and Amazon Polly, change-over is applied to the local language to convert it into International English. Amazon Polly is a paid service and might cost more. DrugBank's API provides information about medicines and practo.com API gives the Physician's data. Mongo DB is utilized to store Frequently Answered Questions (FAQs). Restorative information collections from HealthData.gov are used by the application that is capable of anticipating diverse therapeutic findings. Hub-JS runs the stage with Flask which is facilitated on-site and is changed into a web application. Android Studio is used in developing the application for Android Operating System (OS). This application does not demand 24/7 internet facilities to communicate with the server. Rural India is partially developed with internet facilities and this might act as a barrier. Offline communication is made possible with Twilio. Many people residing in the rural part of India are still ignorant of how to use mobile devices and the internet. Hence, pre-education of technology is required here. There may be situations that demand hiring medical-assistant(s) predominantly for helping people in case of emergencies. Scalable servers are implemented in areas with low bandwidth latency. This Chatbot is conversational software that is available either via standalone apps or web applications. This medical Chatbot mimic a Physician to stimulate a conversation that resembles a human.

It uses NLP to recognize text and interprets the user's queries using algorithms.

It provides information about nearby hospitals, pharmacies and physicians in local language. This bot helps the user to communicate even without an internet connection. It is designed to give a response to the patient through a phone call. It is deployed in social medias like WhatsApp and Facebook as they are used in day-to-day life.

A. User Validation and Symptoms Extraction

The approval of the patient login precision is shown in Fig. 1(a). Symptoms are extracted utilizing string searching algorithms, wherein substrings show the signs to be recognized in the characteristic language content information. When a patient enquires about something, the application recognizes it with least effort. For example, the application probably has the option to deal with inputs like, "When I read, I'm all right from the outset, yet after some time, my eyes appear to get worn out, and I begin to see things". For this situation, the application separates substrings like "eyes tired" and "see things", and not substrings like "read" or "all right".
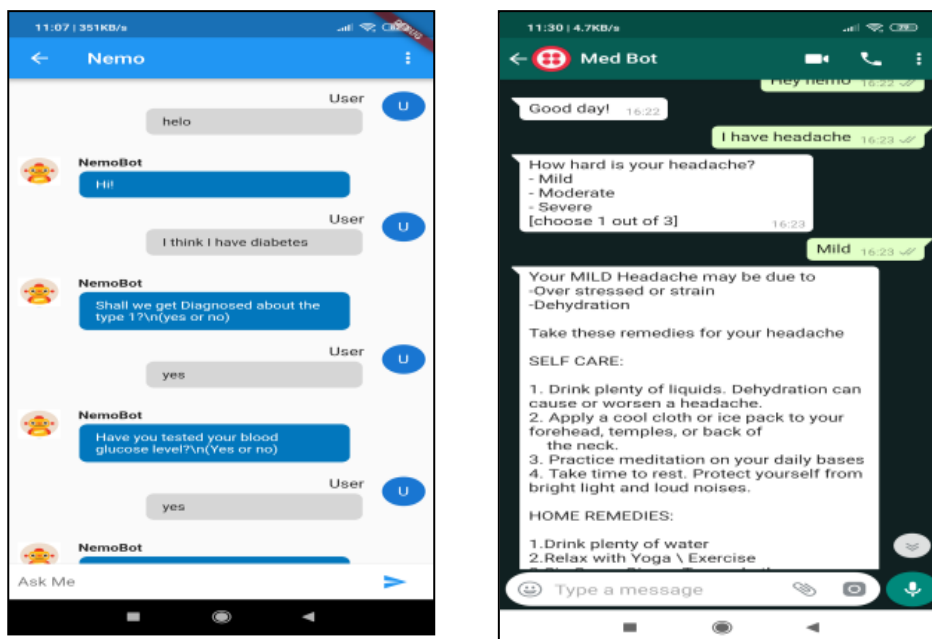

Fig.1 (a) User Validation in Application   (b) Whatsapp Deployment

B. Implementation of Standalone Application in Whatsapp

Whatsapp is a texting online life stage which permits creators to send and get messages, pictures and recordings. The application has millions of month-to-month dynamic creators on the planet. This Chatbot is implemented as standalone application in Whatsapp. The patients can chat with the doctor nearby using this feature as shown in Fig. 1(b).

C. Disease Diagnosis based on Patient's Symptoms

This module deals with the rundown of illness in the database and ensuing effects are compared with the appearances of basic sicknesses by coordinating it with the existing one. The related diseases are found based on the patients' response to the query. The exact infection is recognized and communicated to the patient. The Chatbot categorizes the recognized infection as a major or minor issue based on the conditions in the Chatbot. If it is a major issue, it refers an expert to the patient by sending the Physician details. In case it is a minor issue, the Chatbot determines the illness and gives information about home remedies or first aids and advises the patients to visit a specialist immediately (Fig. 2).

D. FAQ System

The FAQ system is used to deal with the patients' FAQs by employing a separate database. The patient's queries are applied on the database and if similar symptoms are identified, preferences are given based on the FAQ. MongoDB is used for storing queries and data.

E. Work Flow of the System

The bot is programmed to self-learn as it is introduced to new dialogues and words. In effect, as a Chatbot receives new textual dialogues, the number of queries that it can reply and the accuracy of each response increases based on the FAQ stored in the database.

Fig. 3 shows the logical workflow of the proposed system. Python is used at the backend. The Dialog flow, Heroku and Flutter play an important role in creating standalone applications that can be implemented in applications like Whatsapp, Facebook Messenger, GitHub. FireBase database is used to provide static and dynamic web services.
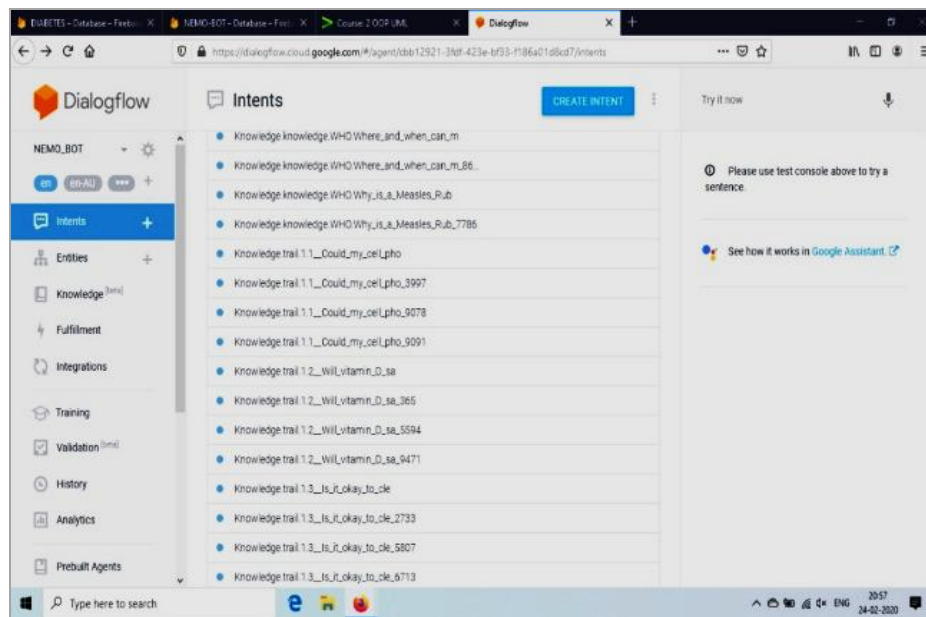
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DOI: 10.35940/ijitee.F3083.049620
Journal Website: www.ijitee.org

26

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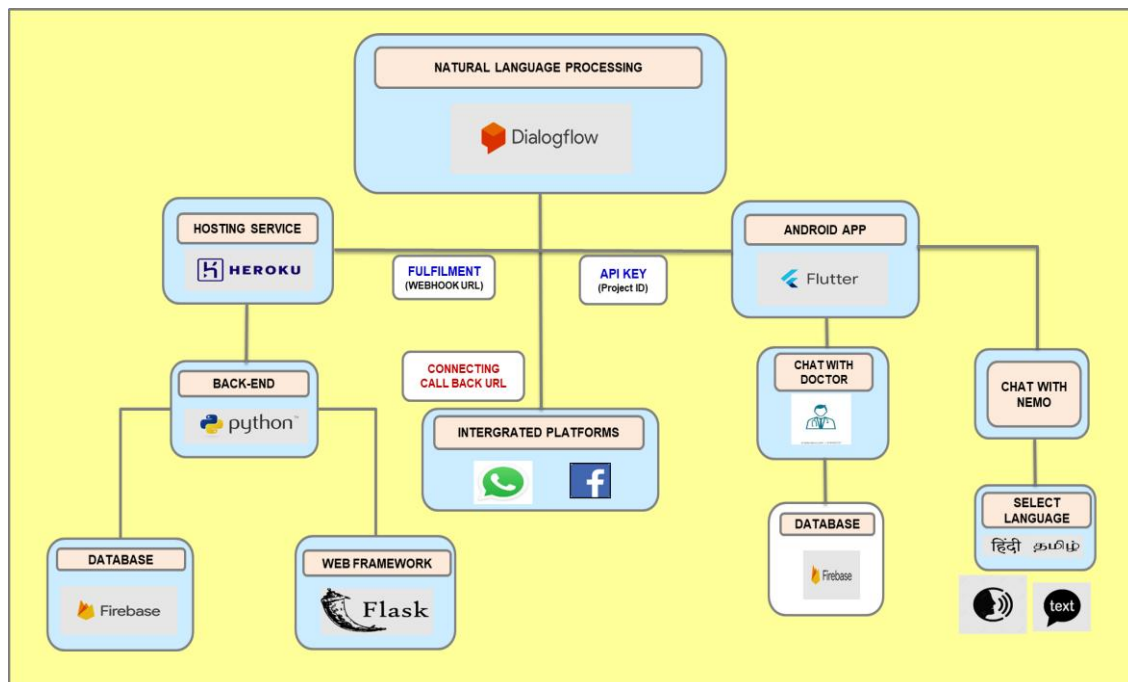
Fig. 2. Diseases Database

Fig. 3. Workflow

Dialogflow - Natural Language Converter

Dialogflow is used to support human-computer interaction based on natural language conversations. Dialog flow naturally transfers activity bundles to Actions, so that actions can be rapidly and effectively tested. Dialog flow is used to develop conversational interfaces for mobile application, websites and Chatbots. The Dialog flow uses natural language understanding to recognize a user's intent such as time, date and numbers. This innovation serves enormous operators with a high number of expectations and handles huge loads. The improved framework element language foundation gives better cross-language support. The dialog flow demands forming -v parameter in the Uniform Resource Locator (URL) [20].

Heroku-Hosting Service

Heroku is a compartment-based cloud Platform-as-a-Service (PaaS) which supports several programming languages. For this reason, it is said to be a polyglot platform as it includes features for developing an application across most languages. It is typically used to route http request to the correct Dyno, web application container. It lets the developer scale the app instantly just by either increasing the number of dynos or by changing the type of dyno the app runs in.

27

Firebase-Database

Firebase depends on the Google establishment and scales normally for even huge applications. It offers databases and crash reports, and supports analytics and messaging, so that one can move quickly and revolve around customers. It stores and coordinates the data with NoSQL cloud database. Clients deal with data continuously and the data is all-time available. Static and dynamic web hosting services are supported by Firebase. Static files such as CSS, HTML, JavaScript are hosted in Heroku supported by cloud functions (Fig. 4).
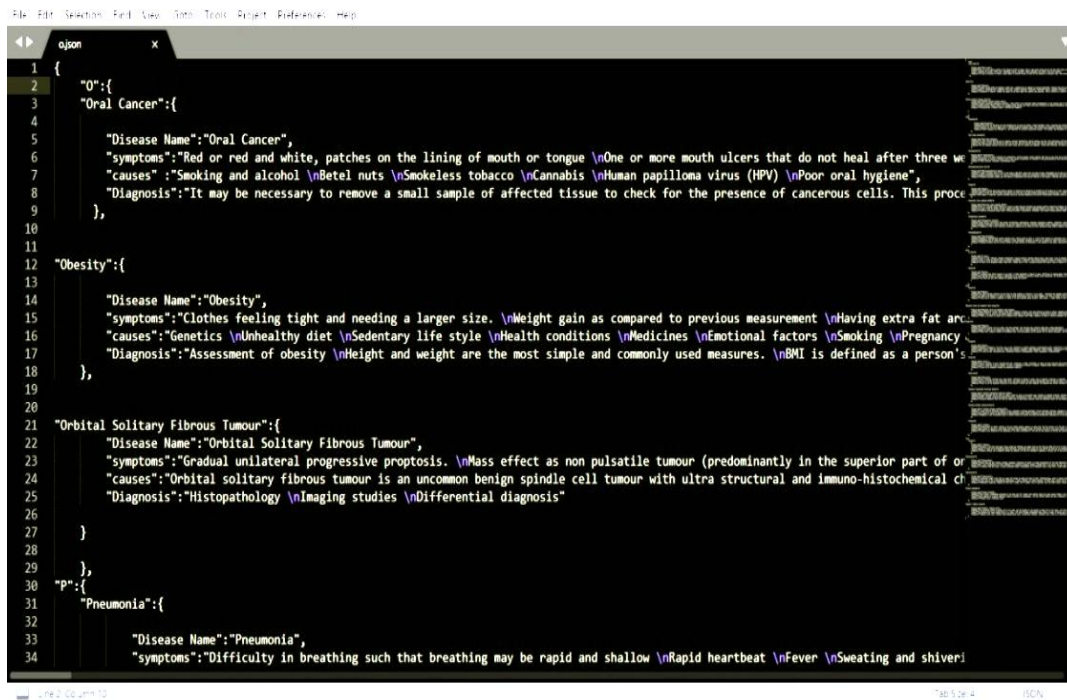

Fig. 4. JSON Disease Database

Flask-Web Application

Flask is a little scale web structure written in Python. It is assigned to micro framework because it doesn't require unequivocal gadgets or libraries. It has no database reflection layer, structure endorsement, or whatever different sections where earlier untouchable libraries give fundamental limits. Regardless, Flask reinforces expansions that are capable of incorporating applications as if they were executed in it. Applications that use the Flask structure include Pinterest, LinkedIn and the site page.

Flask offers recommendations but do not maintain any conditions or undertaking group. It is dependent on the architect to pick the mechanical assemblies and libraries to be used.

Flutter-Android Application

Flutter Google's UI tool is used for developing intractable UI for mobile, web and also desktop applications. Flutter uses a single codebase. The hot reload helps in experimenting and building UIs. The flutter fixes bugs faster as it experiences sub-second reload times without losing state.

It is an open-source UI programming improvement pack made by Google. It is used to build applications for Android, iOS, Windows, Mac, Linux, Google Fuchsia and the web. The chief variation of Flutter is known as codename 'Sky' that runs on the Android working system [21].

F. Algorithms

AI enables a specialist to comprehend patient's queries in regular language and converts them into organized information by removing unwanted parameters. In the Dialogflow, the operator utilizes AI calculations to coordinate patient's solicitations to explicitly extract pertinent information from them. The bot gains information from the query similar to the language models created by Dialogflow. From this information, it generates a model for settling on choices based on which expectations ought to be activated from the patient's input and information that should be removed. The model efficiently develops based on the suggestions given by a specialist. To ensure that the model is improving, the specialist should be prepared on genuine discussion logs.

Naive Bayes Algorithm based Classification

Multinomial Naive Bayes algorithm deals with content grouping and NLP. For example, many sentences belong to a specific class. With new information, each word means its event and represents its shared feature and each class is associated with a score. The noteworthy scored class is destined to be related to the information in the sentence.

A choice tree is a graphical depiction that deals with believable consequences of a decision, considering explicit conditions. In a decision tree, the center point addresses a test on the attribute, each node of the tree addresses the after effect of the test and the leaf center point addresses a particular class name, for instance, the decision made in handling the aggregate of the qualities.

The depiction rules are addressed through the path from the root to the leaf center points.

Decision trees are very instinctual and can be disclosed to anybody effortlessly. Individuals from a non-specialized foundation can likewise translate the theory drawn from a choice tree, as they are clear. The information type isn't a limitation as they can deal with both clear cut and numerical factors. The machine learning calculations do not make any guesses on the classifier structure and space conveyance. Decision tree identifiably includes choice which is important in the psychic examination. When a decision tree is fit into a preparation dataset, the hubs at the top on which the decision tree is a part are considered as significant factors inside a given dataset. It saves information planning time, as they are most certainly not delicate to missing qualities and exceptions.

Natural Language Processing (NLP)

Natural Language Processing (NLP) depends on profound discovering that empowers PCs to obtain importance from inputs given by patients. With regard to bots, it evaluates the purpose of the inputs from patients and reacts based on relevant medical investigation like a human. The Chatbot serves patients who probably attempt to post queries that go beyond the bot's dimension. This can be handled by having default reactions as it isn't conceivable to anticipate the sort of queries that a patient may pose or how they will be raised. Patient's requests are broken and gathered as words. E.g., "Solutions for cerebral pain". The Chatbot uses NLP to convert local language into English for easy understanding. After these steps, the machine interacts with people using their language. The input can be in a local language, and the Bot can give a clear response. NLP aids in suggesting some home remedies and basic first aids in the local language of patients.
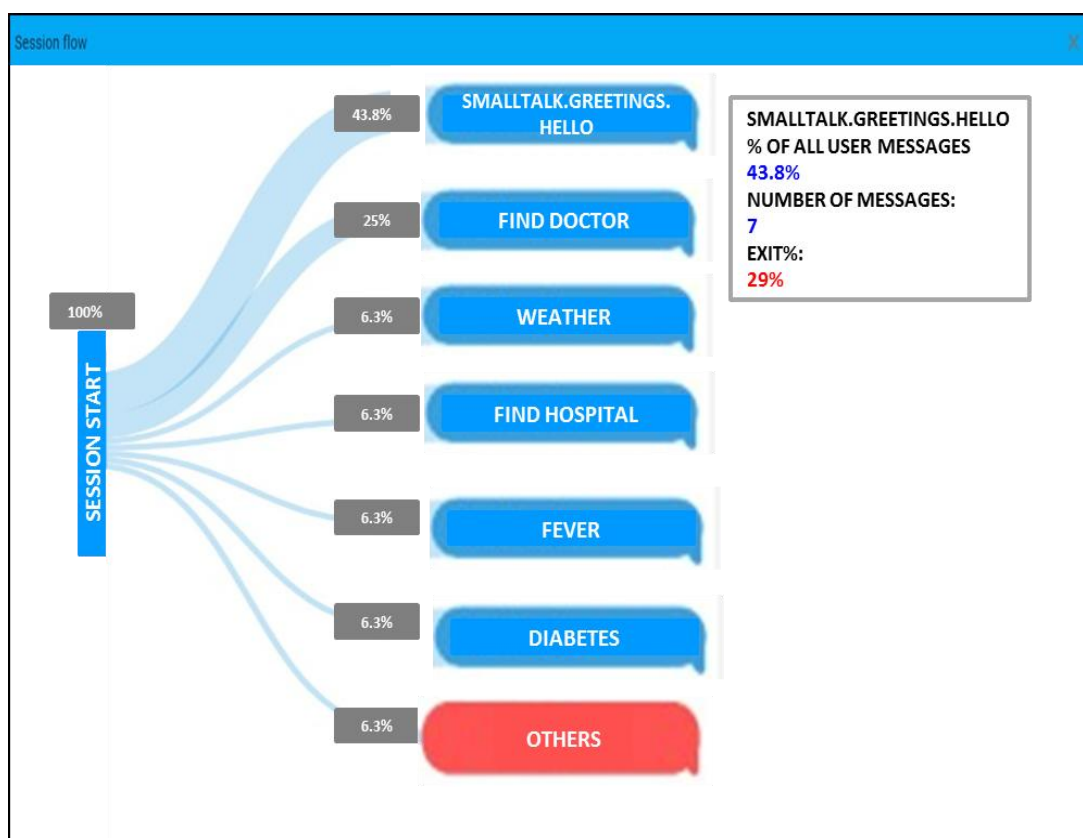

Fig. 5. Session Flow

IV IMPLEMENTATION AND RESULTS

The Session flow (Fig. 5) shows the sessions of different queries like Greetings, Find Doctor, Weather, Find Hospital and others. The sessions include percentages (i.e) the number of users posting particular queries in the same sessions. Fig. 6 shows the number of sessions and messages, and User Exit percentages.

The Analytics (Fig. 7) of the account shows the sessions of the last 7 days. The results of a week's sessions are compared with two different peaks on the current date. It provides information about the average number of queries per session.

INTENT	SESSIONS	COUNT	EXIT%
FIND DOCTOR	10	52	1.92
FIND DOCTOR-CUSTOM	8	48	18.75
SMALLTALK.GREETINGS.HELLO	6	22	18.18
WEATHER	5	16	12.50
FEVER	4	12	8.33
FIND HOSPITAL	5	11	2.5
FIND HOSPITAL-CUSTOM	4	9	22.22
WEATHER-CUSTOM	2	9	8.9
DIABETES	3	7	2.1

Fig. 6. Percentage of Messages, Number of Messages and User Exit Percentage
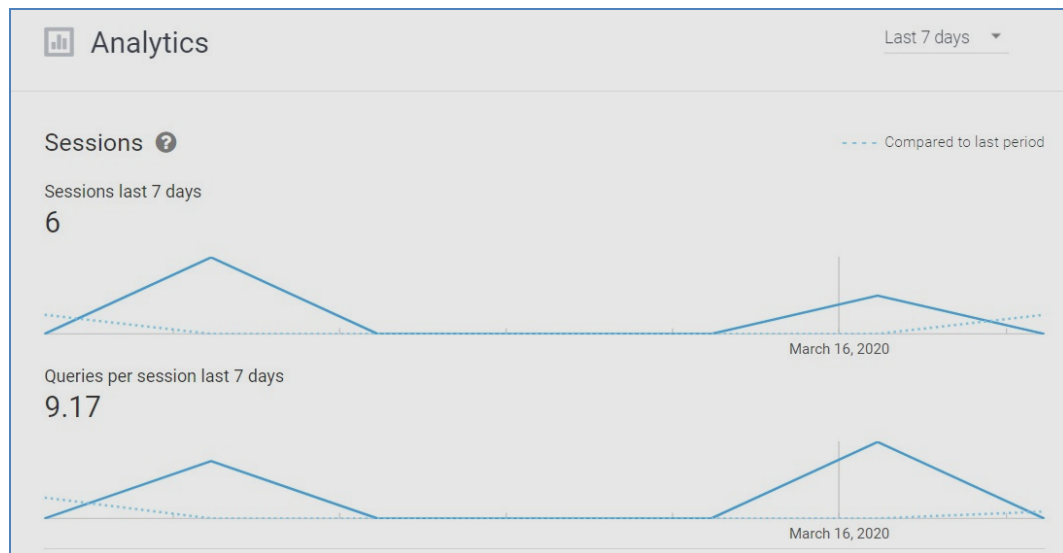

Fig. 7. Analytics

IV CONCLUSION

It is concluded that the usage of Chatbot is user-friendly and it can be used by any person who knows to type in his language in mobile apps. This system provides home remedies and preventive measures for major diseases. This intelligent Chatbot is designed to give suggestions on personalized medicine which would save lives and create medical awareness among people. The system provides details on medicines for minor issues. It is designed based on the patient's review and demands.

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Retrieval Number: F3083049620/2020©BEIESP
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