BUILDING A CONVERSATIONAL AI FOR THE HEALTHCARE INDUSTRY

A Project Report submitted in partial fulfilment
Of the requirement for the award of the degree of

BACHELOR OF TECHNOLOGY
In

Instrumentation and Control Engineering

Submitted by

Chahat Segan
Reg. No.: 170921038

Under the guidance of

MR RAJAT VERMA
(External)
Director
SNUG Technologies Private Limited

&

MS PREETI MOHANTY
(Internal)
Assistant Professor (Sr.)
Department of Instrumentation & Control Engineering

DEPARTMENT OF INSTRUMENTATION AND CONTROL ENGINEERING

MANIPAL INSTITUTE OF TECHNOLOGY
MANIPAL
(A constituent unit of MAHE, Manipal)

INSPIRED BY LIFE

AUGUST 2021

DEPARTMENT OF INSTRUMENTATION AND CONTROL ENGINEERING

MANIPAL INSTITUTE OF TECHNOLOGY

(A Constituent Institution of Manipal Academy of Higher Education)
MANIPAL – 576 104 (KARNATAKA), INDIA

Manipal
06/08/21

CERTIFICATE

This is to certify that the project titled **BUILDING A CONVERSATIONAL AI FOR THE HEALTHCARE INDUSTRY** is a record of the bonafide work done by **CHAHAT SEGAN** (*Reg. No. 170921038*) submitted in partial fulfilment of the requirements for the award of the Degree of Bachelor of Technology (BTech) in **INSTRUMENTATION AND CONTROL ENGINEERING** of Manipal Institute of Technology, Manipal, Karnataka, (A Constituent Institution of Manipal Academy of Higher Education), during the academic year 2020-2021.

Ms Preeti Mohanty
Project Guide

Prof. Dr Shreesha C
HOD, ICE
MIT, MANIPAL

SNUG

M/s SNUG TECHNOLOGIES PRIVATE LIMITED
403, 4TH FLOOR, TOWER B, GLOBAL BUSINESS PARK,
MEHRAULI - GURGAON ROAD, SECTOR 26,
GURUGRAM, HARYANA 122002
PH: +91.124.4112112

Ref: HR-INTERN/2021-22/001
Dept: Professional Services

Date: 10th August 2021

TO WHOM SO EVER IT MAY CONCERN

This is to certify that **Ms. Chahat Segan** (Roll No# 170921038) student of Bachelor of Technology (B.Tech) - Department of Instrumentation & Control Engineering at Manipal Institute of Technology, Manipal, India has completed her Summer Internship in Software Development Department for 06 months from 8th Jan 2021 – 10th August 2021 in our company.

She was actively involved in the software product development and testing along with the other project team members.

Her conduct, throughout her association with SNUG Technologies Private Limited was good.

We wish to place on record our appreciation for the efficient and professional services rendered by Ms. Chahat Segan during her stay at SNUG Technologies Private Limited. During her stay she was found enthusiastic, sincere and hardworking.

We wish her success in all her future endeavors.

Thanking you,

For, SNUG TECHNOLOGIES PRIVATE LIMITED

SAURAB
H MEHTA

Digitally signed by
SAURABH MEHTA
Date: 2021.08.11
16:41:40 +05'30'

[SAURABH MEHTA]
Director
SNUG Technologies Private Limited
Ph: +91 9810808552
E: saurabh.mehta@snug.in

ACKNOWLEDGMENT

I express my gratitude to all the people without whom this project would not have been possible. First, I am grateful to the **Manipal Academy of Higher Education** and **Manipal Institute of Technology** for providing the opportunity to work on the final year project, helping me to enhance my practical knowledge and experience. The process has been smooth and efficient despite the ongoing pandemic.

I want to express my sincere gratitude to my mentor, **Mr Rajat Verma**, for his valuable time, constant guidance, patience, and unconditional support. His immense knowledge, profound experience and professional expertise have enabled me to complete this project successfully. I would also like to thank **Mr Saurabh Mehta** and the entire team at **SNUG Technologies** for their continual guidance and support. Working with the team helped me grow as an engineer and as a professional in the industry.

I want to thank our **HOD, Dr Sreesha C** and the Instrumentation and Control Department for their active and efficient communication, which made the final year project go smoothly without any hassle. They provided all the necessary resources for the project.

I would also like to thank **Ms Preeti Mohanty**, my immediate internal guide, for her prompt guidance and encouragement. All her insights have helped immensely towards the successful completion of the project, reports, and presentations.

I extend my sincere thanks to **Dr Sandra D'Souza**, our project coordinator, for her interaction, help, valuable suggestions, and encouragement during the project.

Thank You for your guidance!

Chahat Segan

ABSTRACT

Artificial intelligence (AI) is the ability of a digital computer or computer-controlled robot to perform tasks commonly associated with intelligent beings. AI is widely adopted in our lives as it improves efficiency and can augment the works humans can do, specifically in workplaces. When AI takes over repetitive or dangerous tasks, it frees up the human workforce to do work they are better equipped for—tasks that involve creativity and empathy, among others. One such application is Conversational AI. Conversational AI is a set of technologies that enable computers to understand, process, and respond to voice or text inputs naturally.

The project aims to develop a working Conversational AI designed to handle the common queries generated in the healthcare department. This project aims to help the healthcare front liner and the patient and their kin to have a streamlined flow of information and improve the response time towards various non-medical procedures.

We approached the project with the literature review where we familiarised ourselves with the current technologies in the field, i.e., the traditional IVR, their applications, scope, and drawbacks. Following this, we collected data with inference to customer satisfaction with the existing technologies and their suggestions. The analysis of all the responses pointed to a solution of a Conversational AI with an Interactive Voice Response System.

Various platforms like Google Dialogflow, Amazon AWS, and Amazon DynamoDB were used to develop and train our AI to implement the AI. The Avaya Aura Experience Portalis is used for the IVR application.

LIST OF TABLES

LIST OF FIGURES

Contents

CHAPTER 1
INTRODUCTION

This chapter is divided into four sections. The opening section will give a brief introduction to the area of our work and its present-day scenario. The second section will list the motivation to do the project, and the third section will cite the project's objectives. The fourth section gives the project schedule.

1.1 INTRODUCTION

Ever since Alan Turing devised this famous test to check if machines could converse just like humans, there has been steady progress towards developing one. Exponential growth in data storage and computing capabilities has led to new and innovative artificial intelligence (AI) technologies that enable machines to learn with minimal human supervision.

Conversational agents, also known as chatbots, are computer programs designed to simulate human text or verbal conversations. Conversational AI can converse like a human by recognising text and speech, deciphering different languages, understanding intent, and responding in a way that imitates human conversation. Conversational AI uses various technologies such as Natural Language Processing (NLP), Automatic Speech Recognition (ASR), Machine Learning (ML) and Advanced Dialog management to understand, react and learn from every interaction. They are used in many Tele-Informative applications such as automated enquiry systems used widely by various industries such as service, travel, banking, and governments.

Healthcare is an industry that has potential for so many use cases of conversational AI. By enabling better accessibility, personalisation, and efficiency, conversational agents have an enormous potential to improve patient care and the lives and workload of medical personnel. These AI's can go a long way in providing technologies that deliver virtual care in a shared physical touch era caused by Covid-19. The AI's can take care of repetitive, non-patient facing, time-consuming and high-precision tasks so that staff is free to focus on actual care and improving patient satisfaction.

1.2 MOTIVATION

The expectations around customer service in today's always-online world are sky-high. Customers want every company they interact with online to be available 24/7 with instant, helpful, and personalised service. Demand is exploding for self-service options across multiple communication channels.

As of today, callers can engage with the Interactive Voice Response (IVR) system. IVR is a system where a caller can interact with support services by calling via their mobile phones. However, in traditional IVR systems, the caller must listen to the complete announcements to understand various options' positions and navigate each option sequentially to reach the desired option.

This causes users to spend additional time over the IVR system and often cannot comprehend the requests made by customers or the intent behind the call. Therefore, this system is nowhere close to the standards demanded by the customers.

The only way to meet these expectations effectively and economically is via Conversational AI-driven virtual agents.

The Conversational AI expands the quality of IVR by entitling it with cutting edge technology of Machine Learning and Natural Language Understanding (NLU), thus offering advanced voice recognition technology. The result of this advanced voice recognition is an application that understands caller intent and responds suitably, accurately, and efficiently. This means that one can ask open-ended questions with the voice self-service applications and provide conversational IVR that is also efficient and customer friendly. With AI, users can input data without using DTMF, and developers do not need to build and manage custom grammars as they did for traditional Automatic Speech Recognition (ASR).

These also satisfy the customers' demand for speedy, 24x7 personal context-based, omnichannel self-service.

1.3 OBJECTIVES

This project aims to create a Conversational AI incorporating IVR for the healthcare industry. This reduces the manual intervention of medical staff to assist the caller with required support services.

This AI aims to facilitate the industry by providing services for scheduling appointments, medical tests, report status, doctors selection and many more.

The developed Conversational AI can be extended to multiple platforms such as WhatsApp, Facebook Messenger, Skype etc., thus enabling omnichannel communications providing a customer-centric experience across any channel of their choice.

This provides a better customer experience and minimises the need for manual assistants to resolve customer queries. Customers will be connected to manual assistants only in failover cases when AI cannot resolve customer concerns or fulfil customer requirements.

In this project, we use software like Google Dialogflow, Amazon AWS, and Amazon DynamoDB to create a Conversational AI that aims to facilitate the daily functioning of hospital-patient communication.

1.4 PROJECT SCHEDULE

6-month project:

Table 1.1: Project Schedule

February 2021	Learning Java Understanding Google Dialogflow
March 2021	Learning Spring and Hibernate Creating and testing sample chatbots on Google Dialogflow
April 2021	Learning about REST API's, Node.js Enhancing chatbot to integrate with different back-end systems to provide automation
May 2021	Learning Node.js Extending chatbot to various communication Channels
June 2021	Creating the back-end business logic and databases
July 2021	Creating the back-end business logic and databases
August 2021	Designing the frontend. Conclusion

CHAPTER 2
BACKGROUND THEORY

This chapter is segmented into five sections, including an explanation of the project title, present scenario, the conversational artificial intelligence including its components, working, integration with IVR and challenges respectively, summary and a conclusion.

2.1 THE PROJECT TITLE

The project title is “Building a Conversational AI for the Healthcare Industry”. As the title suggests, we are developing a Conversational AI-driven virtual agent incorporating IVR for the healthcare industry. Platforms like Google Dialogflow, Amazon AWS, and Amazon DynamoDB were used to create and train the AI. The Avaya Aura Experience Portalis used for the IVR application. The aim is to create a multidimensional AI that automates the daily functioning of hospital-patient communication and assists the medical staff by reducing manual workload while meeting customer expectations.

2.2 PRESENT SCENARIO

Whenever a call is made to the customer care centre or the reception desk of an organisation, be it while having queries regarding a particular product or while asking about different services offered by the organisation, the customer can hear a monotonous incessant response such as “Your call is on waiting, please hold the line”, or “We have registered your request, we will connect you to an executive shortly.” or “Press 1 for placing an order, Press 2 for cancelling an order”.

With monotony in its frequency, this recurrent voice is Interactive Voice Response (IVR), used in every sector to tend to the customer’s needs. IVR is a telephonic catalogue through which the companies register the customer’s queries by recognising, segmenting, and directly connecting the customer to an executive who can attend to their queries.

IVR is a system where a caller can interact with support services by calling via their mobile phones. An IVR system (IVRS) accepts a combination of voice telephone input and touch-tone keypad selection. It provides the appropriate responses in voice, fax, call back, email and other contact methods.

Moreover, in traditional IVR systems, due to its redundant technology, the caller can engage with the IVRS using dual-tone multi-frequency (DTMF) inputs and must listen to the complete announcements to understand the position of various options and must navigate sequentially to each option one by one to reach the desired option. This causes users to spend additional time over the IVRS and often cannot comprehend the requests made by customers or the intent behind the call.

2.3 CONVERSATIONAL ARTIFICIAL INTELLIGENCE

Conversational Artificial Intelligence (AI) is the set of technologies behind automated speech-enabled and messaging applications that offer human-like interactions between humans and computers. Conversational AI can converse like a human by recognising speech and text, deciphering different languages, understanding intent, and responding in a way that imitates human conversation. The best Conversational AI offers a result indistinguishable from what a human could have delivered.

Applied Conversational AI requires both art and science to create successful applications that incorporate context, personalisation, and relevance within the computer to human interaction. Conversational design, a science dedicated to designing flows that sound natural, is a fundamental part of developing Conversational AI applications.

Though chatbots have gained popularity, Conversational AI solutions can be offered over both voice and text modalities and hence various devices and channels that support these modalities – from SMS and webchat for text modality to a phone call and smart speakers for voice modality.

2.3.1 COMPONENTS OF CONVERSATIONAL AI

Conversational AI uses various technologies such as Natural Language Processing (NLP), Automatic Speech Recognition (ASR), Machine Learning (ML) and Advanced Dialog management to understand, react and learn from every interaction.

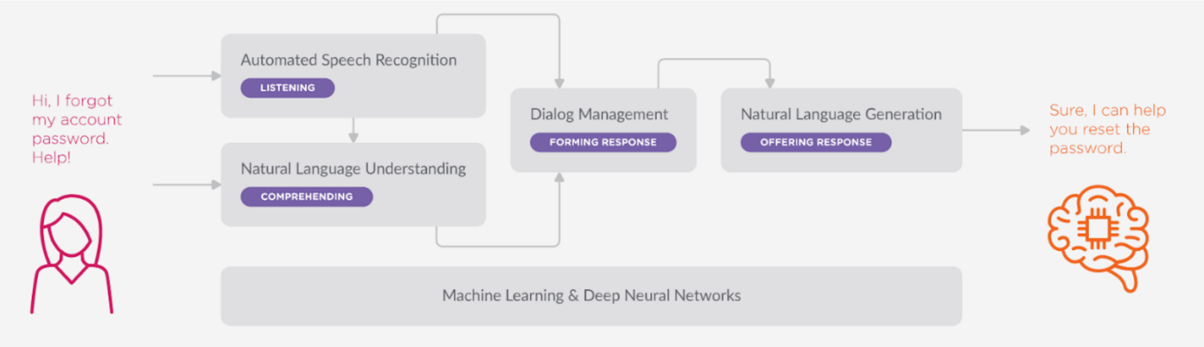

Hi, I forgot my account password. Help!
Automated Speech Recognition
LISTENING
Natural Language Understanding
COMPREHENDING
Dialog Management
FORMING RESPONSE
Natural Language Generation
OFFERING RESPONSE
Sure, I can help you reset the password.
Machine Learning & Deep Neural Networks

Figure 2.1: Components of Conversational AI

2.3.2 WORKING OF CONVERSATIONAL AI

First, the application receives the input from the human, either spoken phrases or written text. If the information is voice-based, ASR, also known as voice recognition, is the technology that makes sense of the spoken words and translates them into a machine-readable text format.

Second, the application must interpret what the text signifies. It applies Natural Language Understanding (NLU), one component of Natural Language Processing (NLP), to comprehend the intent behind the text.

Next, the application shapes the response based on understanding the text's intent using Dialog Management. Dialogue management orchestrates the responses and transforms them into a human-comprehensible format using Natural Language Generation (NLG), the other NLP component.

The application either delivers the response in text or uses speech synthesis, the artificial production of human speech, or text-to-speech to respond to a voice modality.

Last is the component responsible for learning and enhancing the application. This is known as machine or reinforced learning, where the application acknowledges improvements and learns from the experience to produce better responses in future interactions.

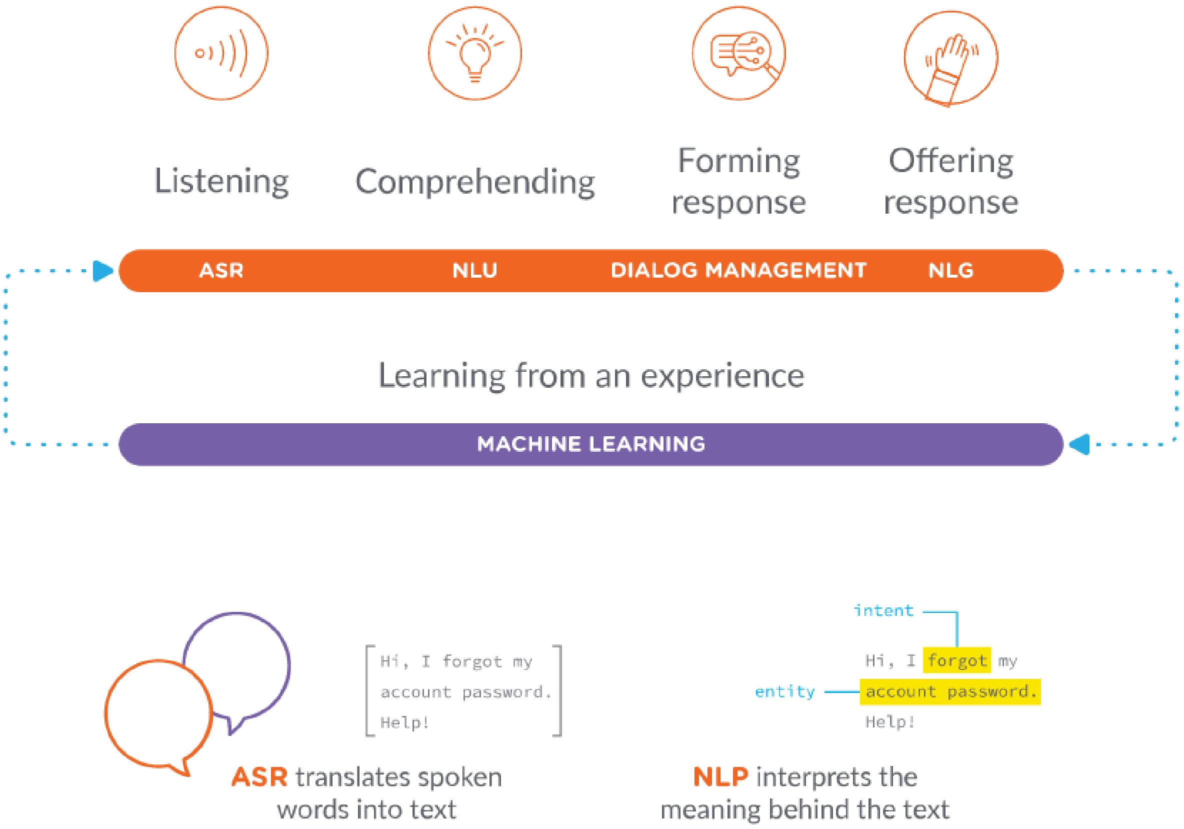

Listening
Comprehending
Forming response
Offering response
ASR
NLU
DIALOG MANAGEMENT
NLG
Learning from an experience
MACHINE LEARNING
Hi, I forgot my account password. Help!
intent
entity
Hi, I forgot my account password. Help!
ASR translates spoken words into text
NLP interprets the meaning behind the text

Figure 2.2: General Working of the AI

2.3.3 INTEGRATING CONVERSATIONAL AI WITH IVR

Conversational AI with IVR systems uses voice commands from callers, allowing them to engage with a self-service model when they approach a business for assistance. These systems are intelligent and intuitive enough to decipher the context and content of a conversation. This is a giant leap forward in eradicating tedious hierarchical menus from communication experiences.

Powered by NLU and ML, Conversational AI with IVR systems allow callers to lead the conversation, with automated systems reposing in complete sentences. This makes the conversation flow more organically without any human interference. As it uses ML in conjunction with the AI, this IVR system can acquire the exact phrases and sentences used by callers, which gives businesses a goldmine of insights into what their callers seek.

Conversational AI with IVR, as a system, can also improve its proficiency based on the inputs it receives. A human agent can take over seamlessly when conversational IVR cannot understand what a caller is saying. The AI system then preserves the inputs for conversational analysis and optimisation. When a similar query is posed again, it can handle it without human interference.

As the data and knowledge build-up, the IVR learns and becomes better equipped to handle calls independently. Moreover, the use of NLU enables IVR systems to imitate human conversations better. This allows a shift from ‘this is what I can do for you’ to ‘what can I do for you ’.

Collectively, these elements allow the callers to take charge of their interaction with a support system, thus, improving their experience.

2.3.4 CHALLENGES WITH CONVERSATIONAL AI

Conversational AI faces challenges that require more advanced technology to overcome.

a) **Constantly changing communication:**
From languages, accents, and dialects to emojis, sarcasm, and slang, many factors can influence the communication between a machine and a human. Conversational AI systems need to keep up with what is normal and what is the ‘new normal’ with human communication.

b) **Security and Privacy:**
Especially when dealing with sensitive personal information that can be stolen, Conversational AI applications must be designed with security in mind to ensure that privacy is respected and all personal details are kept confidential or redacted based on the channel being used.

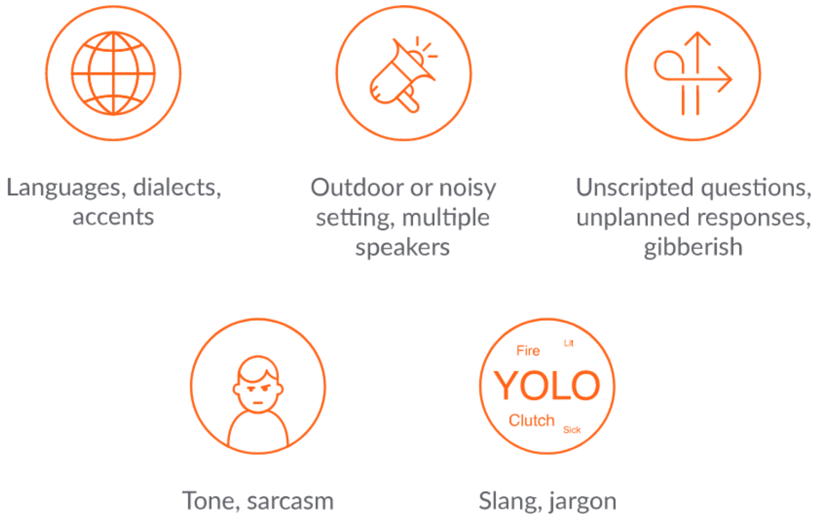

Languages, dialects, accents
Outdoor or noisy setting, multiple speakers
Unscripted questions, unplanned responses, gibberish
Tone, sarcasm
Fire
Lit
YOLO
Clutch
Sick
Slang, jargon

Figure 2.3: Some Challenges

c) **<u>Discovery and Adoption:</u>**

Although Conversational AI applications are becoming more accessible and easier to use and normalised for the general population, there are still trials that can be overcome to raise the number of people who are comfortable using technology for a broader range of use cases. Educating the customer base on opportunities can help the technology be more well-received and create better experiences for those unfamiliar with it.

2.4 SUMMARISED OUTCOME

The following points can be summarised from the above discussion,

- Conversational AI incorporates the cutting-edge technologies of NLU and ML to make the conversations between humans and computers more “human-like” without human intervention
- The integration with IVR allows these features to extend to calls and call systems along with the omnichannel communications like text, web chat, voice chat, etc., provided by the AI.
- ML allows the AI agent to extend and adapt its capabilities according to its experiences with various customers.
- They allow callers to steer the conversation, with automated systems reposing in complete sentences.
- There is no need to follow a standard flow/direction of the conversation; it is now more query and intent-based.
- Human intervention is only required when the AI cannot comprehend the issue on its own.
- The AI also stores each conversation, extracting helpful information, allowing a human agent to take over the conversation seamlessly.

2.5 CONCLUSION:

Conversational AI with IVR is a multifaceted solution ideal for our desired objectives of facilitating the healthcare industry. It is an economical and efficient solution that provides customers with a self-serving experience while meeting their soaring demands. It also has an enormous potential to streamline the workflow in the industry.

CHAPTER 3
METHODOLOGY

This chapter discusses the approach to the project. We will briefly discuss all essential components that build up the AI.

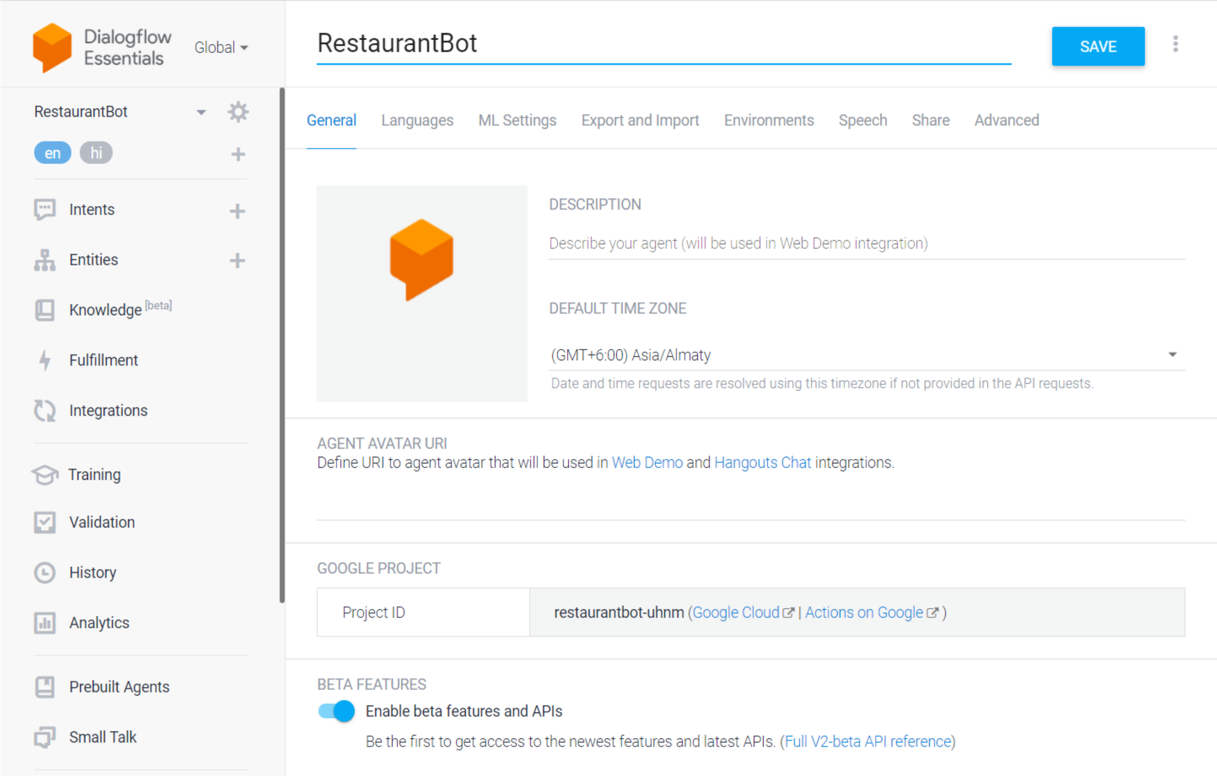
Before attempting to build any virtual agent or AI, it is crucial to understand the components required to make it. It is also essential to understand the working of each element to develop an accurate and fluid conversational AI.

3.1 GOOGLE DIALOGFLOW

Dialogflow (GDF) can analyse multiple types of input from your customers, including text or audio information (like from a phone or voice recording). It can also respond to the customers in a couple of ways, either through text or synthetic speech.

3.1.1 AGENTS

A GDF agent is a virtual agent that handles conversations with the end-users. It is an NLU module that understands the nuances of human language. GDF translates end-user text or audio during a conversation to structured data that various apps and services can utilise. A GDF agent can be built and designed to handle the types of conversations required for the system. The GDF agent is like a human call centre agent. Both can be trained to handle expected conversation scenarios.



RestaurantBot

DESCRIPTION

Describe your agent (will be used in Web Demo integration)

DEFAULT TIME ZONE

(GMT+6:00) Asia/Almaty

Date and time requests are resolved using this timezone if not provided in the API requests.

AGENT AVATAR URI

Define URI to agent avatar that will be used in Web Demo and Hangouts Chat integrations.

GOOGLE PROJECT

Project ID	restaurantbot-uhnm (Google Cloud | Actions on Google)

BETA FEATURES

● Enable beta features and APIs

Be the first to get access to the newest features and latest APIs. (Full V2-beta API reference)

Figure 3.1: Dialogflow ES Console

3.1.2 INTENTS

An intent categorises a user's intention for one conversation turn. One may define many intents for each agent, where combined intents can handle the complete conversation. When a user says or writes anything, referred to as an end-user expression, GDF matches the user expression to the closest intent in the agent. Matching an intent is also called intent classification.

A primary intent contains the following:

- **Training phrases**: These are example phrases for what end-users might say. When an end-user expression resembles one of these phrases, GDF matches the intent.
- **Action**: When an intent is matched, GDF provides the defined action to your system, which can be used to trigger specific actions described in your system.
- **Parameters**: When an intent is matched at runtime, the extracted values from the end-user expression are returned as parameters. Each parameter has a type, called the entity type, which dictates exactly how the data is extracted. Unlike raw end-user input, parameters are structured data that can efficiently perform some logic or generate responses.
- **Responses**: Text, speech, or visual responses can be defined to return to the end-user. These may provide the end-user with answers, ask the end-user for more information, or terminate the conversation.

Figure 3.2 shows the basic flow for intent matching and responding to the end-user:

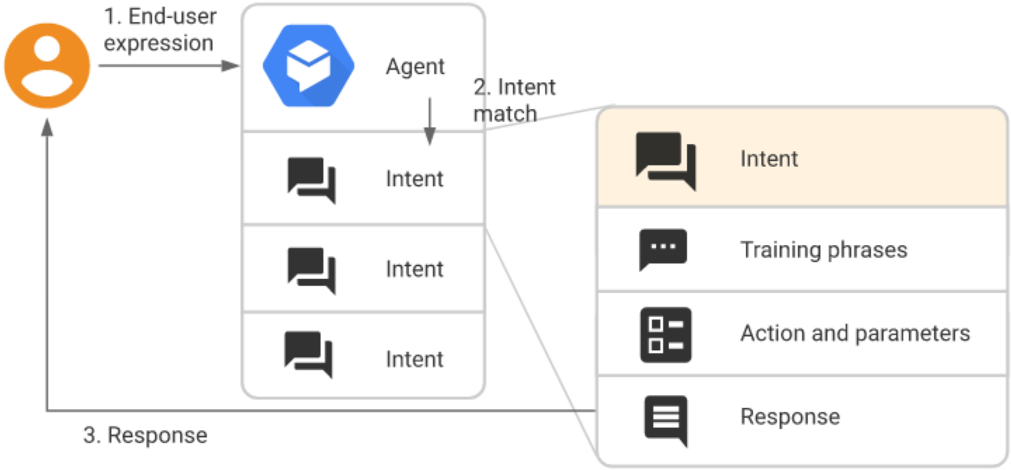


Figure 3.2: Intent Matching

3.1.3 ENTITIES

Each intent parameter has a type, called the entity type, that determines precisely how data from an end-user expression is extracted.

Entities can be of 2 types:

- System Entities: These are predefined entities provided by GDF that can match common types of data. For example, there are system entities for identifying times, dates, colours, email addresses, and so on.
- Custom Entities: These are entities that the developer for matching custom data creates. For example, one could define a *menu* entity that can match the different dishes available with a restaurant agent.

3.1.4 CONTEXTS

GDF *contexts* are like natural language contexts. If a person says, “they are orange”, some context is needed to understand what “they” refers to. Similarly, for GDF to handle a similar end-user expression, it needs to be provided with context to match an intent correctly.

Contexts can also be used to control the flow of a conversation. Contexts for an intent can be configured by setting output and input contexts recognised by string names. When an intent is matched, any constructed *output contexts* for that intent become active. While any contexts are active, GDF is more likely to match intents configured with *input contexts* that correspond to the currently active contexts.

3.1.5 FULFILLMENTS

By default, the agent responds to a matched intent with a static response. For a dynamic response to be sent back to the user, we need to use fulfillments. When fulfilment is enabled for an intent, GDF responds by calling a service that we define. For example, if an end-user wants to reserve a table on Saturday, the service can check the database and respond to the end-users availability details for Saturday.

Each intent has a setting to enable fulfilment. If an intent requires a dynamic response, fulfilment should be enabled for the intent. When an intent without fulfilment enabled is matched, Dialogflow uses the static responses specified for the intent matched.

When an intent with fulfilment enabled is matched, a request to the *webhook* service is sent by GDF with information about the matched intent. Our system can perform the required actions and respond to Dialogflow with information on how to proceed. Figure 3.3 shows the processing flow for fulfilment:

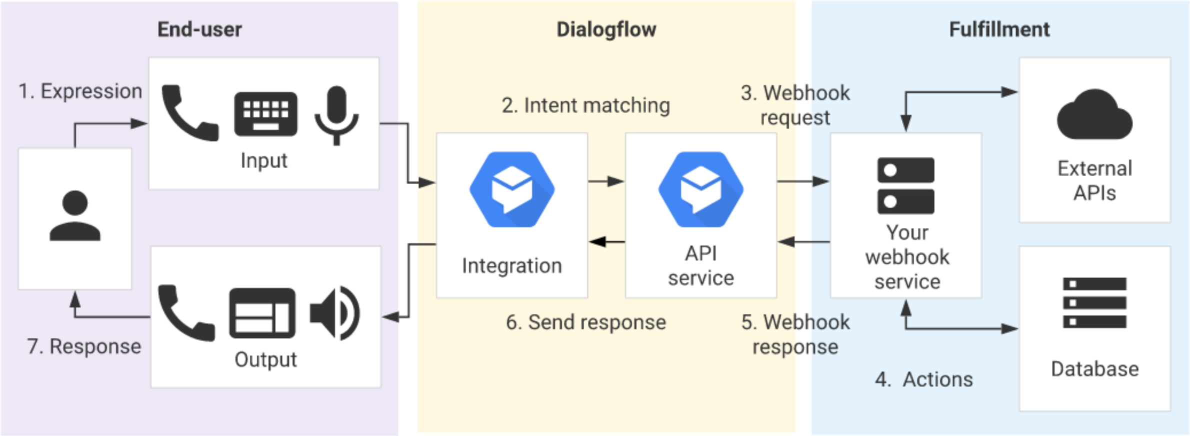


Figure 3.3: How fulfilment works

3.1.6 INTEGRATIONS

Dialogflow integrates with multiple conversation platforms like Google Assistant, Facebook Messenger, and Slack. Direct end-user interactions are handled by GDF itself, while the developer solely needs to focus on building our AI virtual agent.

Partner built-in telephony Integrations: AudioCodes, Avaya, Genesys, SignalWire, Voximplant.

Dialogflow built-in Integrations: Dialogflow Messenger, Dialogflow Phone Gateway, Dialogflow Web Demo, Messenger from Facebook, Workplace from Facebook, Google Assistant (legacy), Hangouts Chat, LINE, Slack, Telegram

Google-contributed open-source Integrations: Kik, Skype, Spark (Cisco Webex), Twilio IP Messaging, Twilio Text Messaging, Twitter, Viber

Independent Integrations: possible

3.2 AMAZON WEB SERVICES (AWS)

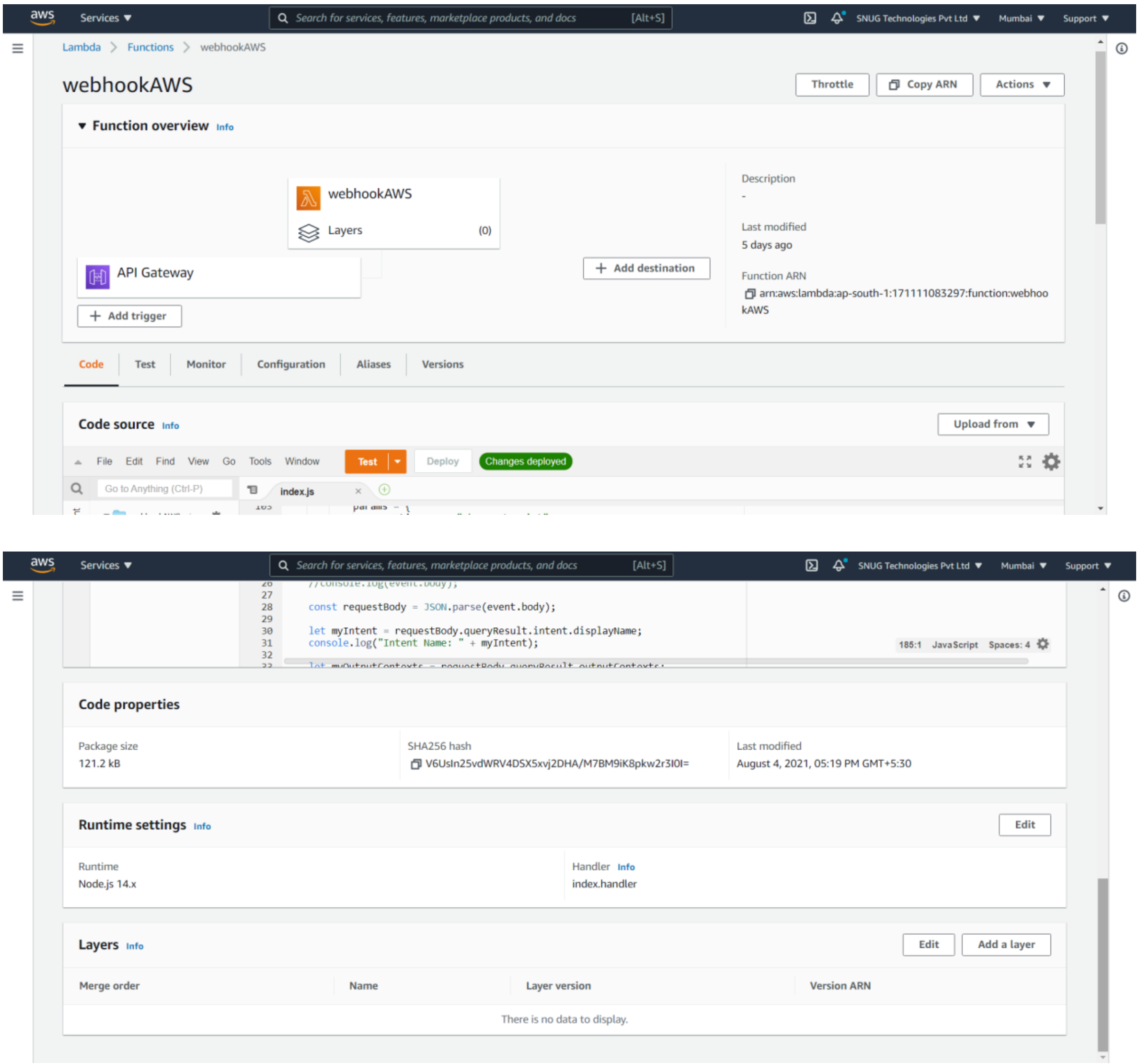
Amazon Web Services offers scalable, reliable, and inexpensive cloud computing services. In this project, we use the various services and infrastructure provided by the platform to build our custom business logic.

3.2.1 AWS LAMBDA:

AWS Lambda is an event-driven, serverless computing platform provided by Amazon as a part of Amazon Web Services. It is a computing service that deploys code in response to events and automatically manages the computing resources required by that code.

The code the run-on AWS Lambda is called a “Lambda function.” After creating the Lambda function, it is always ready to run as soon as triggered. Lambda functions are “stateless”, with no affinity to the underlying infrastructure, so that Lambda can rapidly deploy as many copies of the function as required to scale to the rate of incoming events.

For this project, all back-end logic was written in several Lambda Functions. We were called by one centralised function that gets the results of intent matching and parameters from Dialogflow.



webhookAWS

Function overview

Description
-

Last modified
5 days ago

Function ARN
arn:aws:lambda:ap-south-1:171111083297:function:webhookAWS

Code source

```
    const requestBody = JSON.parse(event.body);

    let myIntent = requestBody.queryResult.intent.displayName;
    console.log("Intent Name: " + myIntent);
```

Code properties

Package size	SHA256 hash	Last modified
121.2 kB	V6UsIn25vdWRV4DSX5xvj2DHA/M7BM9iK8pkw2r3I0I=	August 4, 2021, 05:19 PM GMT+5:30

Runtime settings

Runtime	Handler
Node.js 14.x	index.handler

Layers

Merge order	Name	Layer version	Version ARN

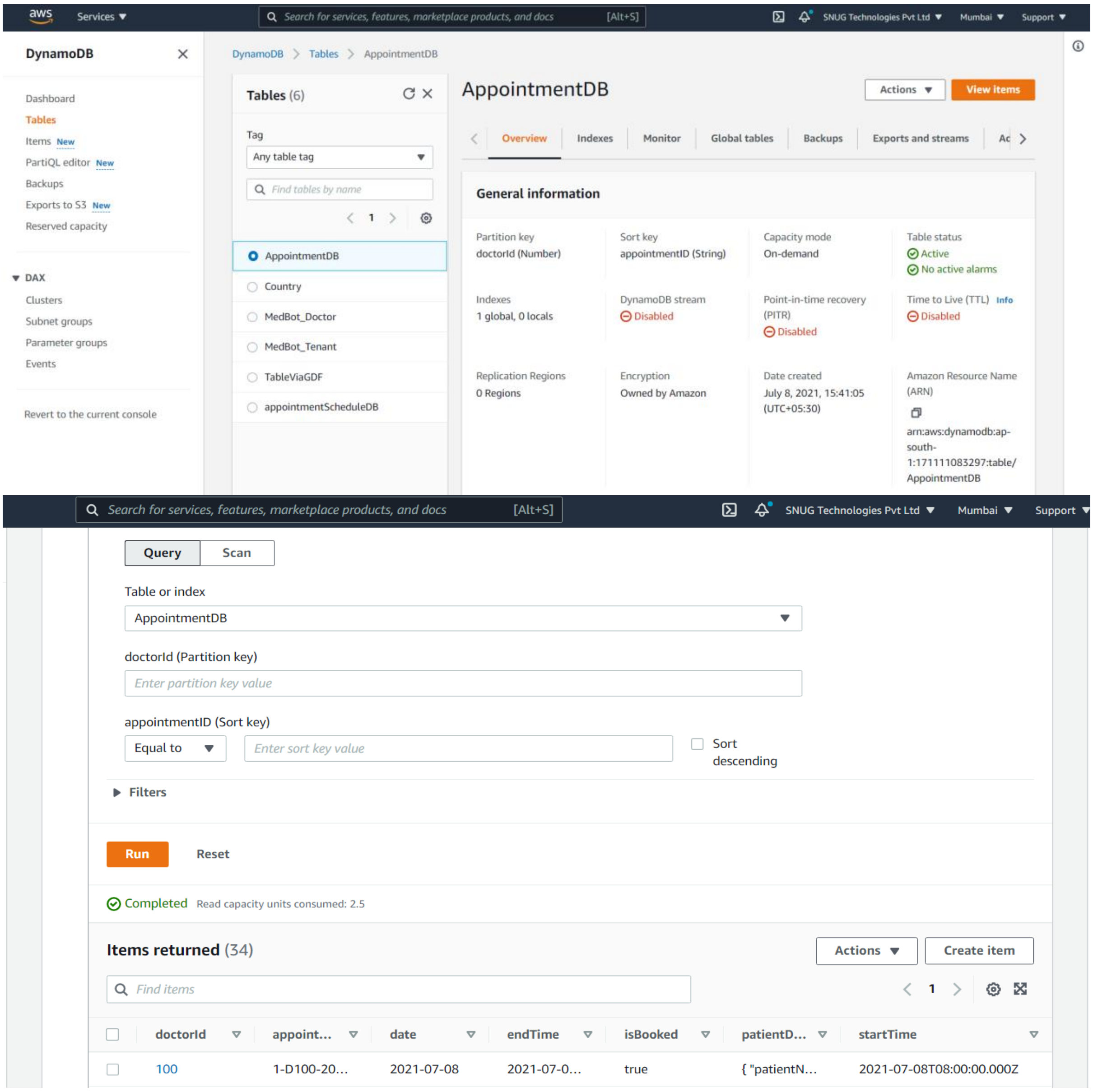
There is no data to display.

Figure 3.4: AWS Lambda Console

3.2.2 AWS DynamoDB

Amazon DynamoDB is a key-value and document database that delivers millisecond performance at any scale. It is a fully managed, multi-region, multi invocation, durable database with built-in security, backup and restores, and in-memory caching for internet-scale applications.

DynamoDB has been utilised for all the underlying database logic. Various databases were designed and developed to track and store all the vital information. Separate tables to amass the details of the healthcare providers utilising this AI, collection of all doctors, database of all upcoming and past appointments and a patient database were designed and deployed.



● AppointmentDB
○ Country
○ MedBot_Doctor
○ MedBot_Tenant
○ TableViaGDF
○ appointmentScheduleDB

AppointmentDB

General information

Partition key: doctorId (Number)
Sort key: appointmentID (String)
Capacity mode: On-demand
Table status: Active; No active alarms
Indexes: 1 global, 0 locals
DynamoDB stream: Disabled
Point-in-time recovery (PITR): Disabled
Time to Live (TTL): Disabled
Replication Regions: 0 Regions
Encryption: Owned by Amazon
Date created: July 8, 2021, 15:41:05 (UTC+05:30)
Amazon Resource Name (ARN): arn:aws:dynamodb:ap-south-1:171111083297:table/AppointmentDB

Table or index: AppointmentDB
doctorId (Partition key): Enter partition key value
appointmentID (Sort key): Equal to ▼ Enter sort key value
□ Sort descending

Completed Read capacity units consumed: 2.5

Items returned (34)

□	doctorId	appoint...	date	endTime	isBooked	patientD...	startTime
□	100	1-D100-20...	2021-07-08	2021-07-0...	true	{ "patientN...	2021-07-08T08:00:00.000Z

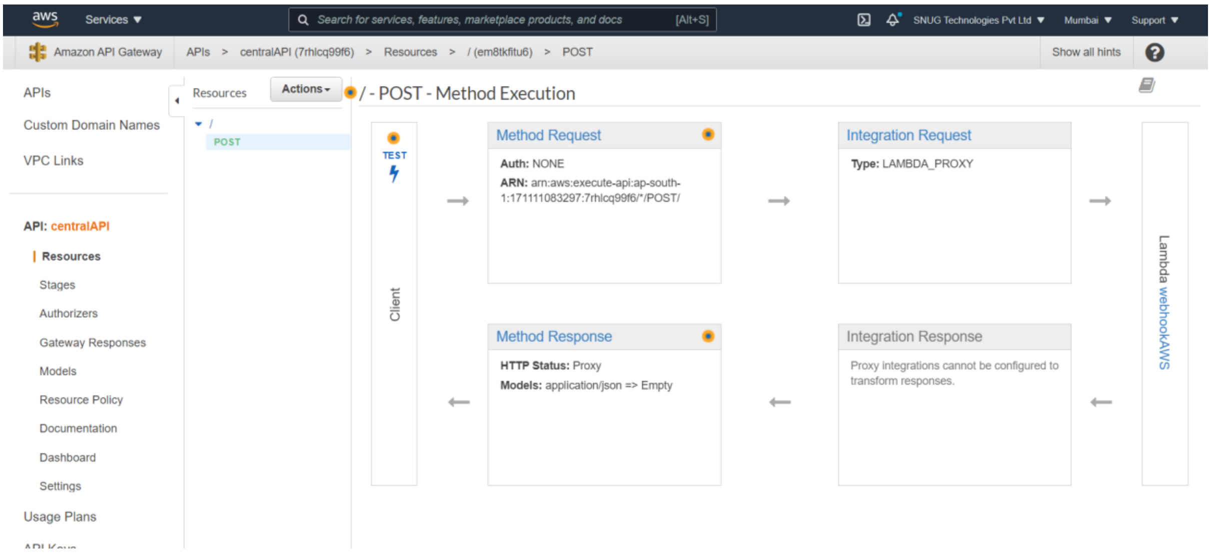
Figure 3.5: DynamoDB Console with sample view of the appointment database

3.2.3 AWS API GATEWAY

Amazon API Gateway is an AWS service for creating, publishing, maintaining, monitoring, and securing REST, WebSocket and HTTP APIs at any scale.

An API or Application Programming Interface is a software liaison that allows two applications to talk to each other. In other words, an API is a messenger that delivers the request to the provider that is requesting it from and then delivers the response back.

Using API Gateway, we created a link between Dialogflow and AWS to integrate the NLP capabilities provided by one to the serverless computation of our business logic offered by the other. These two combined form the core of our Conversational AI.



/ - POST - Method Execution

Method Request

Auth: NONE

ARN: arn:aws:execute-api:ap-south-1:171111083297:7rhlcq99f6/*/POST/

Integration Request

Type: LAMBDA_PROXY

Method Response

HTTP Status: Proxy

Models: application/json => Empty

Integration Response

Proxy integrations cannot be configured to transform responses.

Figure 3.6: API Gateway console for our call to central webhook in AWS

3.3: INTEGRATIONS

As discussed previously, there are various integrations possible with Dialogflow. The virtual agent has been integrated with Dialogflow Messenger, Facebook Messenger, Telegram, and WhatsApp for this project.

Each integration has its procedure to connect them with Dialogflow.

3.4 RICH RESPONSES

Rich response messages are messages provided by Dialogflow to add visual elements to the conversation. These responses are platform-specific and enhance user interactions by providing more than just text responses. These graphic elements can also provide hints on how to continue with the conversation.

Rich Responses can contain the following components:

- Text
- Image
- Quick Replies/Suggestion Chips
- Card (platform-specific)
- Button (platform-specific)
- List (platform-specific)
- Description (platform-specific)
- Accordion (platform-specific)
- Custom (platform-specific)

3.5 WORKING

Figure 3.7 illustrates the overall working of the conversational AI created.

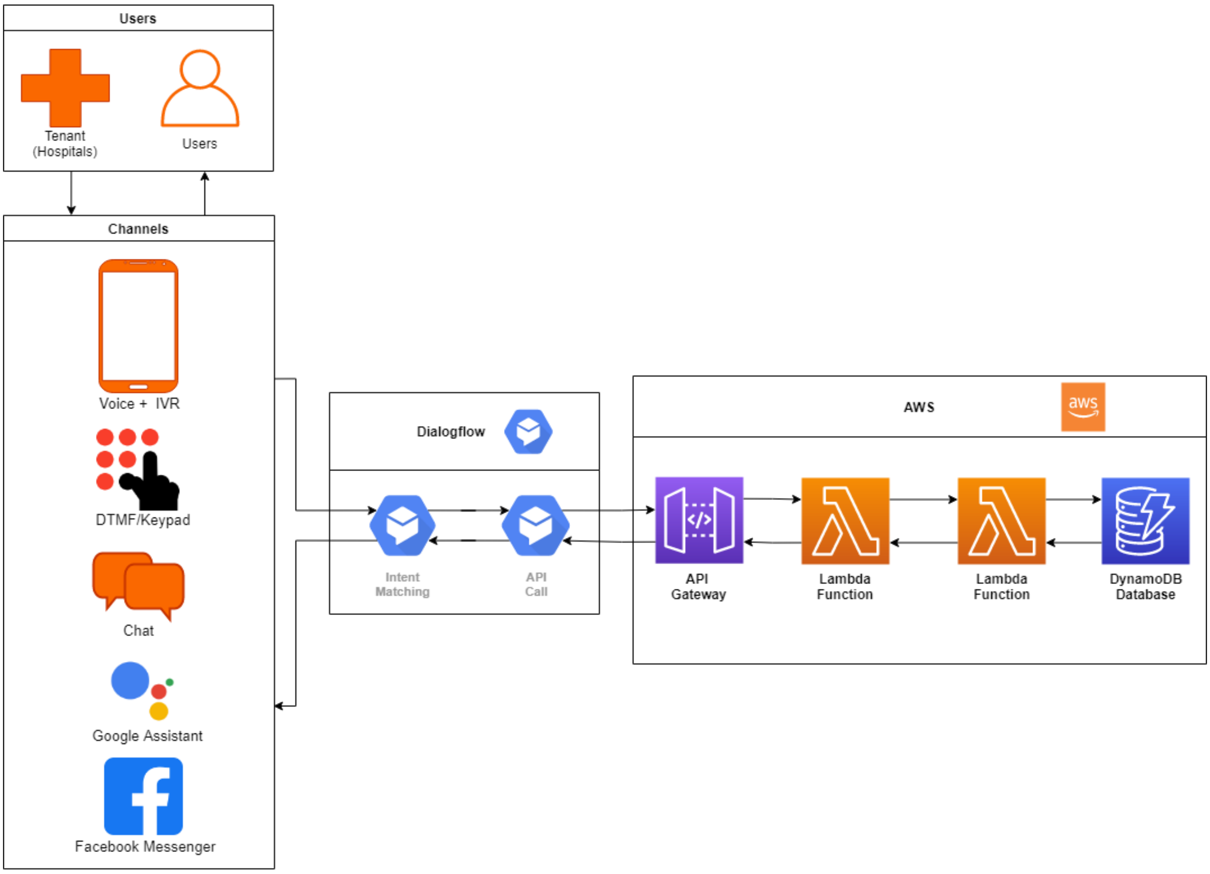


Figure 3.7: Overall Working of the AI

The AI works following the

1. The user provides input via any of the various channels.
2. Dialogflow detects the input (deploys speech-to-text if required).
3. It understands the context and matches the intent.
4. Once the intent is matched, the parameters are extracted, and the webhook is called for business logic.
5. The webhook is called by sending a POST API request to API Gateway.
6. The gateway checks for all required permissions before giving access to the intended function, which is the central webhook.
7. The central webhook further calls the required Lambda Function as per the intent matched.
8. The desired Lambda function executes the required logic and stores all processed data in respective databases.
9. After which, an integration-specific dynamic response is generated and sent to the central webhook.
10. The central webhook then sends the response back to Dialogflow.
11. Dialogflow sends the appropriate response to each integration which then display it

3.6 IVR

For IVR integration, Avaya based IVR application is used to connect to Google Dialog Flow.

AI Bot is developed over Google Dialogflow, to which IVR application is integrated. Google Dialogflow provides SDKs that can be used by 3rd party applications to communicate with Dialogflow. Dialogflow APIs give below two methods for integrations

1. Intent Identification - Pre-recorded caller voice is passed to this method, and it responds with the intent details as identified by Google Dialog Flow.
2. Text to Speech – Text input is passed to this method, and it responds with the recorded voice output of text.

Integration mechanism in IVR Application with Google Dialog Flow

- Personalised greeting to caller based on the name. As soon as the caller dials the IVR application, it collects the phone number of the caller. Based on the phone number collected, the IVR application checks if in the database/config file if the name of the caller is defined against the phone number or not.
    - If the IVR application finds the name defined against the phone number, it collects the name and invokes the GDF application passing the text as "Hello {name}". GDF application responds with an audio file with recorded text as given.
        - IVR application makes use of this audio file to announce to the caller. This gives a personalised greeting experience to the caller.
    - If the IVR application doesn't find the name defined against the phone number, it will move to the next step.
- IVR will prompt the caller as "How may I help you?"
    - The caller will speak out the sentence he wants to do, i.e. "I want to make a new booking."
    - IVR will record the caller speech input in a wave file
        - IVR will wait for 2-3 seconds for silence to conclude that caller has completed leaving his information.
    - IVR will invoke the GDF method to get the intent of the caller based on the recorded file. IVR will pass the recorded file to GDF, and GDF will respond with the intent identified or with blank if not able to locate any intent
        - If not able to identify intent, IVR will prompt, "Sorry we couldn't understand you. Please try again".
        - If able to identify the intent, IVR will collect the fulfilment text from announcing the subsequent text using GDF Text to Speech method.
        - IVR will check the intent name returned from GDF and review and, based on configurations done over IVR, will do one of the below steps. During the IVR development, these logics must be defined.
            - Disconnects the call – if the intent is configured for disconnection
            - Transfers the call – if the intent is configured for transfer

- Collect input Again – if the intent is configured to collect the input from the caller again.

3.7 FLOWCHART

Figure 3.8 depicts a sample flowchart of one of the features - Booking Appointment - of the Conversational AI that we aim to create for this project.

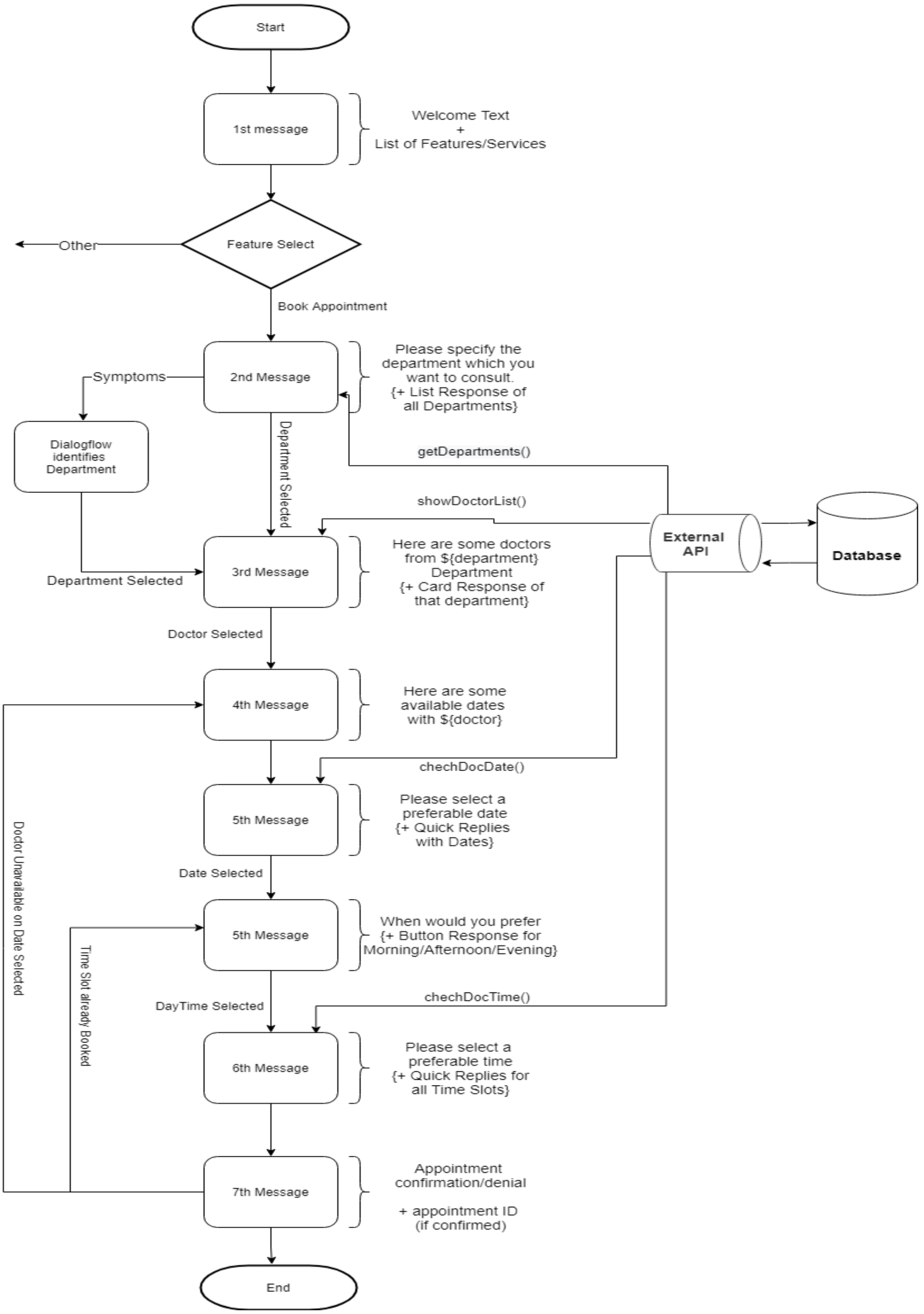

Start
1st message
Welcome Text
+
List of Features/Services
Other
Feature Select
Book Appointment
Symptoms
2nd Message
Please specify the department which you want to consult.
{+ List Response of all Departments}
Dialogflow identifies Department
Department Selected
getDepartments()
showDoctorList()
External API
Database
Department Selected
3rd Message
Here are some doctors from ${department} Department
{+ Card Response of that department}
Doctor Selected
4th Message
Here are some available dates with ${doctor}
chechDocDate()
5th Message
Please select a preferable date
{+ Quick Replies with Dates}
Date Selected
Doctor Unavailable on Date Selected
5th Message
When would you prefer
{+ Button Response for Morning/Afternoon/Evening}
Time Slot already Booked
DayTime Selected
chechDocTime()
6th Message
Please select a preferable time
{+ Quick Replies for all Time Slots}
7th Message
Appointment confirmation/denial
+ appointment ID
(if confirmed)
End

Figure 3.8: Working flow of the Appointment Scheduler

3.8 CONCLUSION

This chapter discussed the various essential components for creating a Conversational AI along with their work. Here we discussed in detail the function as well as the essence of each component. The practical and smooth interconnection of these elements leads to a well-versed Conversational AI.

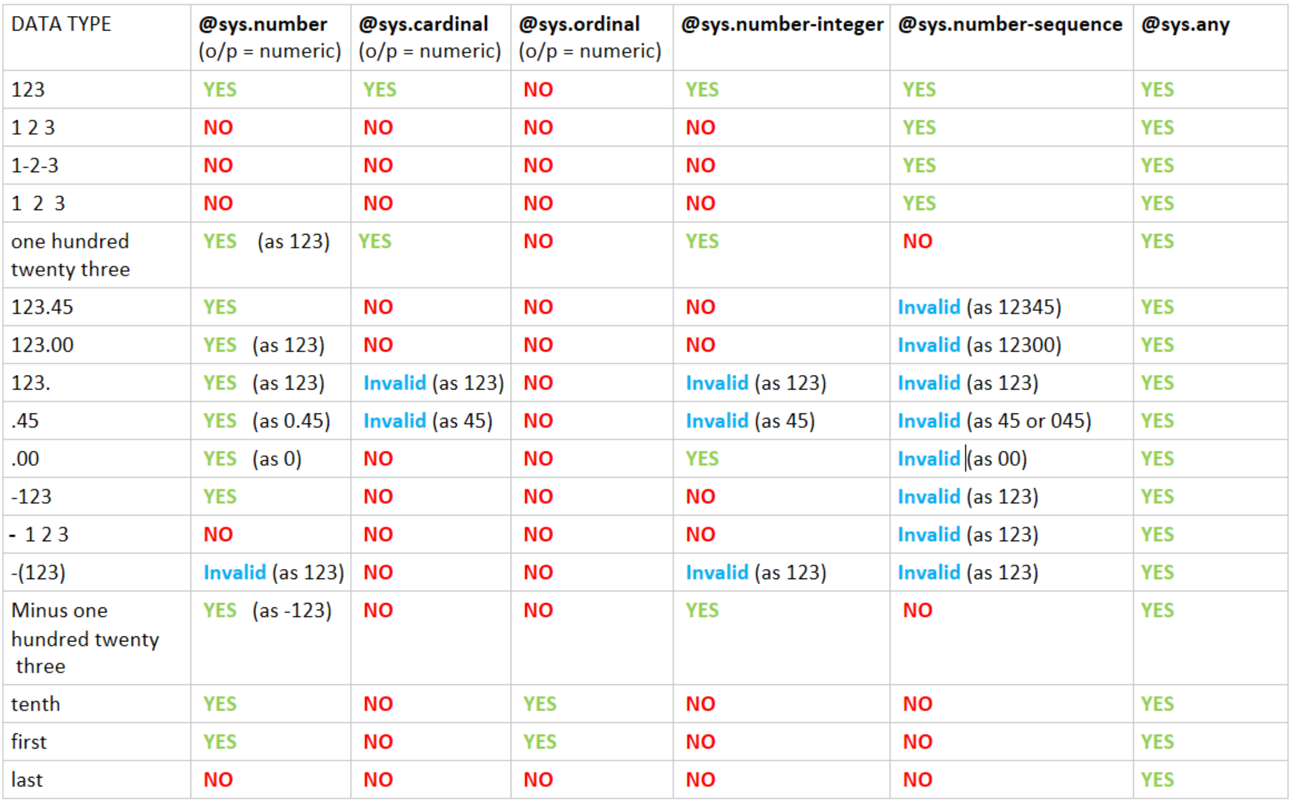
CHAPTER 4
RESULT ANALYSIS

This chapter highlights the results and observations obtained while creating the Conversational AI. Most of these observations were made by creating multiple sample agents and then performing rigorous tests on them to understand how the AI will react to certain types of inputs.

4.1 TESTING SYSTEM ENTITIES

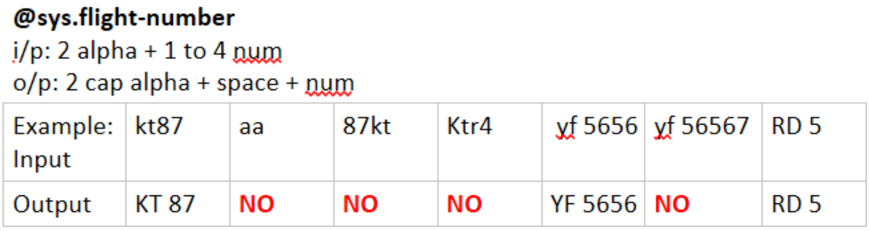
This section consists of observations made when parameters were created to have entity types of the predefined system entities. The agent was then subjected to various types of inputs that can be expected from the end-user to understand how the GDF agent will react to those user inputs. The results have been tabulated as shown in tables 4.1, 4.2 and 4.3:

Table 4.1: Comparative analysis of Numeric System Entities



DATA TYPE	**@sys.number** (o/p = numeric)	**@sys.cardinal** (o/p = numeric)	**@sys.ordinal** (o/p = numeric)	**@sys.number-integer**	**@sys.number-sequence**	**@sys.any**
123	YES	YES	NO	YES	YES	YES
1 2 3	NO	NO	NO	NO	YES	YES
1-2-3	NO	NO	NO	NO	YES	YES
1 2 3	NO	NO	NO	NO	YES	YES
one hundred twenty three	YES (as 123)	YES	NO	YES	NO	YES
123.45	YES	NO	NO	NO	Invalid (as 12345)	YES
123.00	YES (as 123)	NO	NO	NO	Invalid (as 12300)	YES
123.	YES (as 123)	Invalid (as 123)	NO	Invalid (as 123)	Invalid (as 123)	YES
.45	YES (as 0.45)	Invalid (as 45)	NO	Invalid (as 45)	Invalid (as 45 or 045)	YES
.00	YES (as 0)	NO	NO	YES	Invalid (as 00)	YES
-123	YES	NO	NO	NO	Invalid (as 123)	YES
- 1 2 3	NO	NO	NO	NO	Invalid (as 123)	YES
-(123)	Invalid (as 123)	NO	NO	Invalid (as 123)	Invalid (as 123)	YES
Minus one hundred twenty three	YES (as -123)	NO	NO	YES	NO	YES
tenth	YES	NO	YES	NO	NO	YES
first	YES	NO	YES	NO	NO	YES
last	NO	NO	NO	NO	NO	YES

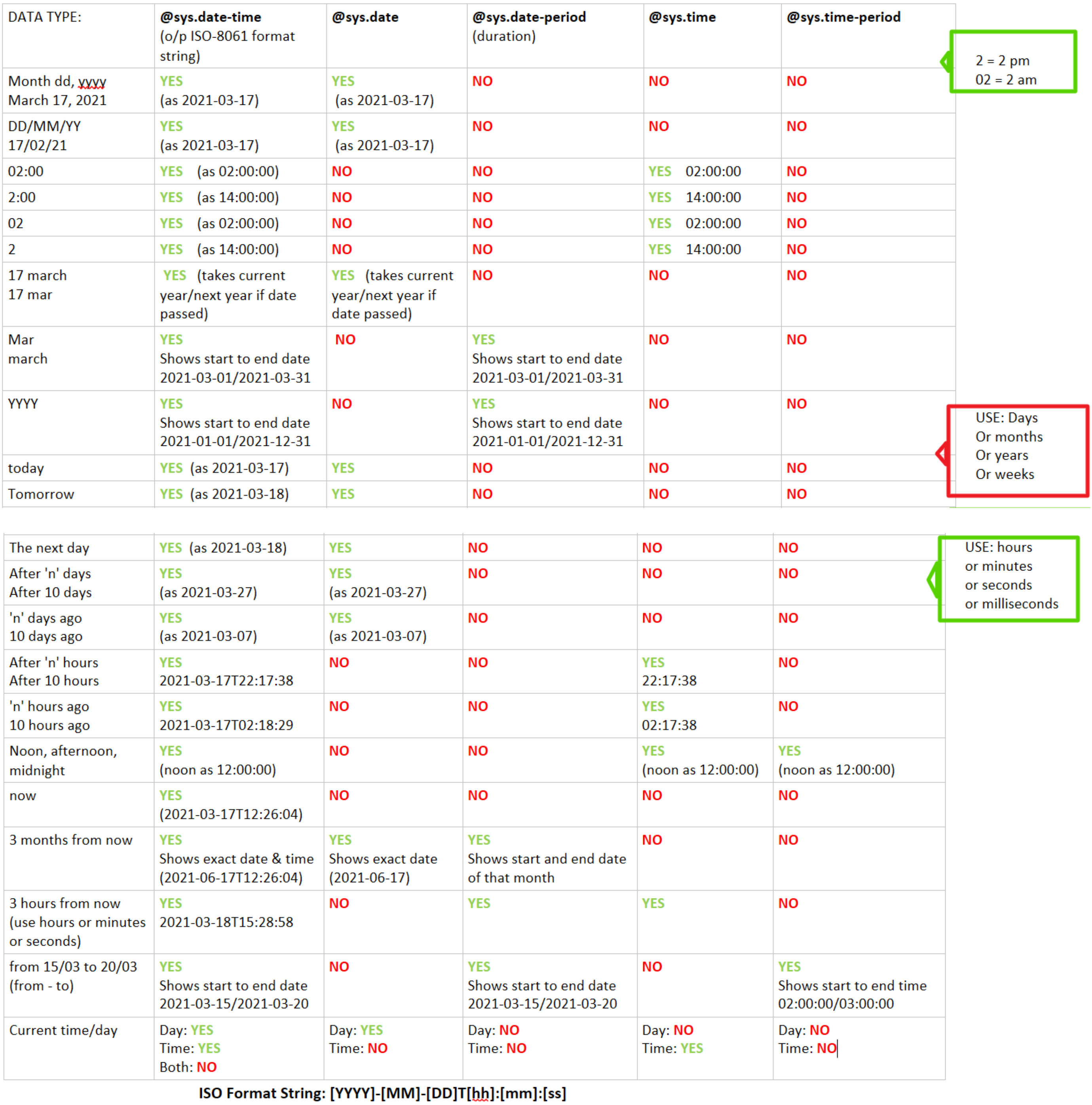
Table 4.2: Comparative analysis of Alphanumeric System Entities



@sys.flight-number
i/p: 2 alpha + 1 to 4 num
o/p: 2 cap alpha + space + num

Example: Input	kt87	aa	87kt	Ktr4	yf 5656	yf 56567	RD 5
Output	KT 87	NO	NO	NO	YF 5656	NO	RD 5

Table 4.3: Comparative analysis of Date & Time System Entities



DATA TYPE:	**@sys.date-time** (o/p ISO-8061 format string)	**@sys.date**	**@sys.date-period** (duration)	**@sys.time**	**@sys.time-period**
Month dd, yyyy March 17, 2021	YES (as 2021-03-17)	YES (as 2021-03-17)	NO	NO	NO
DD/MM/YY 17/02/21	YES (as 2021-03-17)	YES (as 2021-03-17)	NO	NO	NO
02:00	YES (as 02:00:00)	NO	NO	YES 02:00:00	NO
2:00	YES (as 14:00:00)	NO	NO	YES 14:00:00	NO
02	YES (as 02:00:00)	NO	NO	YES 02:00:00	NO
2	YES (as 14:00:00)	NO	NO	YES 14:00:00	NO
17 march 17 mar	YES (takes current year/next year if date passed)	YES (takes current year/next year if date passed)	NO	NO	NO
Mar march	YES Shows start to end date 2021-03-01/2021-03-31	NO	YES Shows start to end date 2021-03-01/2021-03-31	NO	NO
YYYY	YES Shows start to end date 2021-01-01/2021-12-31	NO	YES Shows start to end date 2021-01-01/2021-12-31	NO	NO
today	YES (as 2021-03-17)	YES	NO	NO	NO
Tomorrow	YES (as 2021-03-18)	YES	NO	NO	NO
The next day	YES (as 2021-03-18)	YES	NO	NO	NO
After 'n' days After 10 days	YES (as 2021-03-27)	YES (as 2021-03-27)	NO	NO	NO
'n' days ago 10 days ago	YES (as 2021-03-07)	YES (as 2021-03-07)	NO	NO	NO
After 'n' hours After 10 hours	YES 2021-03-17T22:17:38	NO	NO	YES 22:17:38	NO
'n' hours ago 10 hours ago	YES 2021-03-17T02:18:29	NO	NO	YES 02:17:38	NO
Noon, afternoon, midnight	YES (noon as 12:00:00)	NO	NO	YES (noon as 12:00:00)	YES (noon as 12:00:00)
now	YES (2021-03-17T12:26:04)	NO	NO	NO	NO
3 months from now	YES Shows exact date & time (2021-06-17T12:26:04)	YES Shows exact date (2021-06-17)	YES Shows start and end date of that month	NO	NO
3 hours from now (use hours or minutes or seconds)	YES 2021-03-18T15:28:58	NO	YES	YES	NO
from 15/03 to 20/03 (from - to)	YES Shows start to end date 2021-03-15/2021-03-20	NO	YES Shows start to end date 2021-03-15/2021-03-20	NO	YES Shows start to end time 02:00:00/03:00:00
Current time/day	Day: YES Time: YES Both: NO	Day: YES Time: NO	Day: NO Time: NO	Day: NO Time: YES	Day: NO Time: NO

2 = 2 pm
02 = 2 am

USE: Days
Or months
Or years
Or weeks

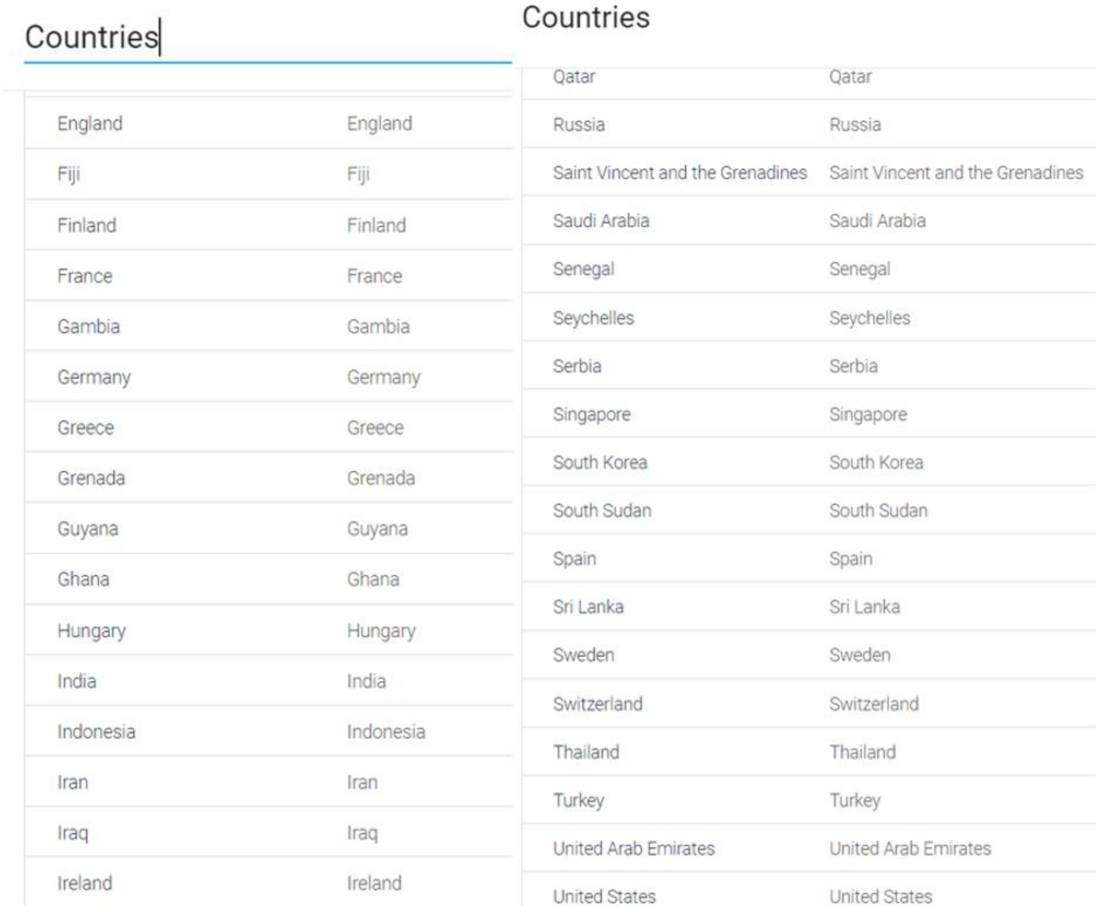
USE: hours
or minutes
or seconds
or milliseconds

ISO Format String: [YYYY]-[MM]-[DD]T[hh]:[mm]:[ss]

4.2 TESTING CUSTOM ENTITIES

This section consists of observations made when parameters were created to have entity types of the custom entities created explicitly for testing. The agent was then subjected to various types of inputs that can be expected from the end-user to understand how the GDF agent will react to those user inputs. The results have been tabulated as shown:

- Can create custom entities for the entities that are defined by the system.



Countries

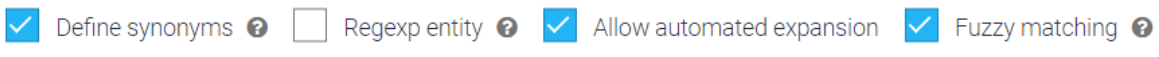
England	England
Fiji	Fiji
Finland	Finland
France	France
Gambia	Gambia
Germany	Germany
Greece	Greece
Grenada	Grenada
Guyana	Guyana
Ghana	Ghana
Hungary	Hungary
India	India
Indonesia	Indonesia
Iran	Iran
Iraq	Iraq
Ireland	Ireland

Countries

Qatar	Qatar
Russia	Russia
Saint Vincent and the Grenadines	Saint Vincent and the Grenadines
Saudi Arabia	Saudi Arabia
Senegal	Senegal
Seychelles	Seychelles
Serbia	Serbia
Singapore	Singapore
South Korea	South Korea
South Sudan	South Sudan
Spain	Spain
Sri Lanka	Sri Lanka
Sweden	Sweden
Switzerland	Switzerland
Thailand	Thailand
Turkey	Turkey
United Arab Emirates	United Arab Emirates
United States	United States

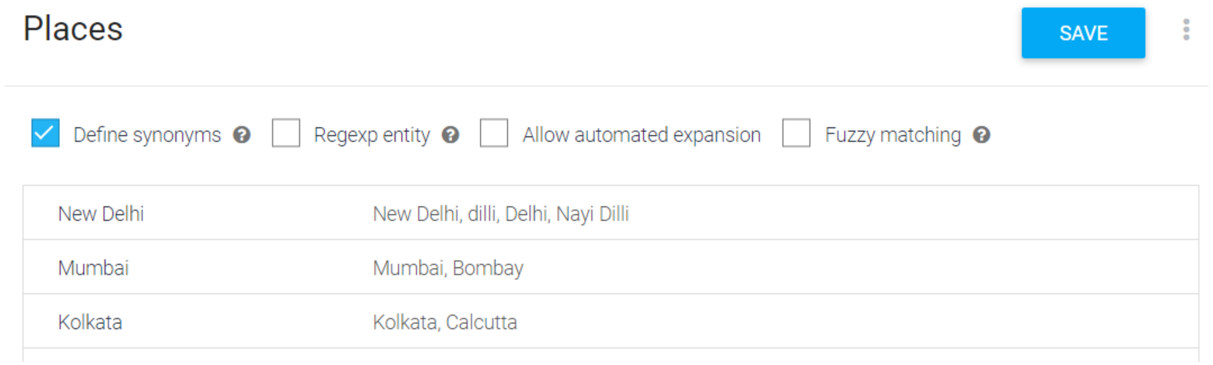
Figure 4.1: Sample Custom Entity

4.2.1 EXPLORING CUSTOM ENTITY OPTIONS



☑ Define synonyms ❓ □ Regexp entity ❓ ☑ Allow automated expansion ☑ Fuzzy matching ❓

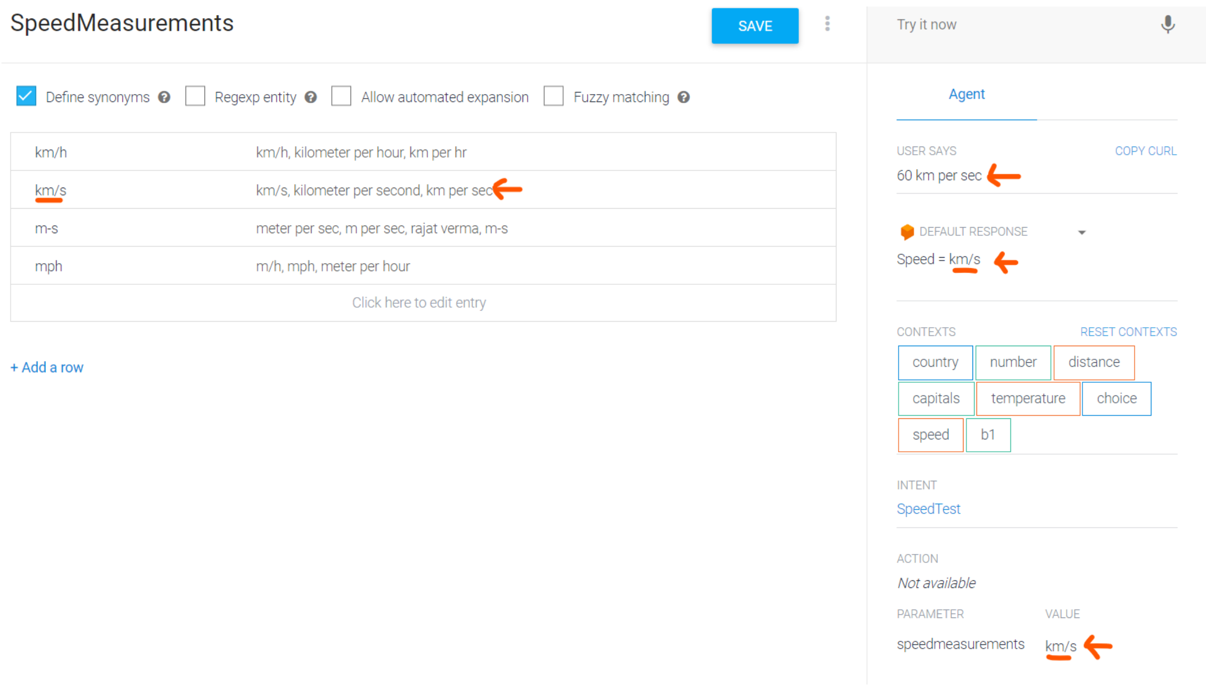
1. **Define synonyms:**



Places

☑ Define synonyms ❓ □ Regexp entity ❓ □ Allow automated expansion □ Fuzzy matching ❓

New Delhi	New Delhi, dilli, Delhi, Nayi Dilli
Mumbai	Mumbai, Bombay
Kolkata	Kolkata, Calcutta



SpeedMeasurements

☑ Define synonyms ☐ Regexp entity ☐ Allow automated expansion ☐ Fuzzy matching

km/h	km/h, kilometer per hour, km per hr
km/s	km/s, kilometer per second, km per sec
m-s	meter per sec, m per sec, rajat verma, m-s
mph	m/h, mph, meter per hour

USER SAYS

60 km per sec

DEFAULT RESPONSE

Speed = km/s

CONTEXTS

country number distance capitals temperature choice speed b1

INTENT

SpeedTest

ACTION

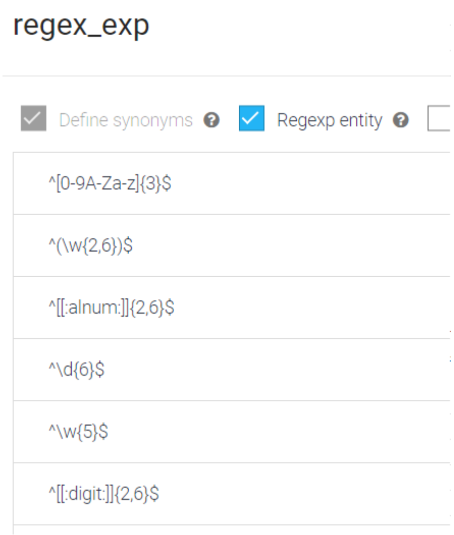
Not available

PARAMETER	VALUE
speedmeasurements	km/s

Figure 4.2: Observations using “Define synonyms”

In all these cases, any synonyms added will return the entity’s name, as illustrated in Figure 4.2. For example, entering km per sec, a synonym for km/s, returns the extracted value km/s.

2. Regexp entity:



regex_exp

☑ Define synonyms ☑ Regexp entity ☐

^[0-9A-Za-z]{3}$

^(\w{2,6})$

^[[:alnum:]]{2,6}$

^\d{6}$

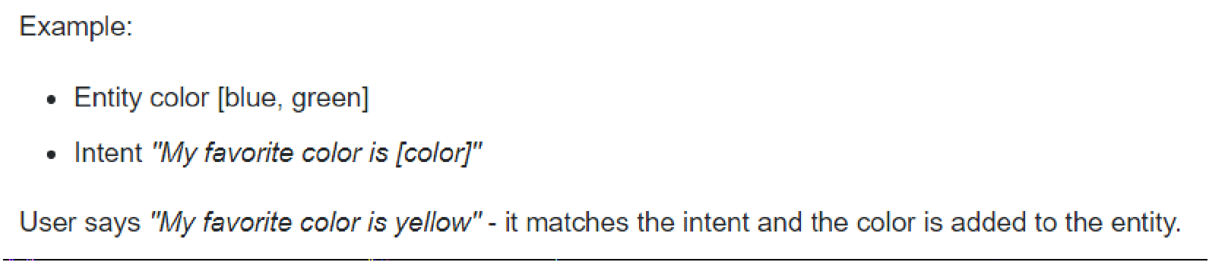
^\w{5}$

^[[:digit:]]{2,6}$

Figure 4.3: Observations using “Regexp entity”

3. Allow automated expansion:

Automated expansion is used when a user input matches an intent, but the entity value doesn’t exist yet.



Example:

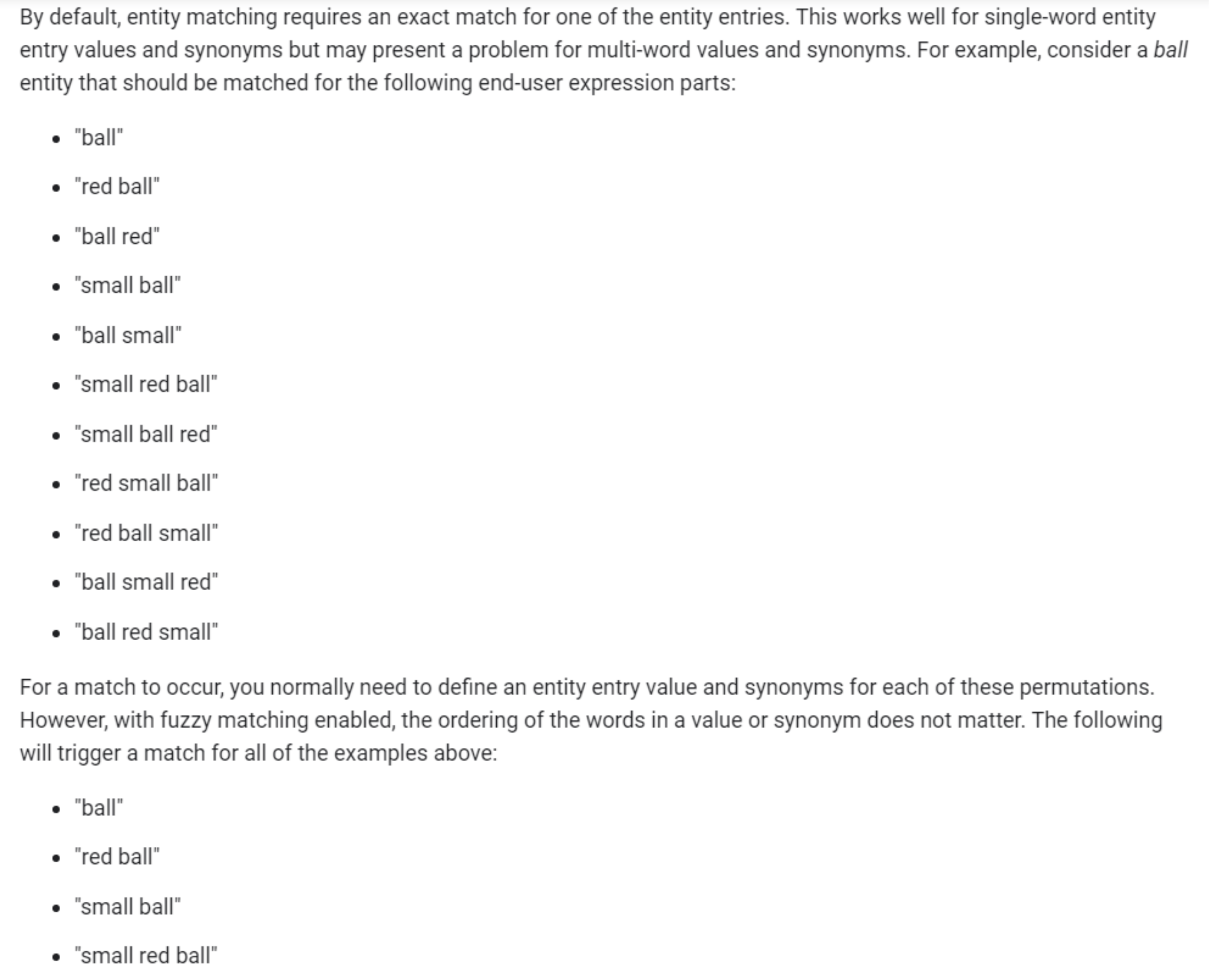
- Entity color [blue, green]
- Intent *"My favorite color is [color]"*

User says *"My favorite color is yellow"* - it matches the intent and the color is added to the entity.

Figure 4.4: Observations using “Automated Expansion”

4. <u>Fuzzy matching:</u>

- It acts like a spell checker and spelling-error, typos corrector.
- Example: METRE (input by user) => (matched to) METER (by gdf)



By default, entity matching requires an exact match for one of the entity entries. This works well for single-word entity entry values and synonyms but may present a problem for multi-word values and synonyms. For example, consider a *ball* entity that should be matched for the following end-user expression parts:

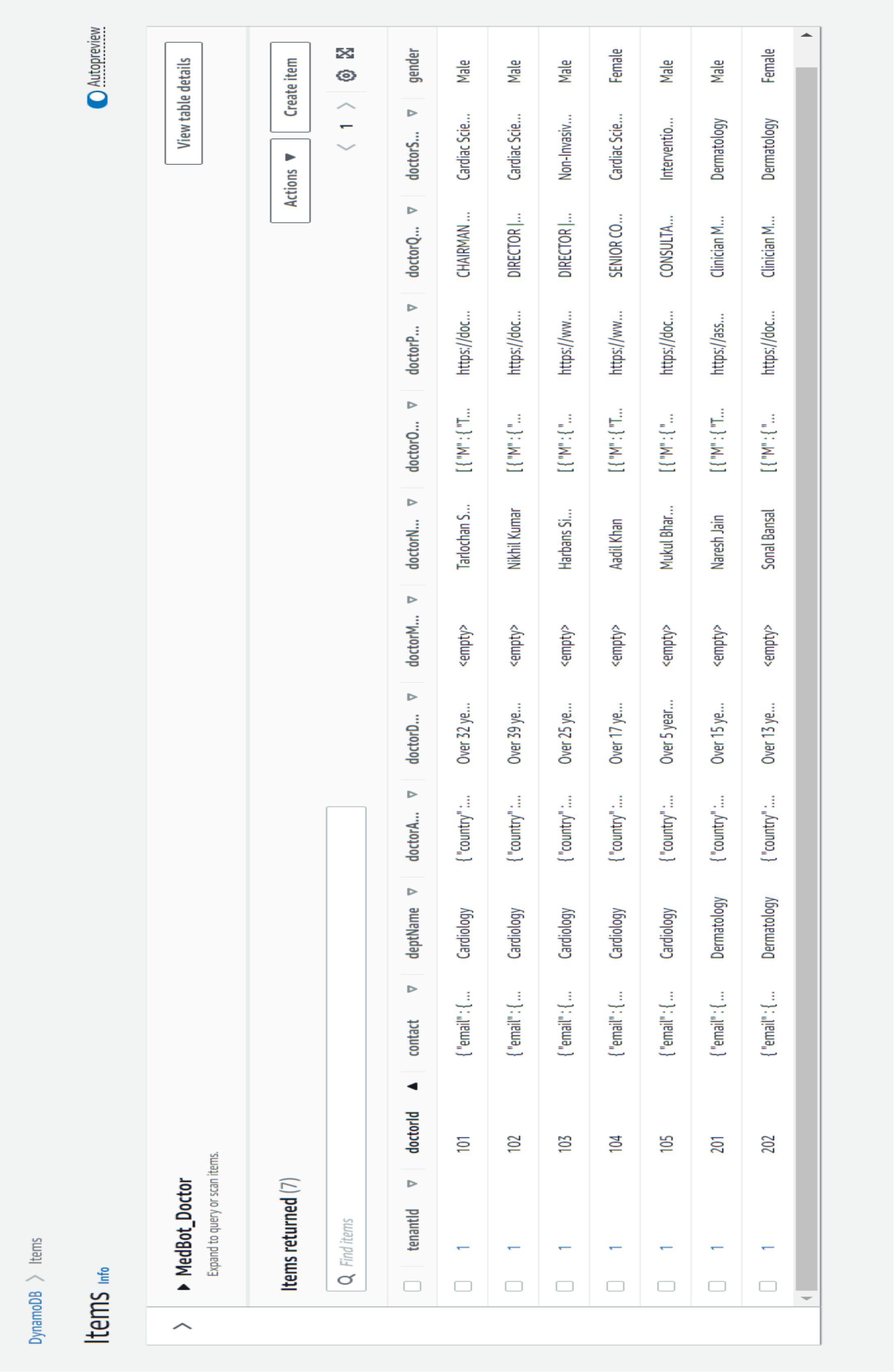
- "ball"
- "red ball"
- "ball red"
- "small ball"
- "ball small"
- "small red ball"
- "small ball red"
- "red small ball"
- "red ball small"
- "ball small red"
- "ball red small"

For a match to occur, you normally need to define an entity entry value and synonyms for each of these permutations. However, with fuzzy matching enabled, the ordering of the words in a value or synonym does not matter. The following will trigger a match for all of the examples above:

- "ball"
- "red ball"
- "small ball"
- "small red ball"

Figure 4.5: Observations using “Fuzzy Matching”

4.3 DATABASE WITH DynamoDB



▸ MedBot_Doctor

Expand to query or scan items.

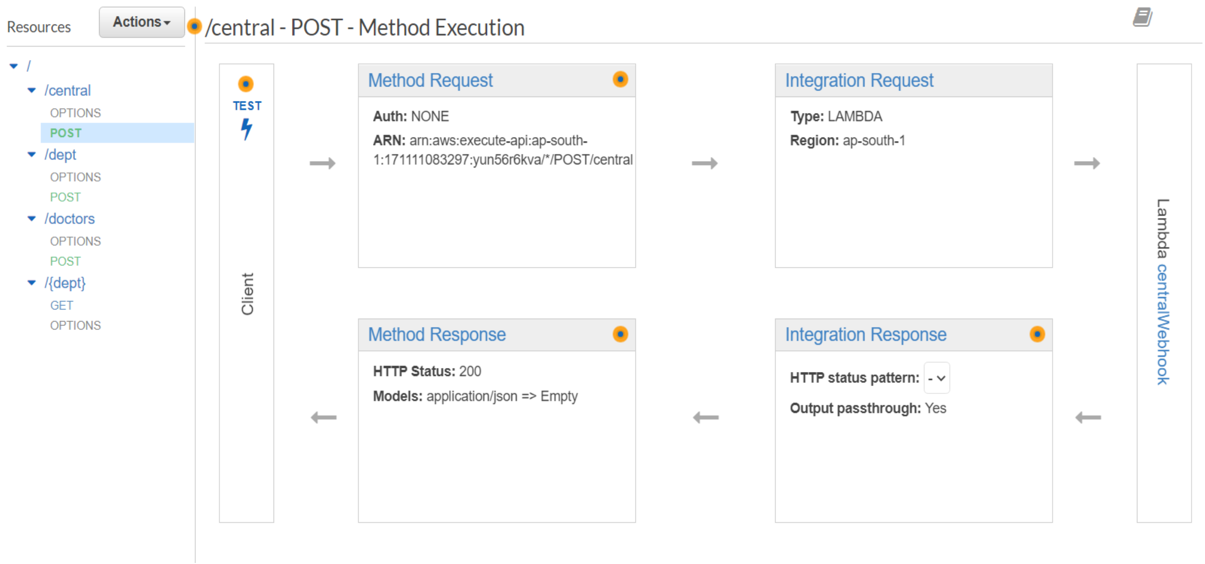
Items returned (7)

□	tenantId	doctorId ▲	contact	deptName	doctorA...	doctorD...	doctorM...	doctorN...	doctorO...	doctorP...	doctorQ...	doctorS...	gender
□	1	101	{"email":{...	Cardiology	{"country":...	Over 32 ye...	<empty>	Tarlochan S...	[{"M":{"T...	https://doc...	CHAIRMAN ...	Cardiac Scie...	Male
□	1	102	{"email":{...	Cardiology	{"country":...	Over 39 ye...	<empty>	Nikhil Kumar	[{"M":{"...	https://doc...	DIRECTOR |...	Cardiac Scie...	Male
□	1	103	{"email":{...	Cardiology	{"country":...	Over 25 ye...	<empty>	Harbans Si...	[{"M":{"...	https://ww...	DIRECTOR |...	Non-Invasiv...	Male
□	1	104	{"email":{...	Cardiology	{"country":...	Over 17 ye...	<empty>	Aadil Khan	[{"M":{"T...	https://ww...	SENIOR CO...	Cardiac Scie...	Female
□	1	105	{"email":{...	Cardiology	{"country":...	Over 5 year...	<empty>	Mukul Bhar...	[{"M":{"...	https://doc...	CONSULTA...	Interventio...	Male
□	1	201	{"email":{...	Dermatology	{"country":...	Over 15 ye...	<empty>	Naresh Jain	[{"M":{"T...	https://ass...	Clinician M...	Dermatology	Male
□	1	202	{"email":{...	Dermatology	{"country":...	Over 13 ye...	<empty>	Sonal Bansal	[{"M":{"...	https://doc...	Clinician M...	Dermatology	Female

Figure 4.6: Sample design of the Database for all Doctors

4.4 API GATEWAY

Figure 4.7 illustrates the final execution of our API. The different boxes indicate the various levels/stages of compliance needed for successful communication between the two platforms.



/central - POST - Method Execution

Method Request

Auth: NONE

ARN: arn:aws:execute-api:ap-south-1:171111083297:yun56r6kva/*/POST/central

Integration Request

Type: LAMBDA

Region: ap-south-1

Method Response

HTTP Status: 200

Models: application/json => Empty

Integration Response

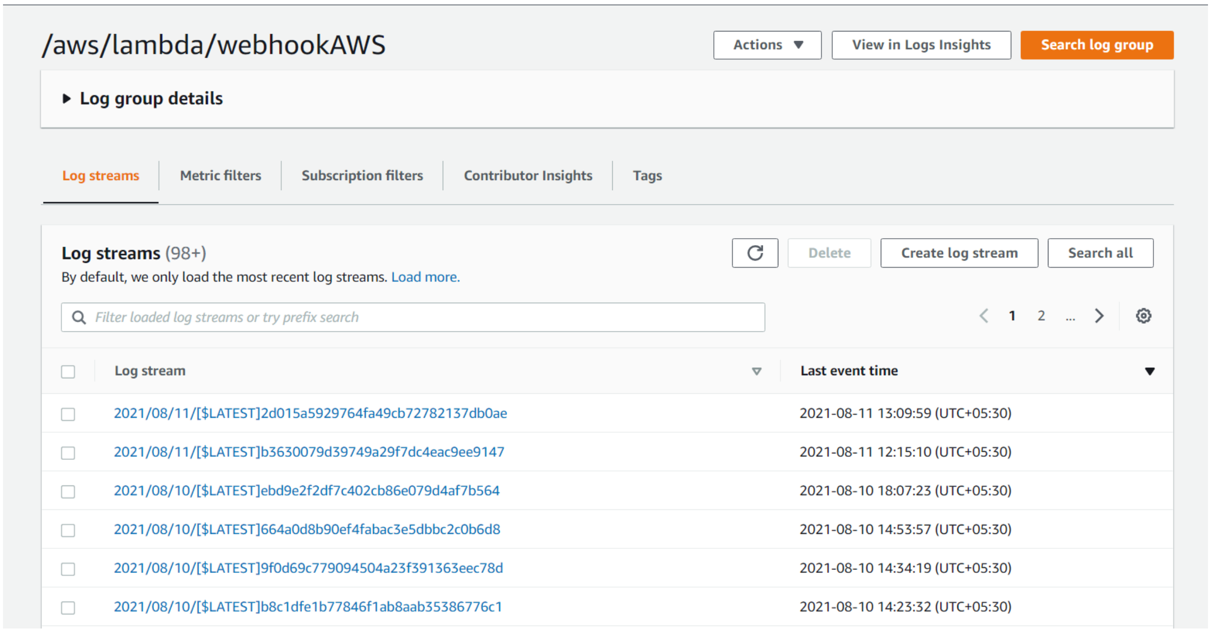
HTTP status pattern: -

Output passthrough: Yes

Figure 4.7: Execution of API

4. 5 AWS CloudWatch:

CloudWatch is another platform offered by Amazon and is used for logging and metrics purposes. It creates separate log files for each conversation, and within these files, one can find the detailed logging for each turn in the conversation.

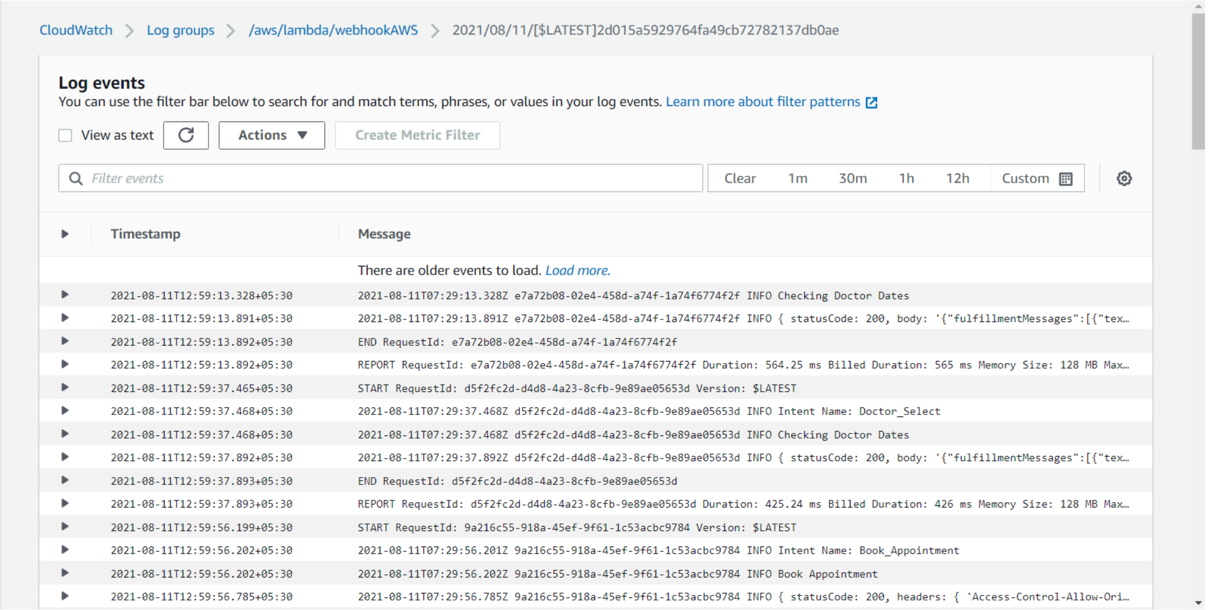


/aws/lambda/webhookAWS

Log streams (98+)

By default, we only load the most recent log streams. Load more.

□	Log stream	Last event time
□	2021/08/11/[$LATEST]2d015a5929764fa49cb72782137db0ae	2021-08-11 13:09:59 (UTC+05:30)
□	2021/08/11/[$LATEST]b3630079d39749a29f7dc4eac9ee9147	2021-08-11 12:15:10 (UTC+05:30)
□	2021/08/10/[$LATEST]ebd9e2f2df7c402cb86e079d4af7b564	2021-08-10 18:07:23 (UTC+05:30)
□	2021/08/10/[$LATEST]664a0d8b90ef4fabac3e5dbbc2c0b6d8	2021-08-10 14:53:57 (UTC+05:30)
□	2021/08/10/[$LATEST]9f0d69c779094504a23f391363eec78d	2021-08-10 14:34:19 (UTC+05:30)
□	2021/08/10/[$LATEST]b8c1dfe1b77846f1ab8aab35386776c1	2021-08-10 14:23:32 (UTC+05:30)



CloudWatch > Log groups > /aws/lambda/webhookAWS > 2021/08/11/[$LATEST]2d015a5929764fa49cb72782137db0ae

Log events

You can use the filter bar below to search for and match terms, phrases, or values in your log events. Learn more about filter patterns

```
Timestamp                      Message
                               There are older events to load. Load more.
2021-08-11T12:59:13.328+05:30  2021-08-11T07:29:13.328Z e7a72b08-02e4-458d-a74f-1a74f6774f2f INFO Checking Doctor Dates
2021-08-11T12:59:13.891+05:30  2021-08-11T07:29:13.891Z e7a72b08-02e4-458d-a74f-1a74f6774f2f INFO { statusCode: 200, body: '{"fulfillmentMessages":[{"tex…
2021-08-11T12:59:13.892+05:30  END RequestId: e7a72b08-02e4-458d-a74f-1a74f6774f2f
2021-08-11T12:59:13.892+05:30  REPORT RequestId: e7a72b08-02e4-458d-a74f-1a74f6774f2f Duration: 564.25 ms Billed Duration: 565 ms Memory Size: 128 MB Max…
2021-08-11T12:59:37.465+05:30  START RequestId: d5f2fc2d-d4d8-4a23-8cfb-9e89ae05653d Version: $LATEST
2021-08-11T12:59:37.468+05:30  2021-08-11T07:29:37.468Z d5f2fc2d-d4d8-4a23-8cfb-9e89ae05653d INFO Intent Name: Doctor_Select
2021-08-11T12:59:37.468+05:30  2021-08-11T07:29:37.468Z d5f2fc2d-d4d8-4a23-8cfb-9e89ae05653d INFO Checking Doctor Dates
2021-08-11T12:59:37.892+05:30  2021-08-11T07:29:37.892Z d5f2fc2d-d4d8-4a23-8cfb-9e89ae05653d INFO { statusCode: 200, body: '{"fulfillmentMessages":[{"tex…
2021-08-11T12:59:37.893+05:30  END RequestId: d5f2fc2d-d4d8-4a23-8cfb-9e89ae05653d
2021-08-11T12:59:37.893+05:30  REPORT RequestId: d5f2fc2d-d4d8-4a23-8cfb-9e89ae05653d Duration: 425.24 ms Billed Duration: 426 ms Memory Size: 128 MB Max…
2021-08-11T12:59:56.199+05:30  START RequestId: 9a216c55-918a-45ef-9f61-1c53acbc9784 Version: $LATEST
2021-08-11T12:59:56.202+05:30  2021-08-11T07:29:56.201Z 9a216c55-918a-45ef-9f61-1c53acbc9784 INFO Intent Name: Book_Appointment
2021-08-11T12:59:56.202+05:30  2021-08-11T07:29:56.202Z 9a216c55-918a-45ef-9f61-1c53acbc9784 INFO Book Appointment
2021-08-11T12:59:56.785+05:30  2021-08-11T07:29:56.785Z 9a216c55-918a-45ef-9f61-1c53acbc9784 INFO { statusCode: 200, headers: { 'Access-Control-Allow-Ori…
```

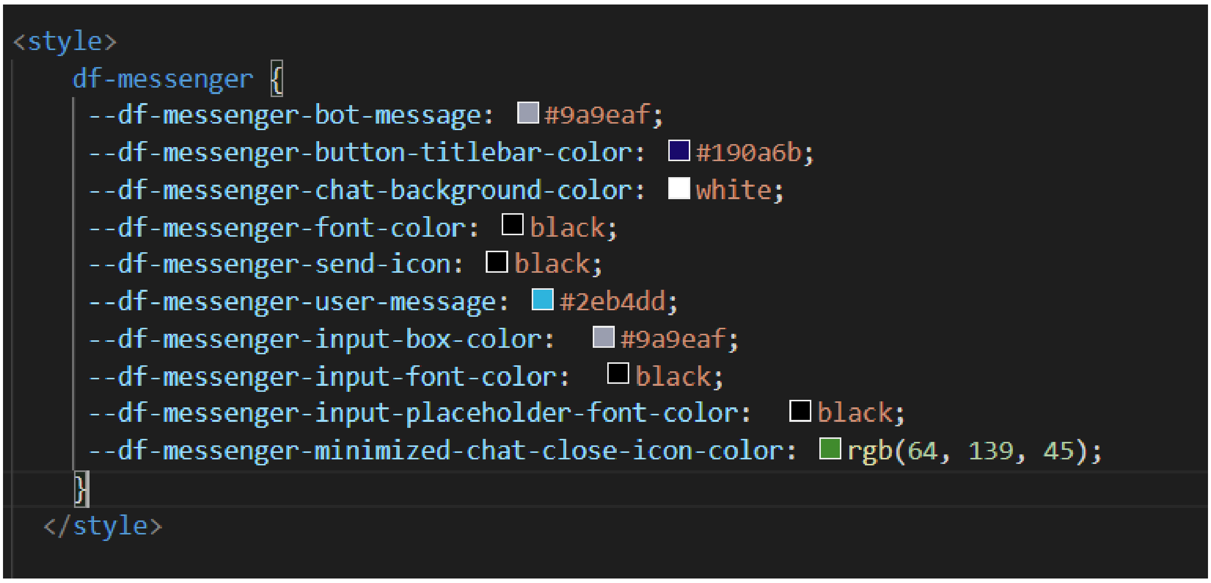
Figure 4.8: Understanding logs in AWS CloudWatch

4.6 RICH RESPONSES:

Each integration has its specifications and options when it comes to Rich Responses. The following are the observations made with each platform integration

4.6.1 RICH RESPONSE WITH DIALOGFLOW MESSENGER

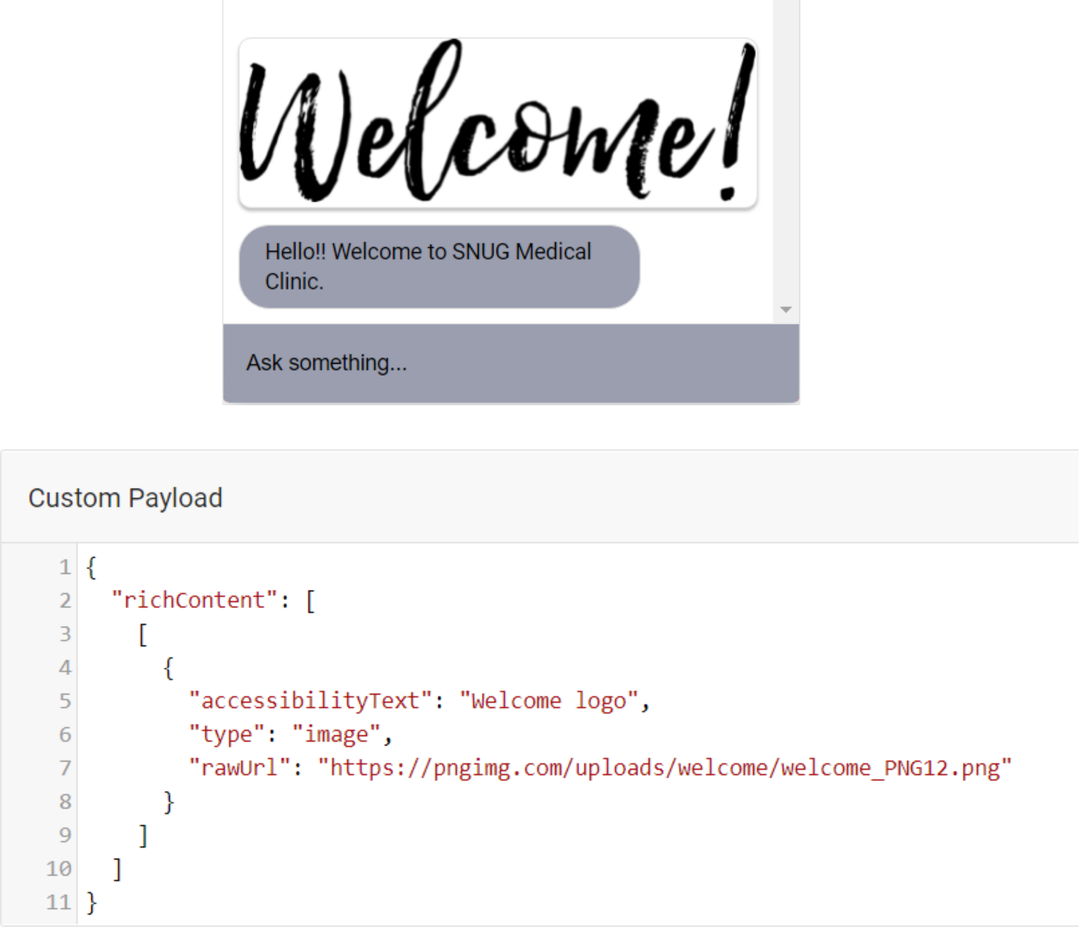
Dialogflow has its messenger, which is still a beta feature. Dialogflow messenger is a versatile platform that was the most suited to our needs. It even has customisations for colour that can be set in the following way.



```
<style>
    df-messenger {
     --df-messenger-bot-message: #9a9eaf;
     --df-messenger-button-titlebar-color: #190a6b;
     --df-messenger-chat-background-color: white;
     --df-messenger-font-color: black;
     --df-messenger-send-icon: black;
     --df-messenger-user-message: #2eb4dd;
     --df-messenger-input-box-color: #9a9eaf;
     --df-messenger-input-font-color: black;
     --df-messenger-input-placeholder-font-color: black;
     --df-messenger-minimized-chat-close-icon-color: rgb(64, 139, 45);
    }
  </style>
```

Figure 4.9: Colour customisations in Dialogflow Messenger

a) Image Response:



Hello!! Welcome to SNUG Medical Clinic.

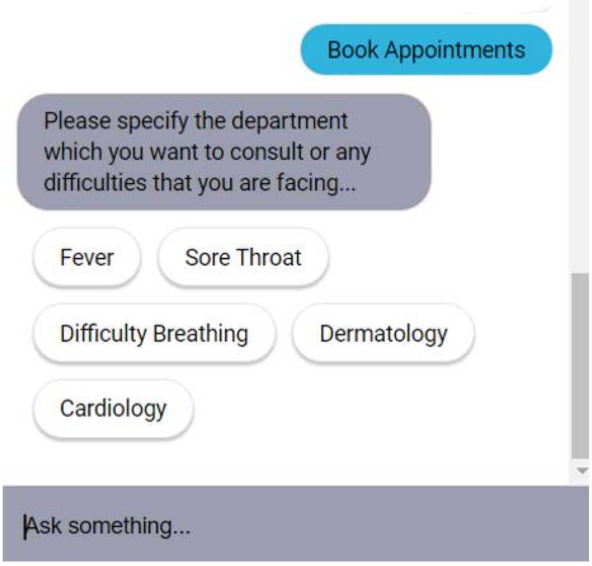
Ask something...

Custom Payload

```
{
  "richContent": [
    [
      {
        "accessibilityText": "Welcome logo",
        "type": "image",
        "rawUrl": "https://pngimg.com/uploads/welcome/welcome_PNG12.png"
      }
    ]
  ]
}
```

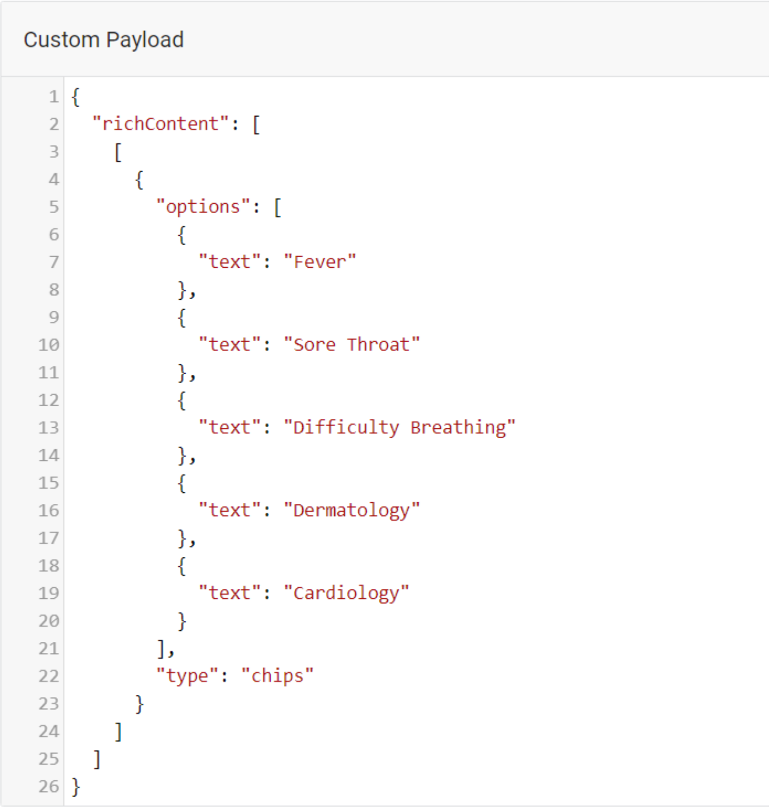
Figure 4.10: Output and code for Image response in Dialogflow Messenger

b) Quick Replies


Book Appointments

Please specify the department which you want to consult or any difficulties that you are facing...

Ask something...



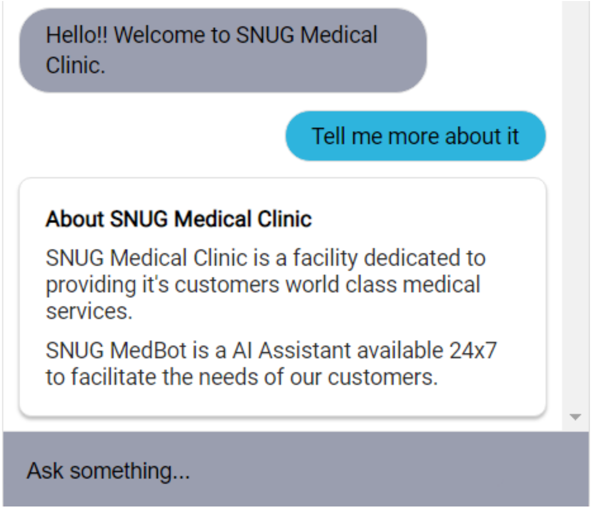
Custom Payload

```
{
  "richContent": [
    [
      {
        "options": [
          {
            "text": "Fever"
          },
          {
            "text": "Sore Throat"
          },
          {
            "text": "Difficulty Breathing"
          },
          {
            "text": "Dermatology"
          },
          {
            "text": "Cardiology"
          }
        ],
        "type": "chips"
      }
    ]
  ]
}
```

Figure 4.11: Output and code for Suggestion chip response in Dialogflow Messenger

c) Description Response

It gives the title and 2 (or more) lines of description.



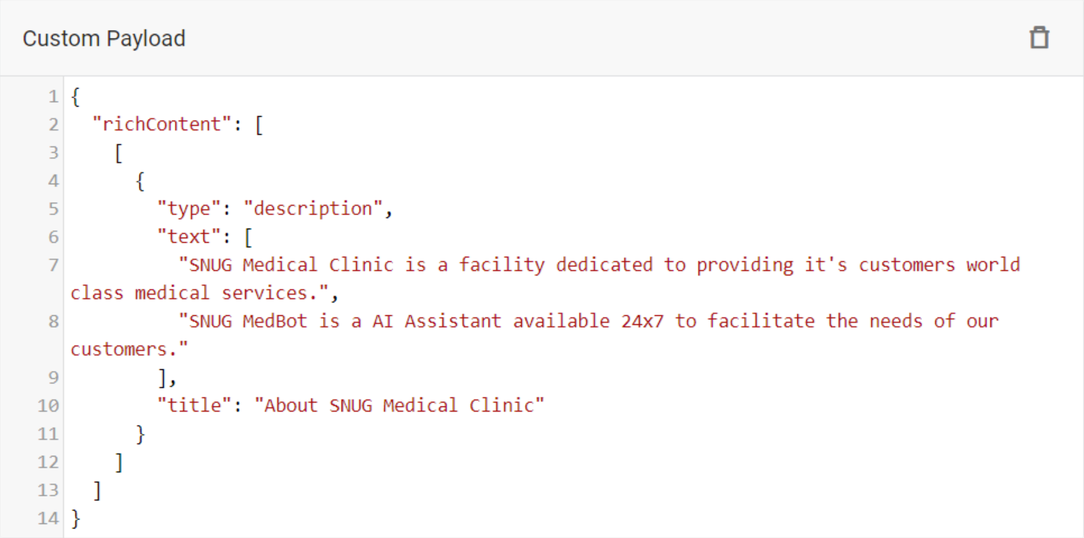
Hello!! Welcome to SNUG Medical Clinic.

Tell me more about it

About SNUG Medical Clinic

SNUG Medical Clinic is a facility dedicated to providing it's customers world class medical services.

SNUG MedBot is a AI Assistant available 24x7 to facilitate the needs of our customers.



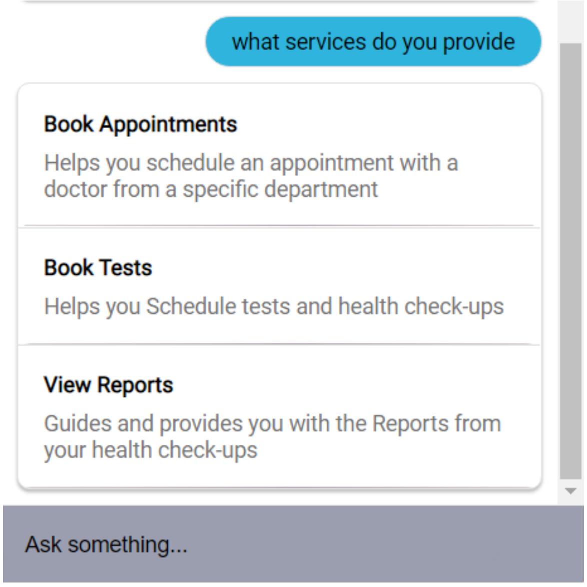
Custom Payload

```
{
  "richContent": [
    [
      {
        "type": "description",
        "text": [
          "SNUG Medical Clinic is a facility dedicated to providing it's customers world class medical services.",
          "SNUG MedBot is a AI Assistant available 24x7 to facilitate the needs of our customers."
        ],
        "title": "About SNUG Medical Clinic"
      }
    ]
  ]
}
```

Figure 4.12: Output and code for Description response in Dialogflow Messenger

d) List Type:

It gives a title and a Subtitle/description line.
Clickable and can internally call a Dialogflow EVENT.

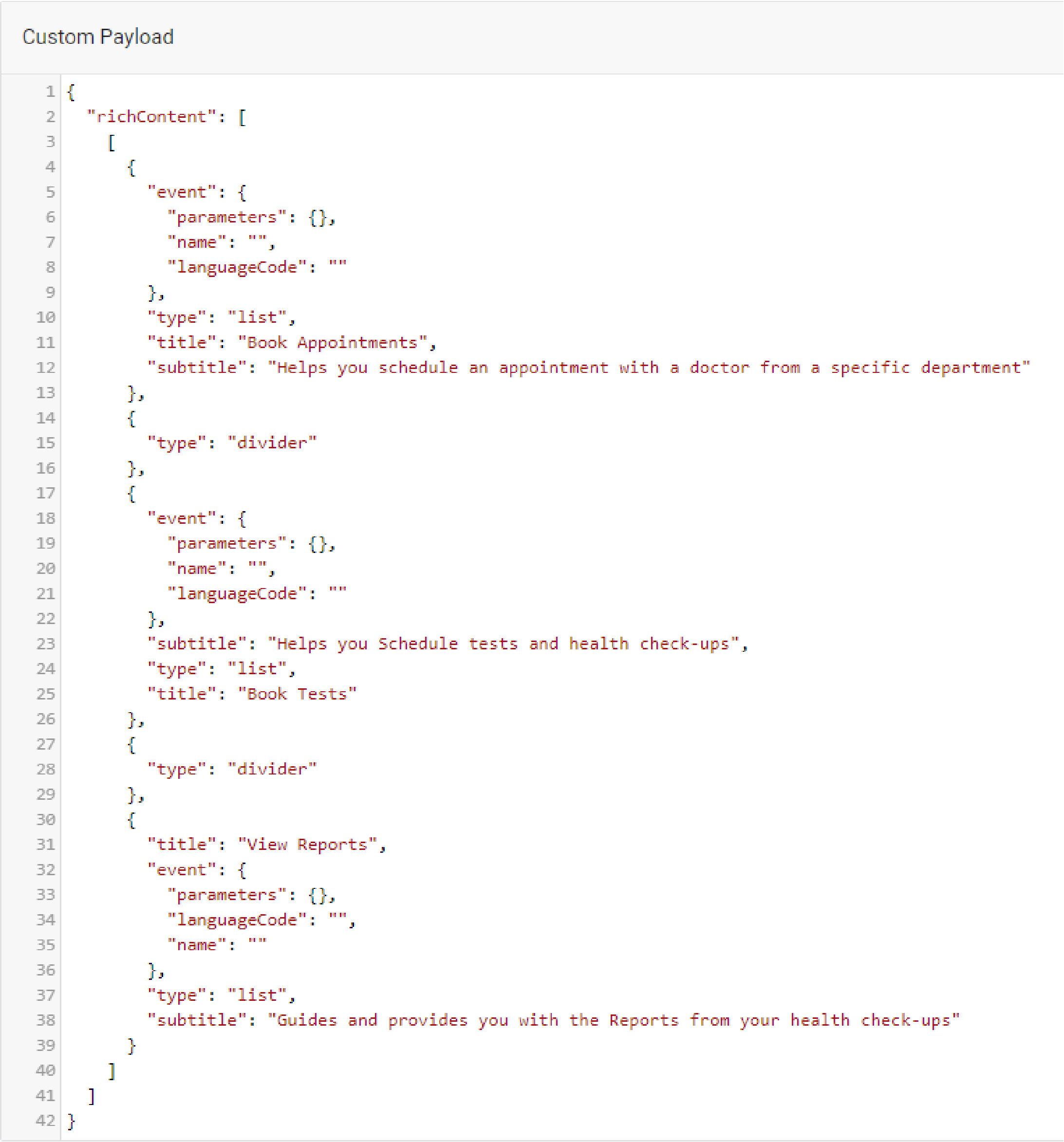


what services do you provide

Book Appointments
Helps you schedule an appointment with a doctor from a specific department

Book Tests
Helps you Schedule tests and health check-ups

View Reports
Guides and provides you with the Reports from your health check-ups



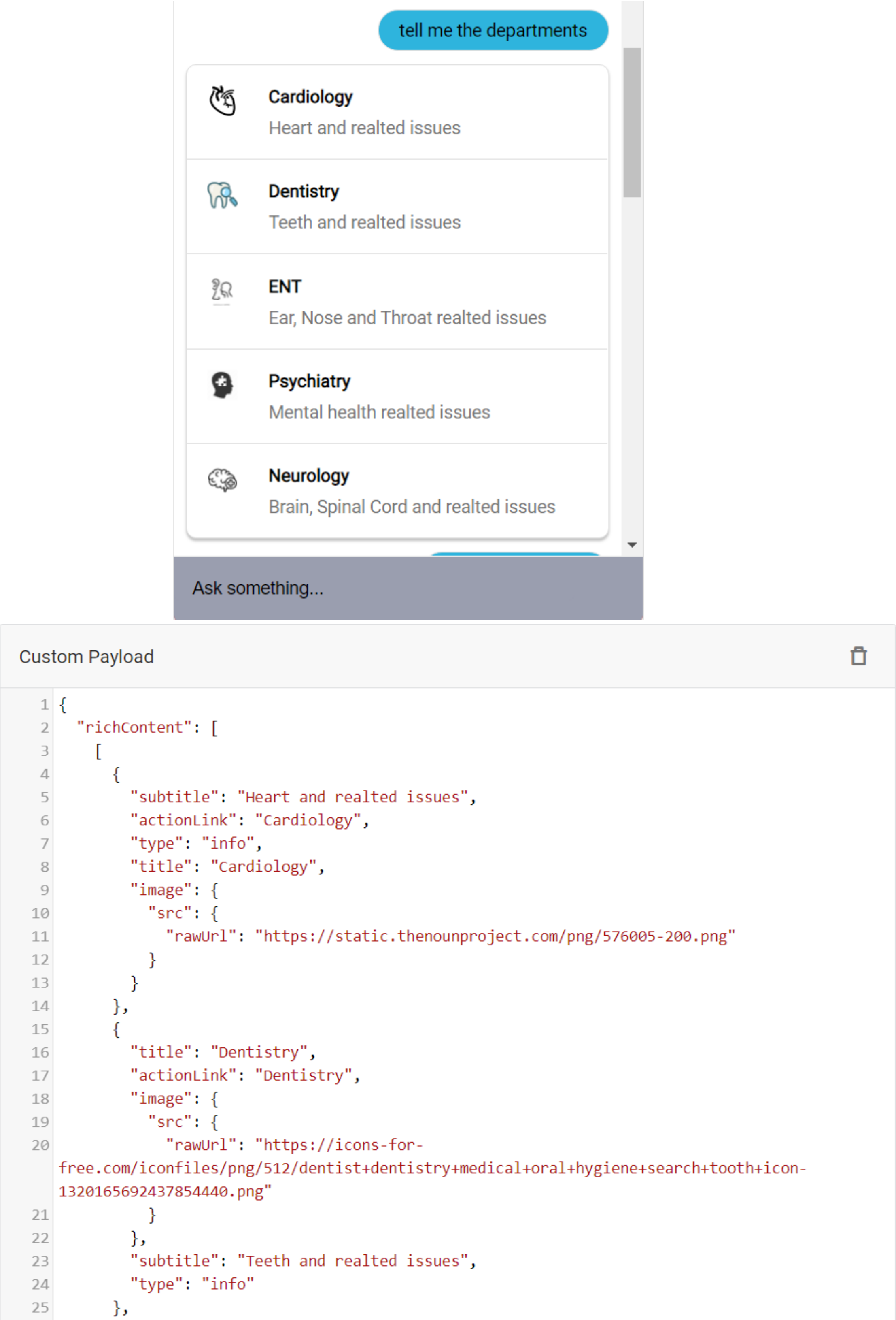
Custom Payload

```
{
  "richContent": [
    [
      {
        "event": {
          "parameters": {},
          "name": "",
          "languageCode": ""
        },
        "type": "list",
        "title": "Book Appointments",
        "subtitle": "Helps you schedule an appointment with a doctor from a specific department"
      },
      {
        "type": "divider"
      },
      {
        "event": {
          "parameters": {},
          "name": "",
          "languageCode": ""
        },
        "subtitle": "Helps you Schedule tests and health check-ups",
        "type": "list",
        "title": "Book Tests"
      },
      {
        "type": "divider"
      },
      {
        "title": "View Reports",
        "event": {
          "parameters": {},
          "languageCode": "",
          "name": ""
        },
        "type": "list",
        "subtitle": "Guides and provides you with the Reports from your health check-ups"
      }
    ]
  ]
}
```

Figure 4.13: Output and code for List response in Dialogflow Messenger

e) Information Response

It gives an image/icon, title, 1 line of subtitle/description
Click on a particular info-tile can lead to the related URL.



tell me the departments

Cardiology
Heart and realted issues

Dentistry
Teeth and realted issues

ENT
Ear, Nose and Throat realted issues

Psychiatry
Mental health realted issues

Neurology
Brain, Spinal Cord and realted issues

Ask something...

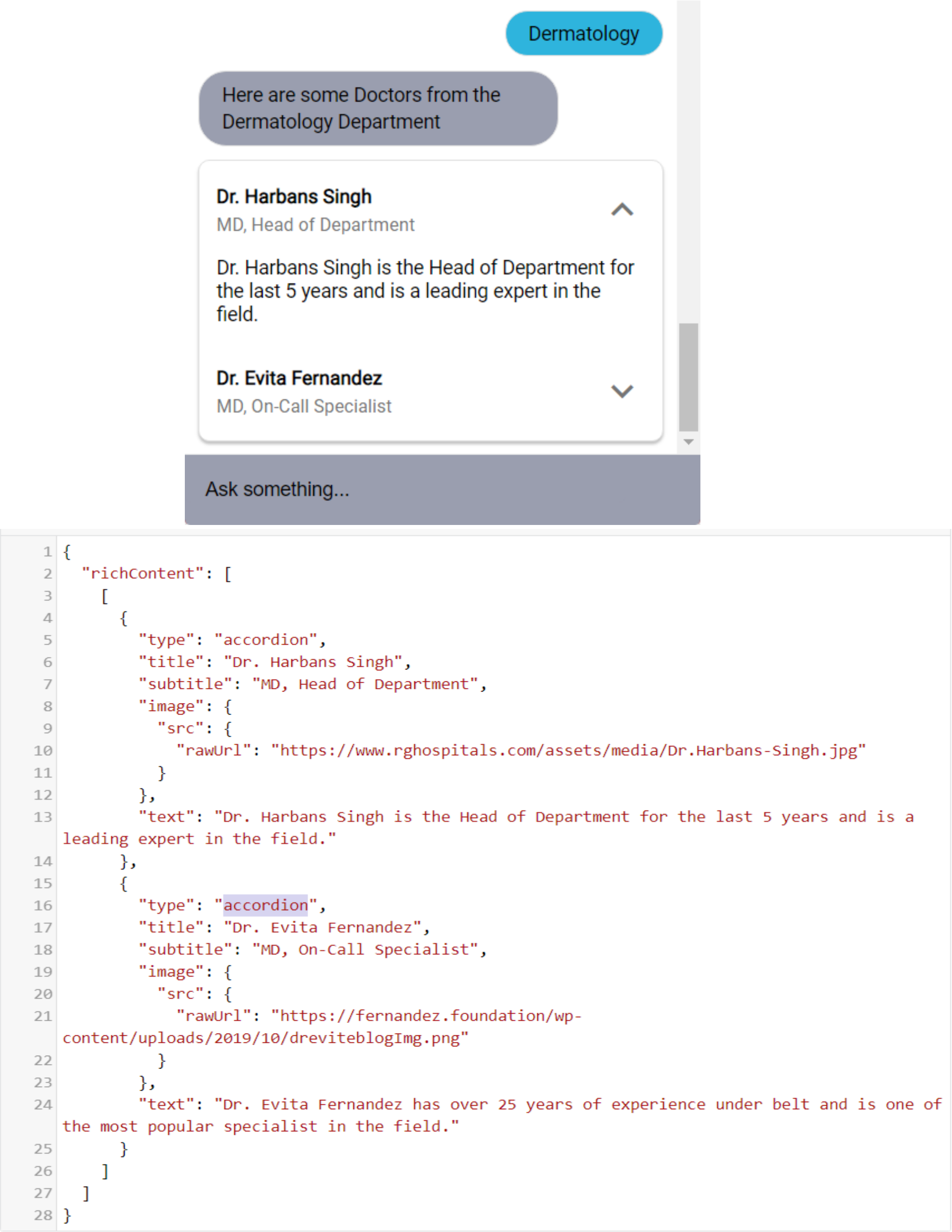
Custom Payload

```
{
  "richContent": [
    [
      {
        "subtitle": "Heart and realted issues",
        "actionLink": "Cardiology",
        "type": "info",
        "title": "Cardiology",
        "image": {
          "src": {
            "rawUrl": "https://static.thenounproject.com/png/576005-200.png"
          }
        }
      },
      {
        "title": "Dentistry",
        "actionLink": "Dentistry",
        "image": {
          "src": {
            "rawUrl": "https://icons-for-free.com/iconfiles/png/512/dentist+dentistry+medical+oral+hygiene+search+tooth+icon-1320165692437854440.png"
          }
        },
        "subtitle": "Teeth and realted issues",
        "type": "info"
      },
```

Figure 4.14: Output and code for Information response in Dialogflow Messenger

f) **Accordion Response:**

It gives the title and one subtitle/description line; click the down arrow for more information.



Dermatology

Here are some Doctors from the Dermatology Department

Dr. Harbans Singh
MD, Head of Department

Dr. Harbans Singh is the Head of Department for the last 5 years and is a leading expert in the field.

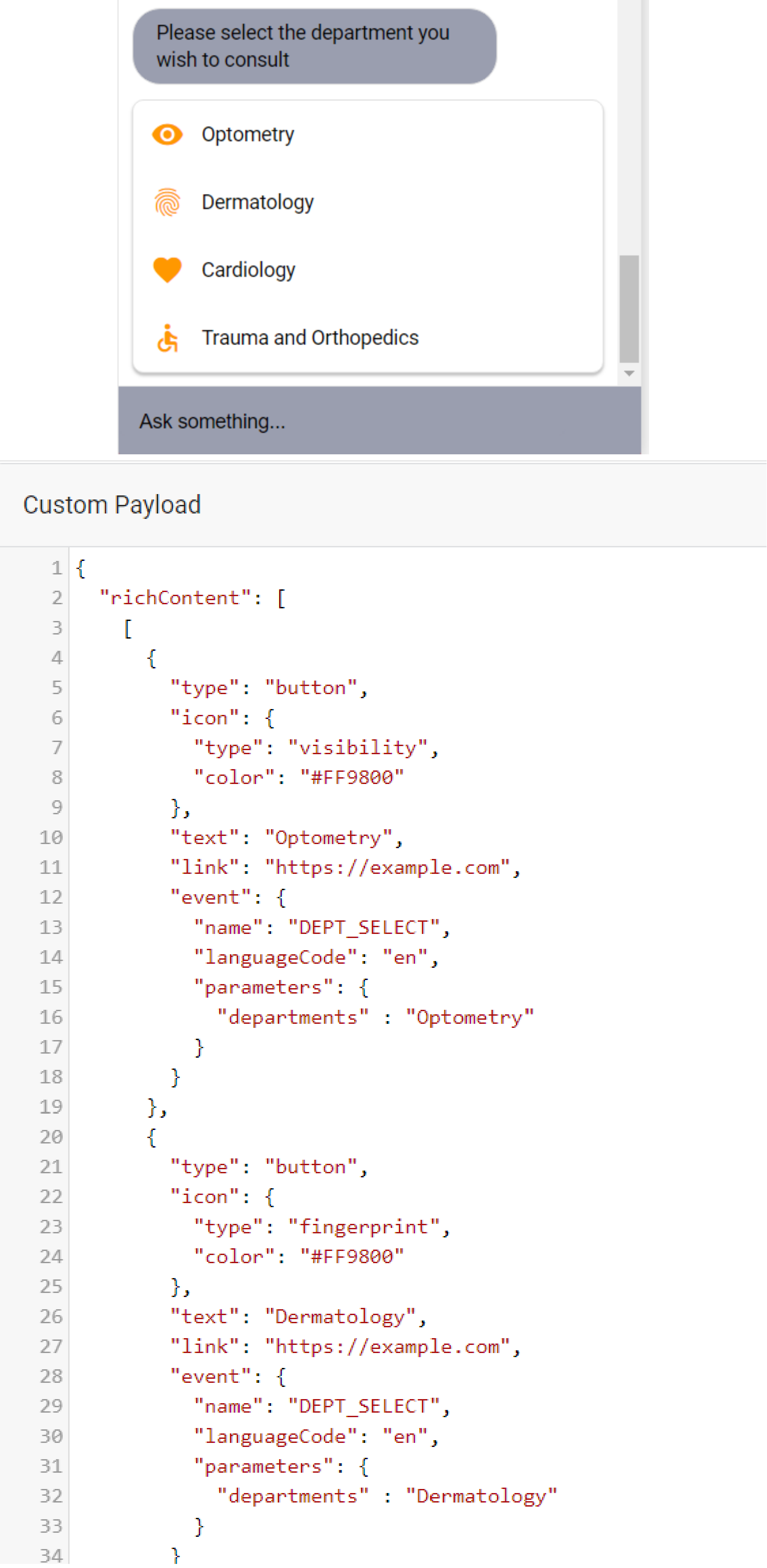
Dr. Evita Fernandez
MD, On-Call Specialist

Ask something...

```
{
  "richContent": [
    [
      {
        "type": "accordion",
        "title": "Dr. Harbans Singh",
        "subtitle": "MD, Head of Department",
        "image": {
          "src": {
            "rawUrl": "https://www.rghospitals.com/assets/media/Dr.Harbans-Singh.jpg"
          }
        },
        "text": "Dr. Harbans Singh is the Head of Department for the last 5 years and is a leading expert in the field."
      },
      {
        "type": "accordion",
        "title": "Dr. Evita Fernandez",
        "subtitle": "MD, On-Call Specialist",
        "image": {
          "src": {
            "rawUrl": "https://fernandez.foundation/wp-content/uploads/2019/10/dreviteblogImg.png"
          }
        },
        "text": "Dr. Evita Fernandez has over 25 years of experience under belt and is one of the most popular specialist in the field."
      }
    ]
  ]
}
```

Figure 4.15: Output and code for Accordion response in Dialogflow Messenger

g) Button Response

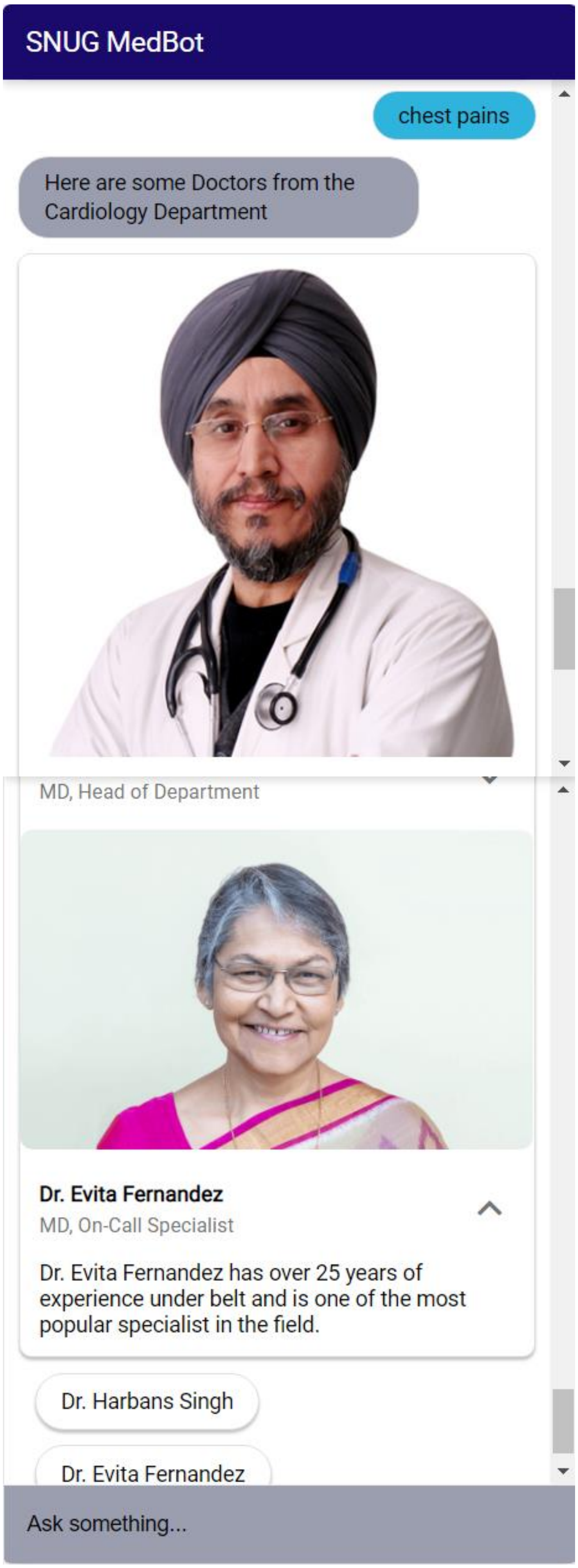


Please select the department you wish to consult

```
{
  "richContent": [
    [
      {
        "type": "button",
        "icon": {
          "type": "visibility",
          "color": "#FF9800"
        },
        "text": "Optometry",
        "link": "https://example.com",
        "event": {
          "name": "DEPT_SELECT",
          "languageCode": "en",
          "parameters": {
            "departments" : "Optometry"
          }
        }
      },
      {
        "type": "button",
        "icon": {
          "type": "fingerprint",
          "color": "#FF9800"
        },
        "text": "Dermatology",
        "link": "https://example.com",
        "event": {
          "name": "DEPT_SELECT",
          "languageCode": "en",
          "parameters": {
            "departments" : "Dermatology"
          }
        }
```

Figure 4.16: Output and code for Button response in Dialogflow Messenger

h) Custom / Combined Response:



SNUG MedBot

chest pains

Here are some Doctors from the Cardiology Department

MD, Head of Department

Dr. Evita Fernandez

MD, On-Call Specialist

Dr. Evita Fernandez has over 25 years of experience under belt and is one of the most popular specialist in the field.

Dr. Harbans Singh

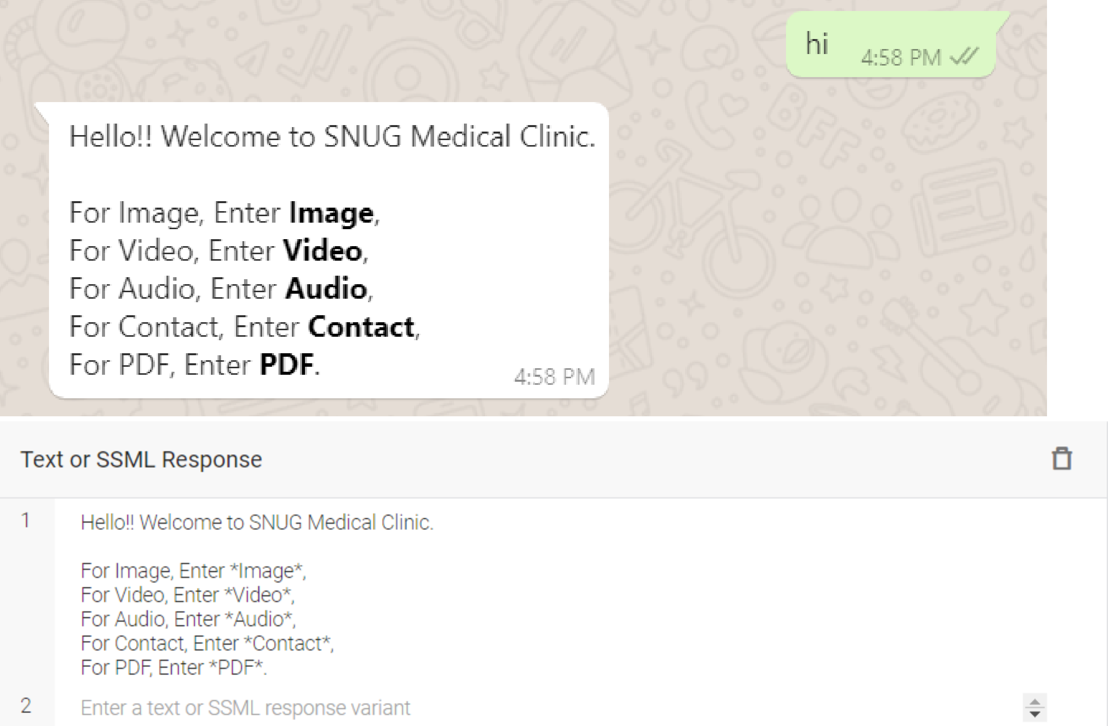
Dr. Evita Fernandez

Ask something...

Figure 4.17: Output Combined response in Dialogflow Messenger

4.6.2 RICH RESPONSE WITH WHATSAPP

a) Text Response:



hi 4:58 PM

Hello!! Welcome to SNUG Medical Clinic.

For Image, Enter **Image**,
For Video, Enter **Video**,
For Audio, Enter **Audio**,
For Contact, Enter **Contact**,
For PDF, Enter **PDF**.
4:58 PM

Text or SSML Response

```
Hello!! Welcome to SNUG Medical Clinic.

For Image, Enter *Image*,
For Video, Enter *Video*,
For Audio, Enter *Audio*,
For Contact, Enter *Contact*,
For PDF, Enter *PDF*.
```

Enter a text or SSML response variant

Figure 4.18: Output and code for Text response in WhatsApp

b) Image Response

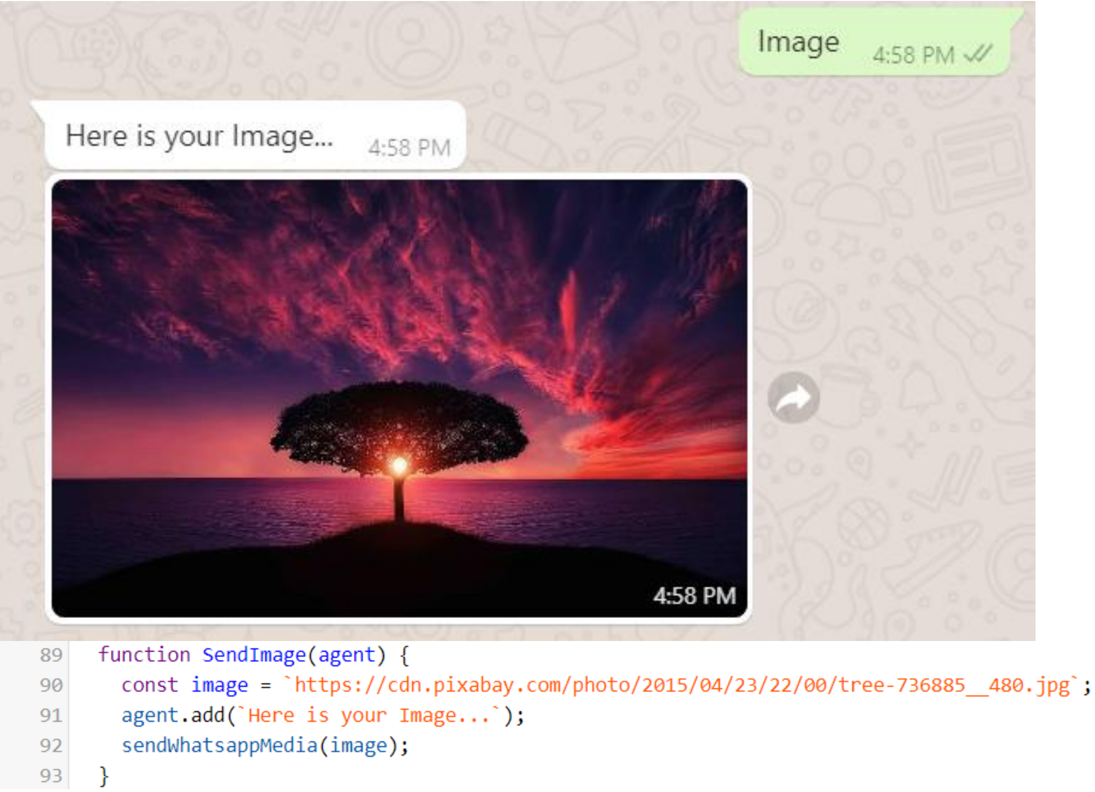


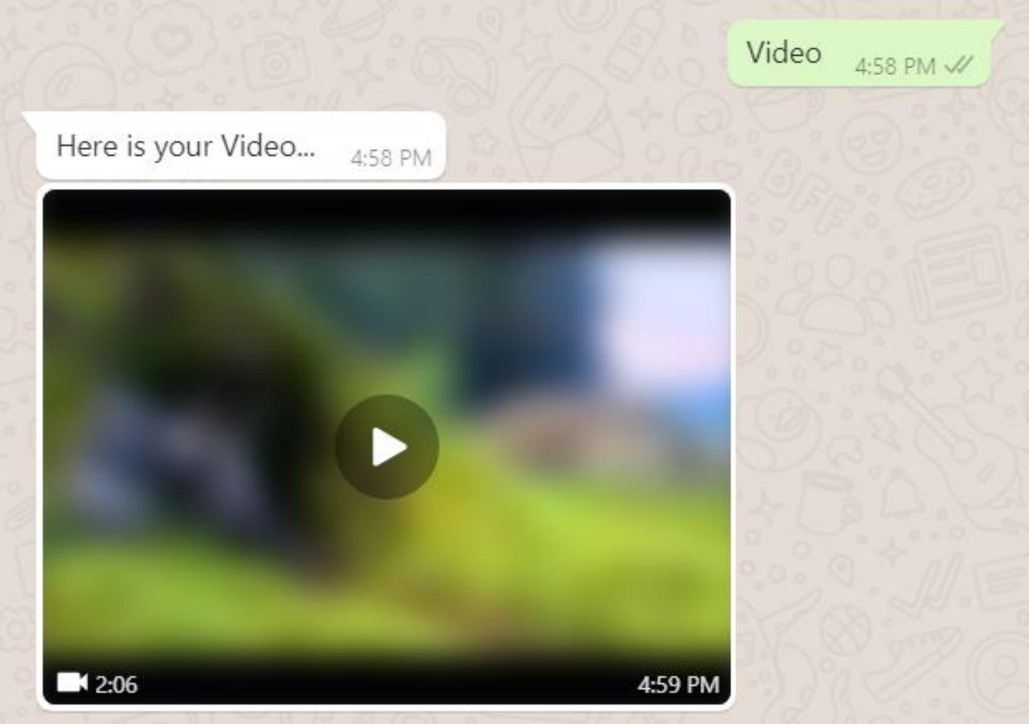
Image 4:58 PM

Here is your Image... 4:58 PM

```
function SendImage(agent) {
  const image = `https://cdn.pixabay.com/photo/2015/04/23/22/00/tree-736885__480.jpg`;
  agent.add(`Here is your Image...`);
  sendWhatsappMedia(image);
}
```

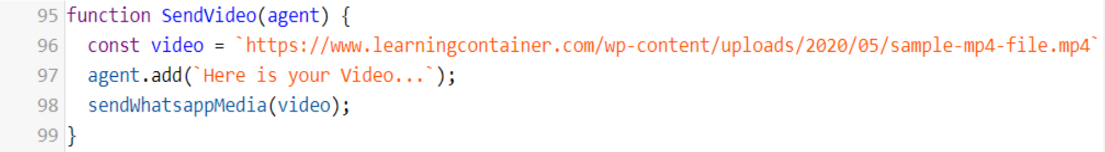
Figure 4.18: Output and code for Image response in WhatsApp

c) Video Response



Video 4:58 PM

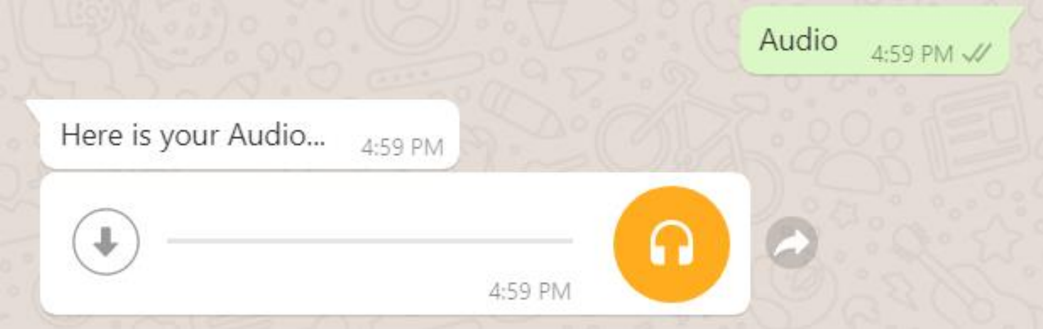
Here is your Video... 4:58 PM



```
function SendVideo(agent) {
  const video = `https://www.learningcontainer.com/wp-content/uploads/2020/05/sample-mp4-file.mp4`
  agent.add(`Here is your Video...`);
  sendWhatsappMedia(video);
}
```

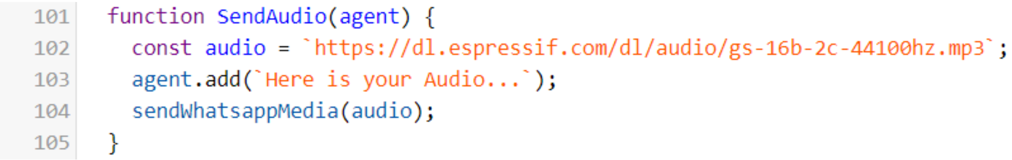
Figure 4.20: Output and code for Video response in WhatsApp

d) Audio Response



Audio 4:59 PM

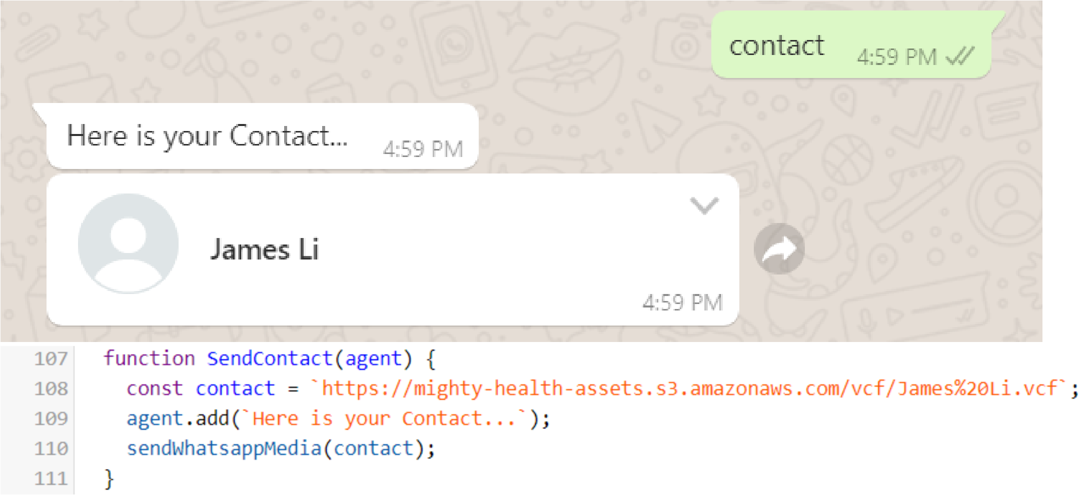
Here is your Audio... 4:59 PM



```
function SendAudio(agent) {
  const audio = `https://dl.espressif.com/dl/audio/gs-16b-2c-44100hz.mp3`;
  agent.add(`Here is your Audio...`);
  sendWhatsappMedia(audio);
}
```

Figure 4.21: Output and code for Audio response in WhatsApp

e) Contact Response



contact 4:59 PM

Here is your Contact... 4:59 PM

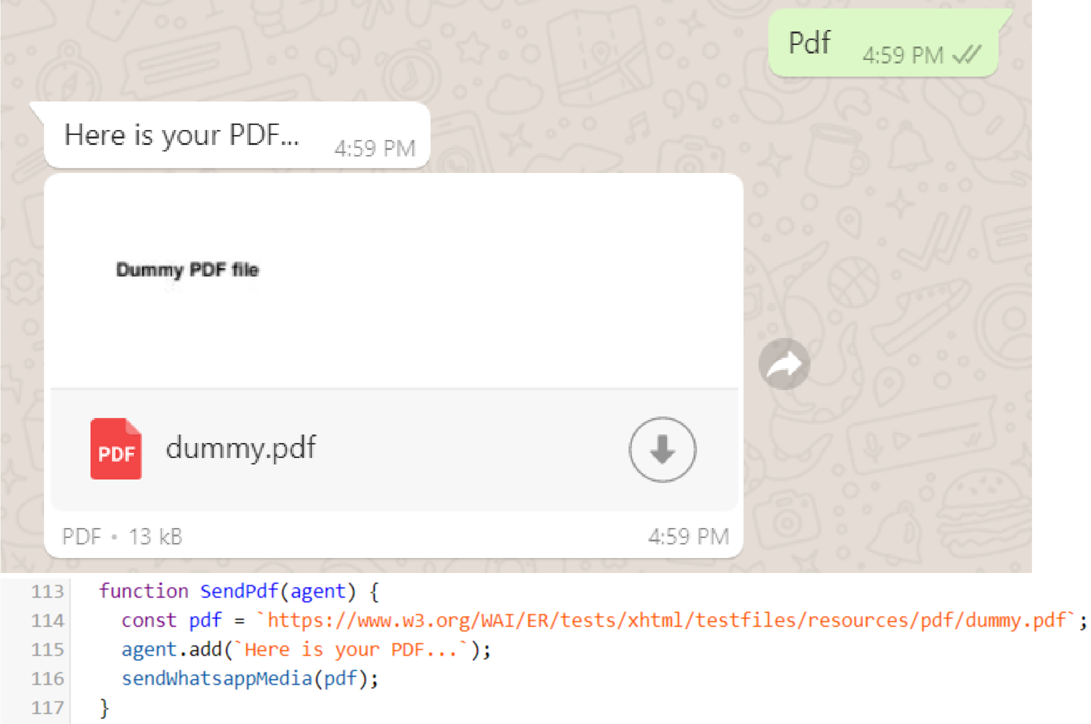
James Li

4:59 PM

```
function SendContact(agent) {
  const contact = `https://mighty-health-assets.s3.amazonaws.com/vcf/James%20Li.vcf`;
  agent.add(`Here is your Contact...`);
  sendWhatsappMedia(contact);
}
```

Figure 4.22: Output and code for Contact response in WhatsApp

f) File Response



Pdf 4:59 PM

Here is your PDF... 4:59 PM

Dummy PDF file

dummy.pdf

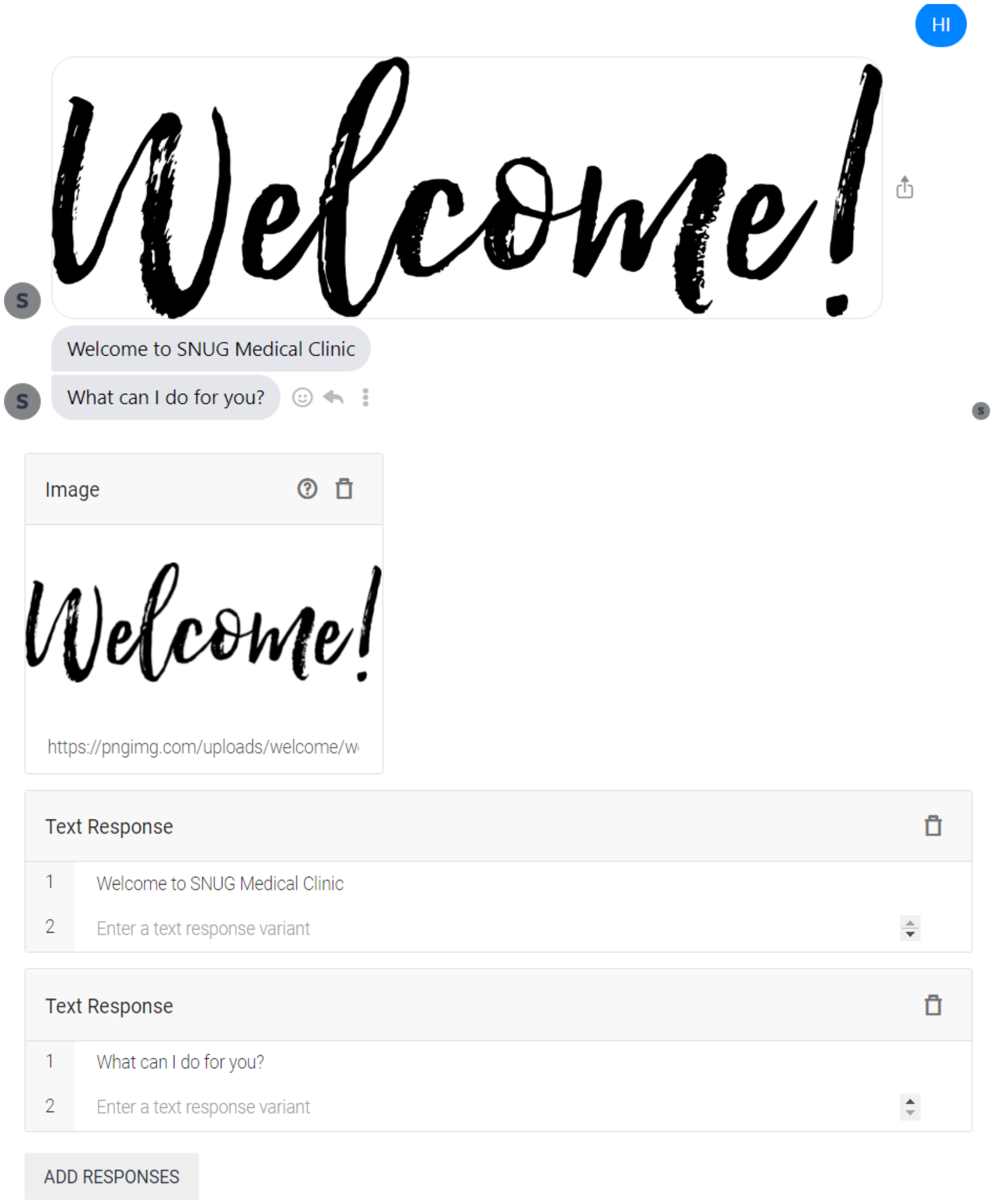
PDF • 13 kB 4:59 PM

```
function SendPdf(agent) {
  const pdf = `https://www.w3.org/WAI/ER/tests/xhtml/testfiles/resources/pdf/dummy.pdf`;
  agent.add(`Here is your PDF...`);
  sendWhatsappMedia(pdf);
}
```

Figure 4.23: Output and code for File response in WhatsApp

4.6.3 RICH RESPONSE WITH FACEBOOK MESSENGER

a) Image Response:



HI

Welcome to SNUG Medical Clinic

What can I do for you?

Image

https://pngimg.com/uploads/welcome/w

Text Response

1 Welcome to SNUG Medical Clinic

2 Enter a text response variant

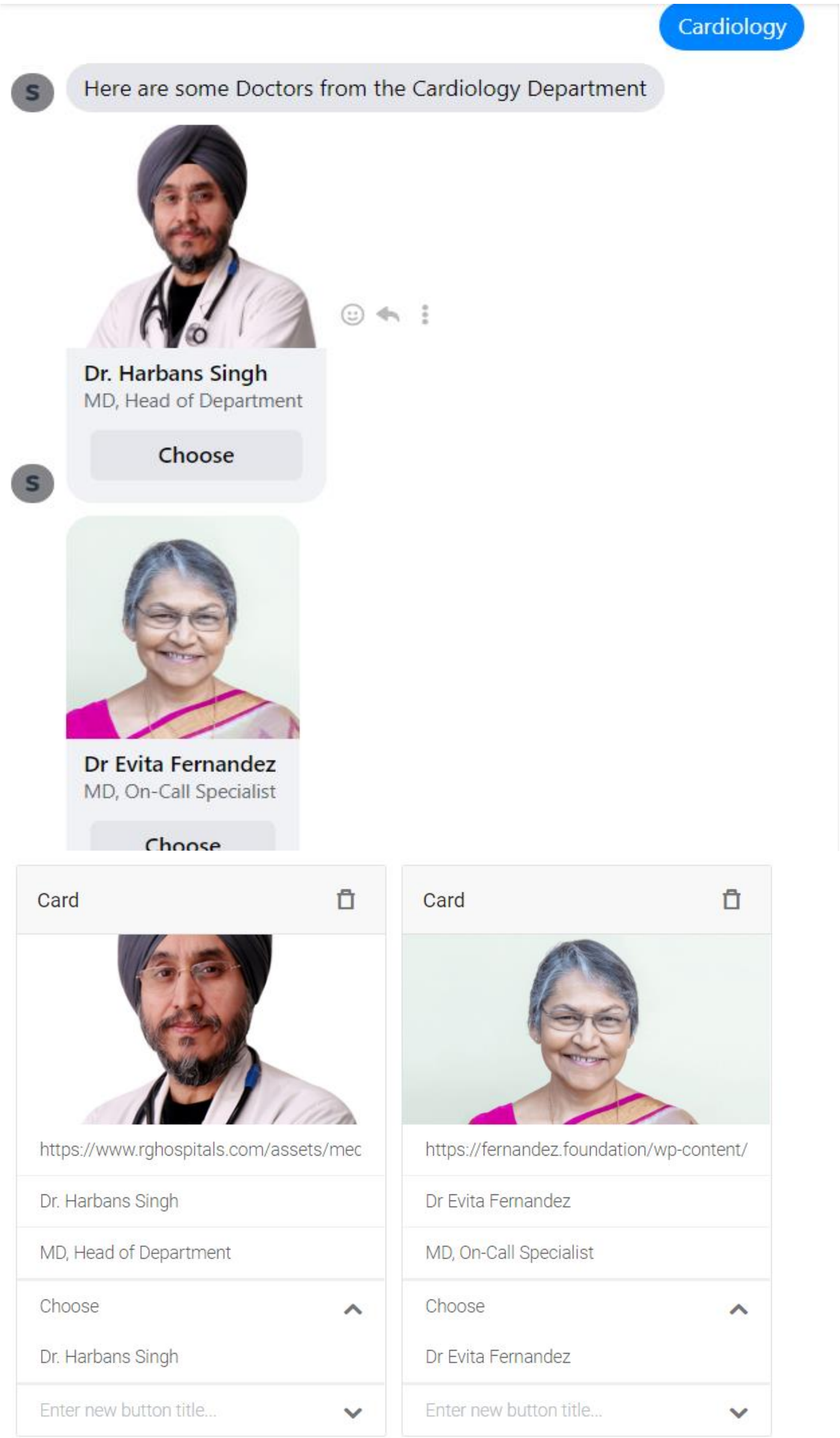
Text Response

1 What can I do for you?

2 Enter a text response variant

Figure 4.24: Output and code for Image response in Facebook

b) Card Response



Cardiology

S Here are some Doctors from the Cardiology Department

Dr. Harbans Singh
MD, Head of Department
Choose

S

Dr Evita Fernandez
MD, On-Call Specialist
Choose

Card

https://www.rghospitals.com/assets/mec

Dr. Harbans Singh

MD, Head of Department

Choose

Dr. Harbans Singh

Enter new button title...

Card

https://fernandez.foundation/wp-content/

Dr Evita Fernandez

MD, On-Call Specialist

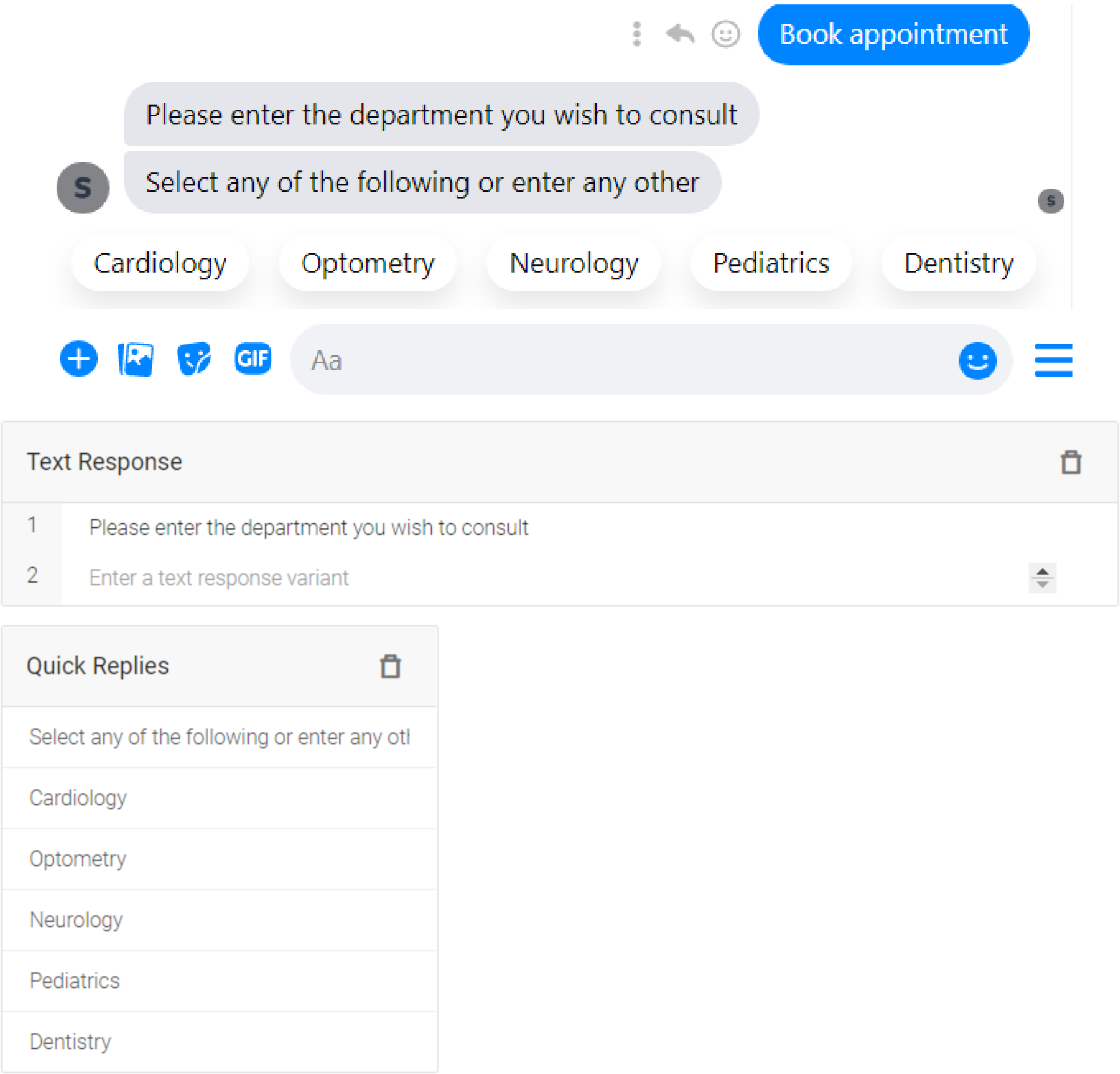
Choose

Dr Evita Fernandez

Enter new button title...

Figure 4.25: Output and code for Card response in Facebook

c) Quick Replies



Book appointment

Please enter the department you wish to consult

Select any of the following or enter any other

Text Response

1 Please enter the department you wish to consult

2 Enter a text response variant

Quick Replies

Select any of the following or enter any otl

Cardiology

Optometry

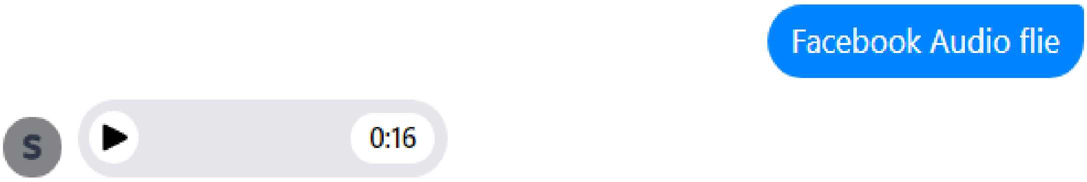
Neurology

Pediatrics

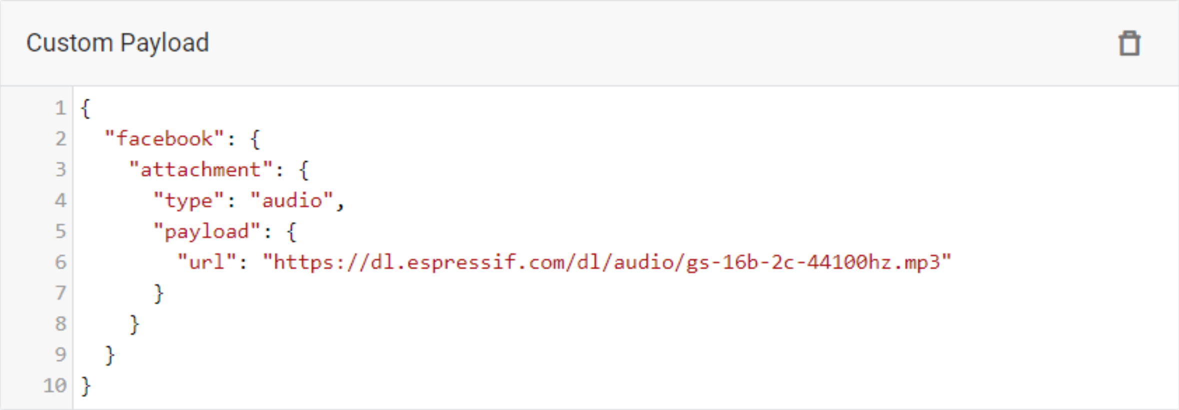
Dentistry

Figure 4.26: Output and code for Quick response in Facebook

d) Audio Response



Facebook Audio flie

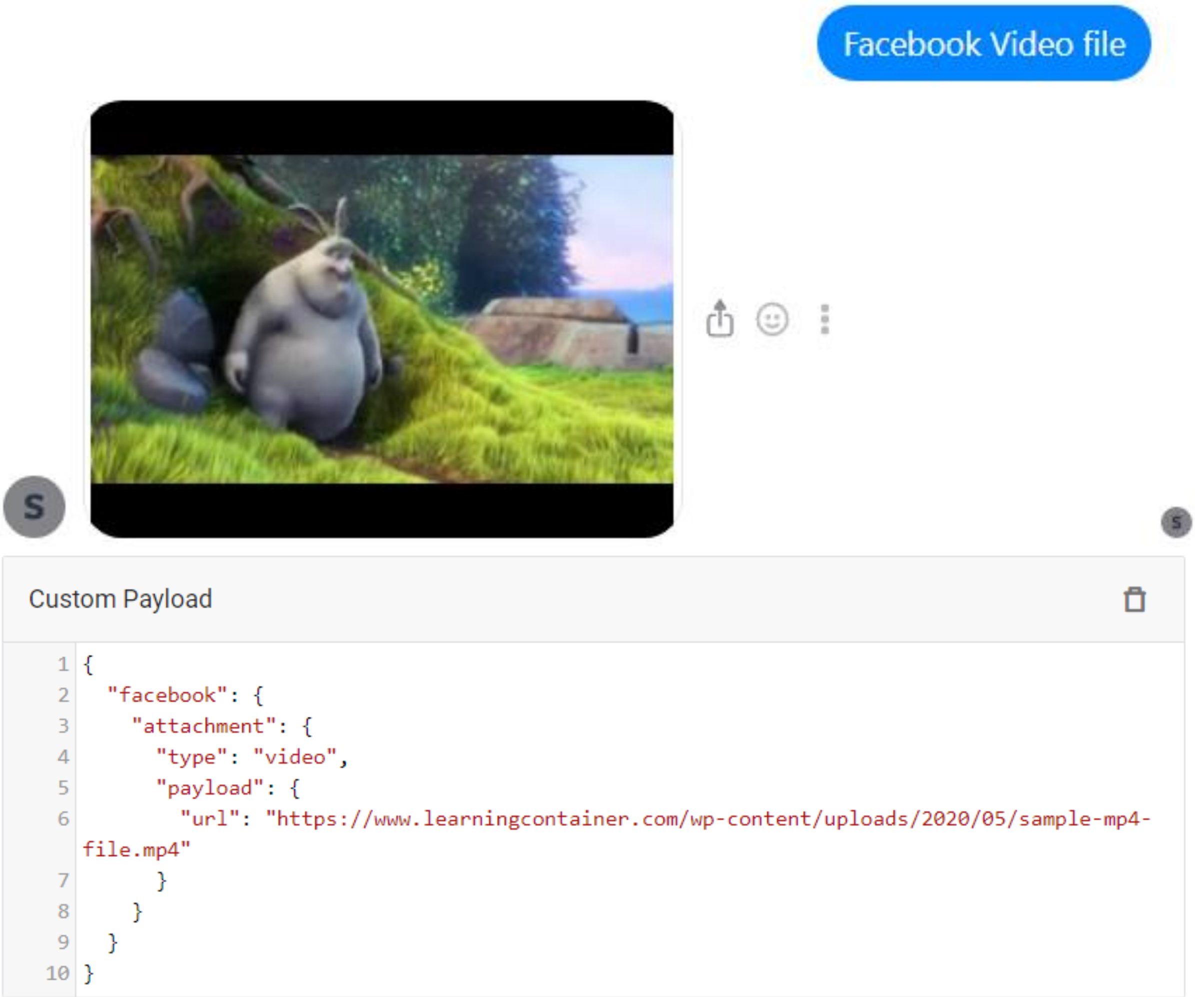


Custom Payload

```
{
  "facebook": {
    "attachment": {
      "type": "audio",
      "payload": {
        "url": "https://dl.espressif.com/dl/audio/gs-16b-2c-44100hz.mp3"
      }
    }
  }
}
```

Figure 4.27: Output and code for Audio response in Facebook

e) Video Response



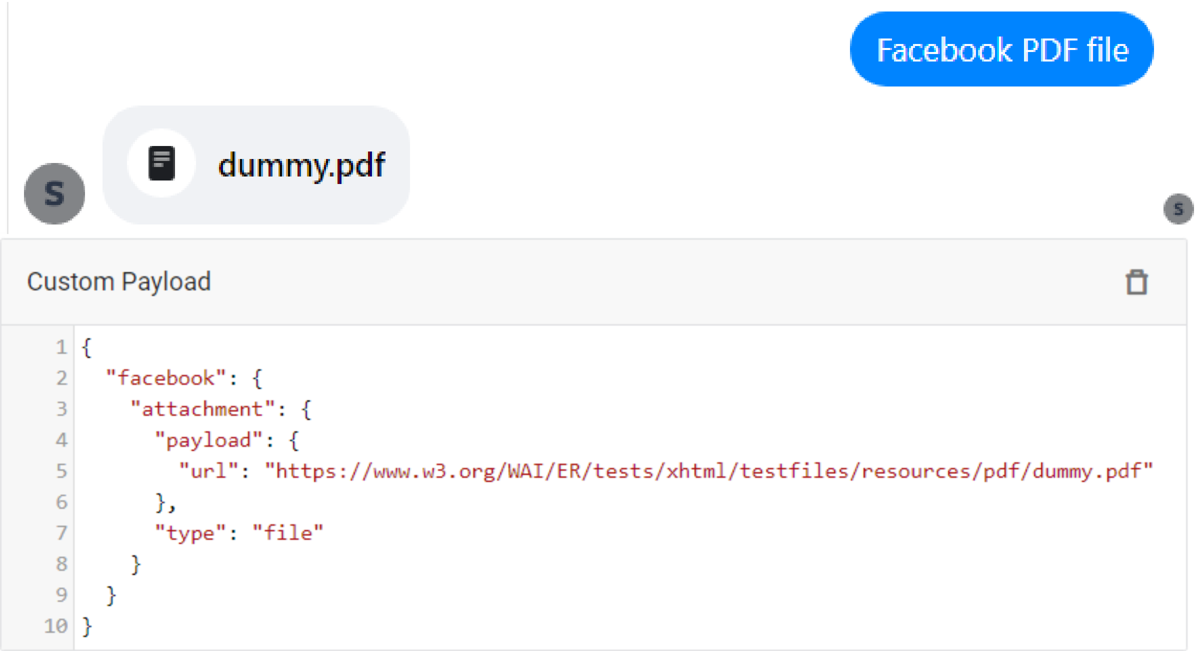
Facebook Video file

Custom Payload

```
{
  "facebook": {
    "attachment": {
      "type": "video",
      "payload": {
        "url": "https://www.learningcontainer.com/wp-content/uploads/2020/05/sample-mp4-file.mp4"
      }
    }
  }
}
```

Figure 4.28: Output and code for Video response in Facebook

f) File Response



Facebook PDF file

dummy.pdf

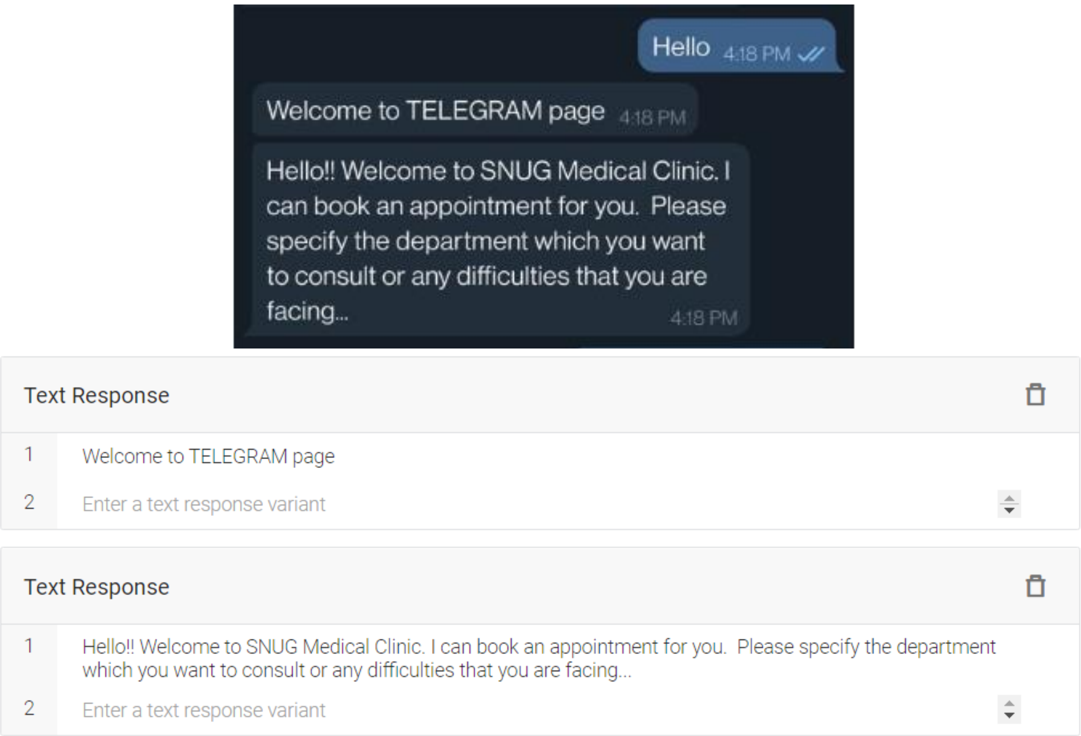
Custom Payload

```
{
  "facebook": {
    "attachment": {
      "payload": {
        "url": "https://www.w3.org/WAI/ER/tests/xhtml/testfiles/resources/pdf/dummy.pdf"
      },
      "type": "file"
    }
  }
}
```

Figure 4.29: Output and code for File response in Facebook

4.6.4 RICH RESPONSE WITH FACEBOOK MESSENGER

a) Text Response:



Hello 4:18 PM

Welcome to TELEGRAM page 4:18 PM

Hello!! Welcome to SNUG Medical Clinic. I can book an appointment for you. Please specify the department which you want to consult or any difficulties that you are facing... 4:18 PM

Text Response

1 Welcome to TELEGRAM page

2 Enter a text response variant

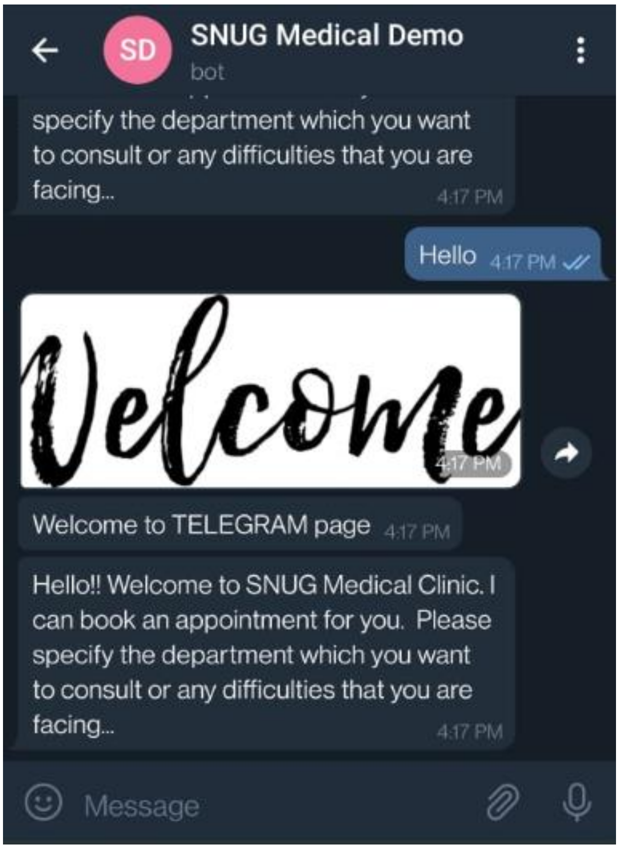
Text Response

1 Hello!! Welcome to SNUG Medical Clinic. I can book an appointment for you. Please specify the department which you want to consult or any difficulties that you are facing...

2 Enter a text response variant

Figure 4.30: Output and code for Text response in Telegram

b) Image Response



SNUG Medical Demo

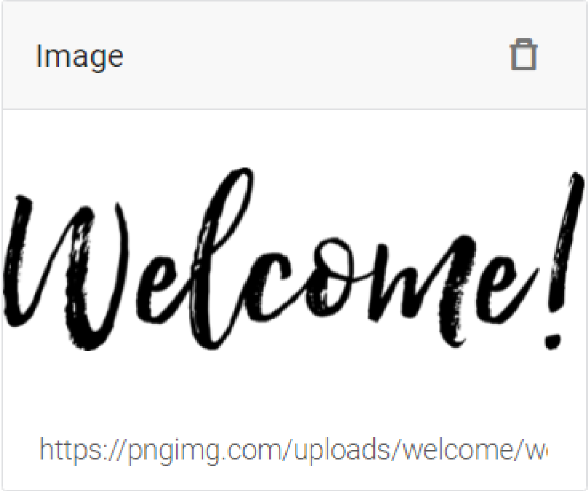
bot

specify the department which you want to consult or any difficulties that you are facing... 4:17 PM

Hello 4:17 PM

Welcome to TELEGRAM page 4:17 PM

Hello!! Welcome to SNUG Medical Clinic. I can book an appointment for you. Please specify the department which you want to consult or any difficulties that you are facing... 4:17 PM

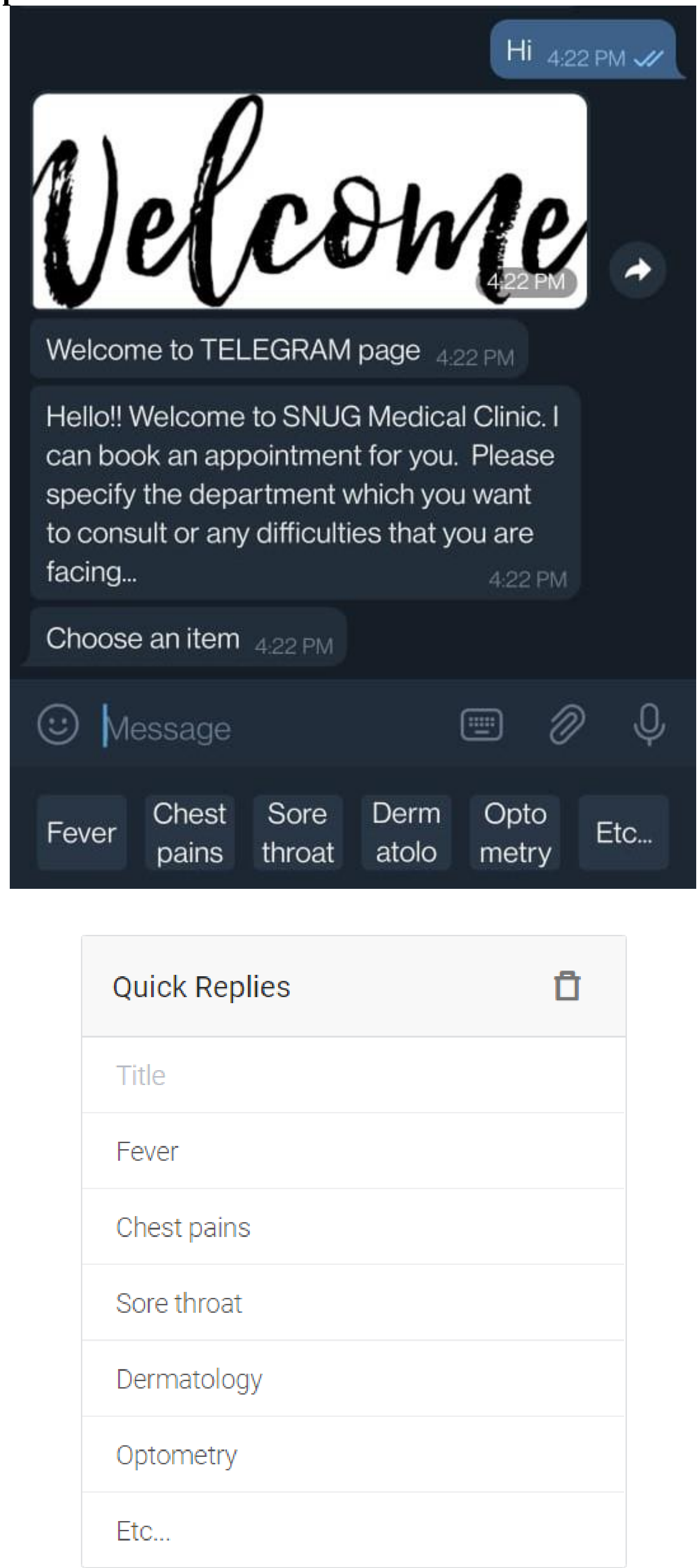


Image

https://pngimg.com/uploads/welcome/w

Figure 4.31: Output and code for Image response in Telegram

c) Quick Replies:



Hi 4:22 PM

Welcome to TELEGRAM page 4:22 PM

Hello!! Welcome to SNUG Medical Clinic. I can book an appointment for you. Please specify the department which you want to consult or any difficulties that you are facing... 4:22 PM

Choose an item 4:22 PM

Quick Replies

Title

Fever

Chest pains

Sore throat

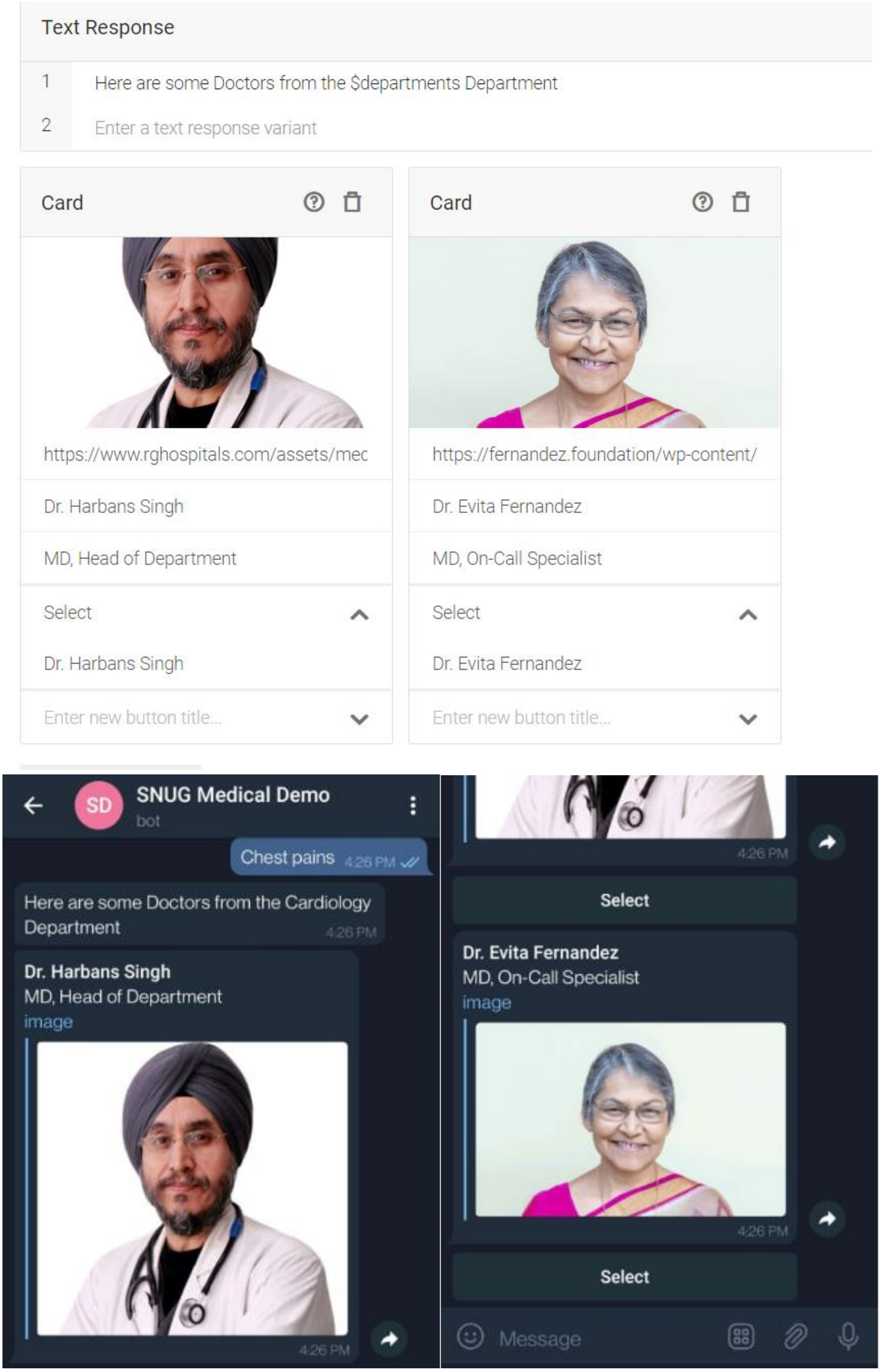
Dermatology

Optometry

Etc...

Figure 4.32: Output and code for Quick response in Telegram

d) Card Response:



Text Response

1 Here are some Doctors from the $departments Department

2 Enter a text response variant

Card

https://www.rghospitals.com/assets/mec

Dr. Harbans Singh

MD, Head of Department

Select

Dr. Harbans Singh

Enter new button title...

Card

https://fernandez.foundation/wp-content/

Dr. Evita Fernandez

MD, On-Call Specialist

Select

Dr. Evita Fernandez

Enter new button title...

SNUG Medical Demo

bot

Chest pains 4:26 PM

Here are some Doctors from the Cardiology Department 4:26 PM

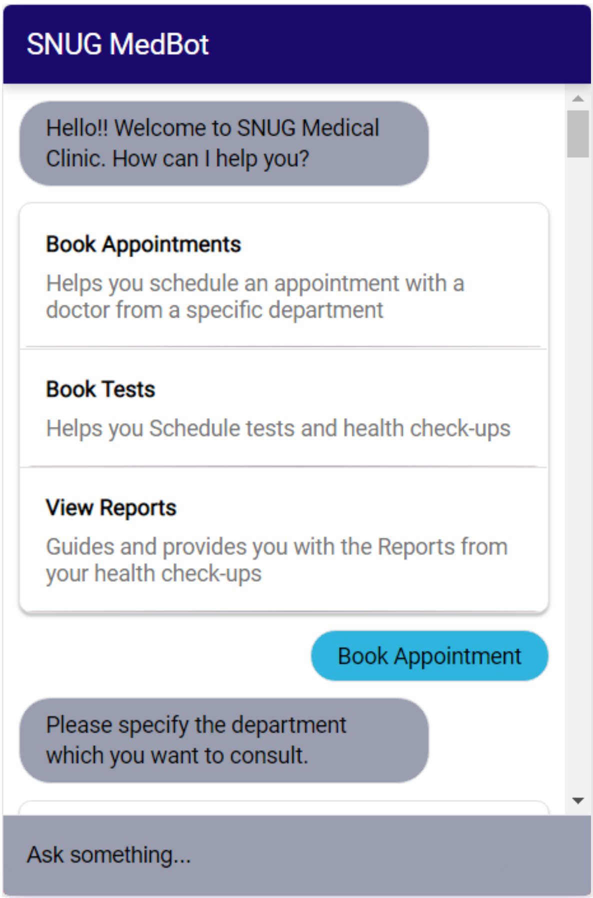
Dr. Harbans Singh
MD, Head of Department
image
4:26 PM

4:26 PM

Dr. Evita Fernandez
MD, On-Call Specialist
image
4:26 PM

Figure 4.33: Output and code for Card response in Telegram

4.7 FINAL OUTCOME


SNUG MedBot

Hello!! Welcome to SNUG Medical Clinic. How can I help you?

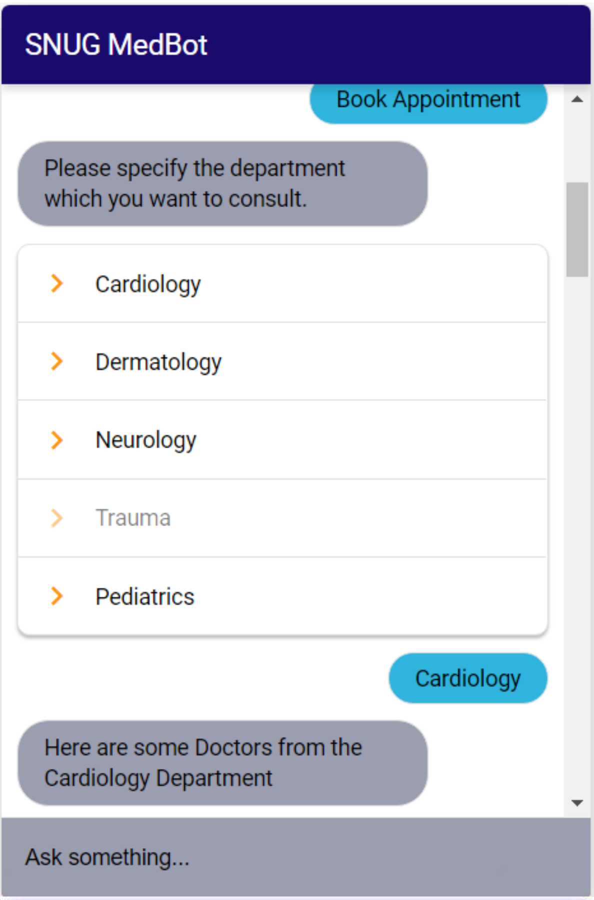
Book Appointments
Helps you schedule an appointment with a doctor from a specific department

Book Tests
Helps you Schedule tests and health check-ups

View Reports
Guides and provides you with the Reports from your health check-ups

Book Appointment

Please specify the department which you want to consult.


SNUG MedBot

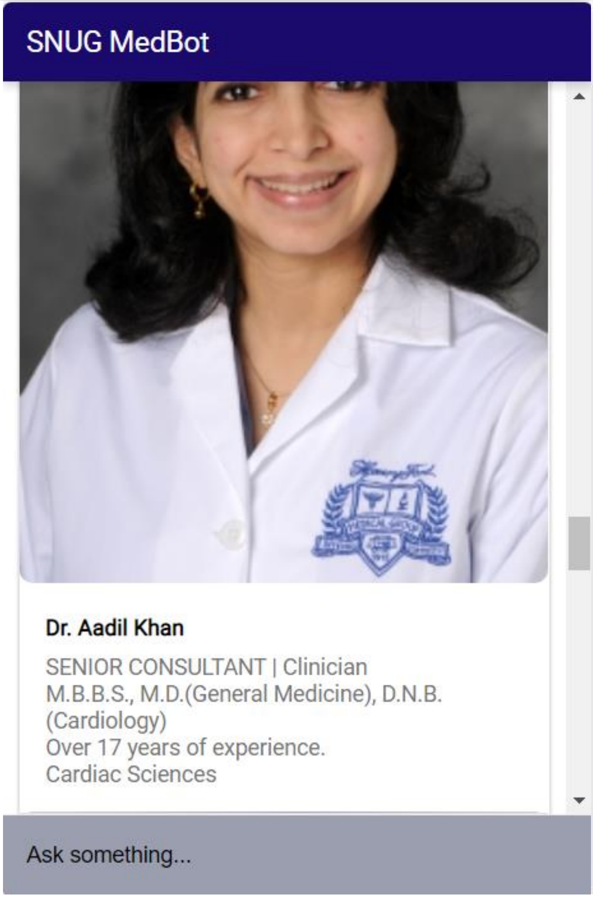
Book Appointment

Please specify the department which you want to consult.

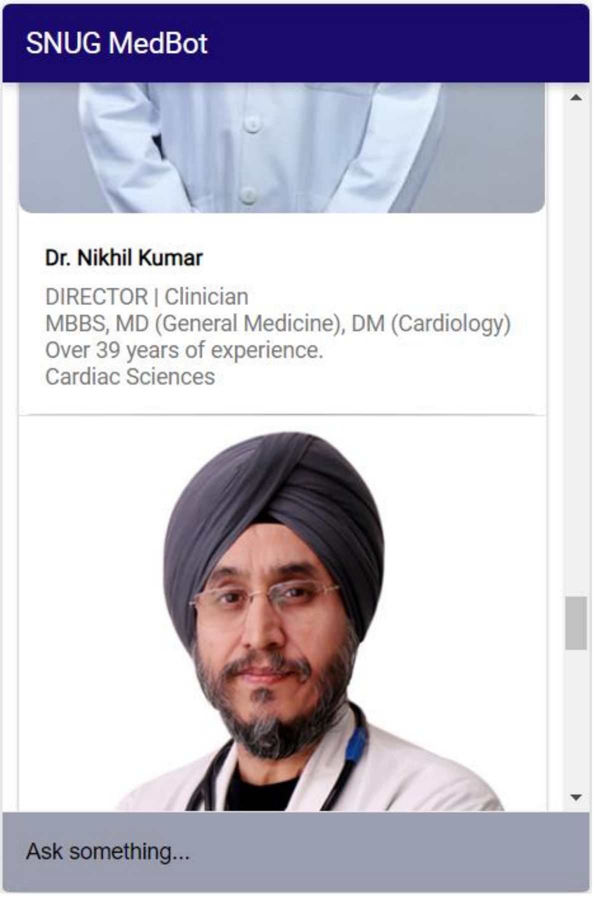
- Cardiology
- Dermatology
- Neurology
- Trauma
- Pediatrics

Cardiology

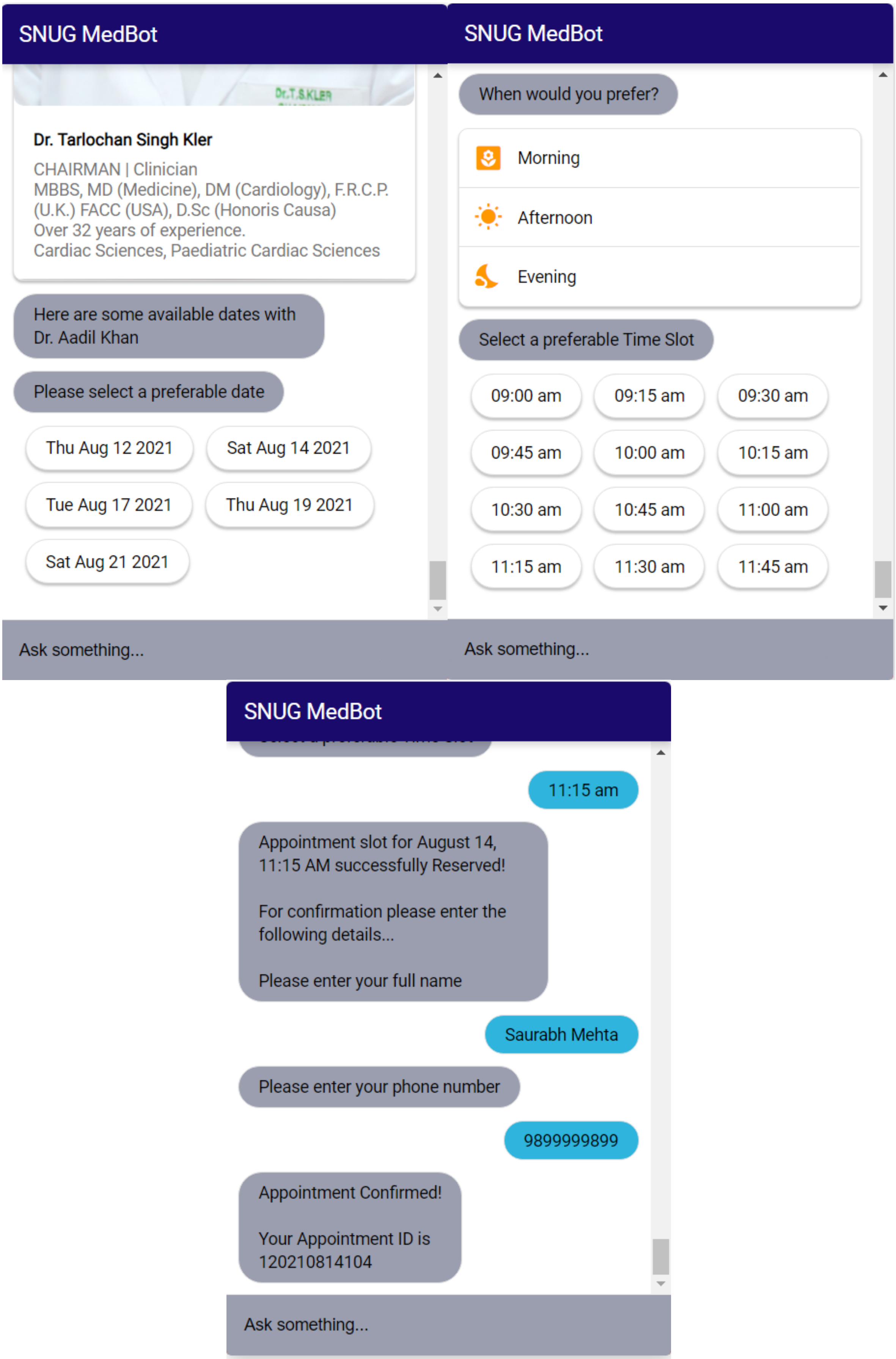
Here are some Doctors from the Cardiology Department


SNUG MedBot

Dr. Aadil Khan
SENIOR CONSULTANT | Clinician
M.B.B.S., M.D.(General Medicine), D.N.B. (Cardiology)
Over 17 years of experience.
Cardiac Sciences


SNUG MedBot

Dr. Nikhil Kumar
DIRECTOR | Clinician
MBBS, MD (General Medicine), DM (Cardiology)
Over 39 years of experience.
Cardiac Sciences



SNUG MedBot

Dr. Tarlochan Singh Kler

CHAIRMAN | Clinician
MBBS, MD (Medicine), DM (Cardiology), F.R.C.P. (U.K.) FACC (USA), D.Sc (Honoris Causa)
Over 32 years of experience.
Cardiac Sciences, Paediatric Cardiac Sciences

Here are some available dates with Dr. Aadil Khan

Please select a preferable date

Thu Aug 12 2021
Sat Aug 14 2021
Tue Aug 17 2021
Thu Aug 19 2021
Sat Aug 21 2021

Ask something...

SNUG MedBot

When would you prefer?

Morning
Afternoon
Evening

Select a preferable Time Slot

09:00 am
09:15 am
09:30 am
09:45 am
10:00 am
10:15 am
10:30 am
10:45 am
11:00 am
11:15 am
11:30 am
11:45 am

Ask something...

SNUG MedBot

11:15 am

Appointment slot for August 14, 11:15 AM successfully Reserved!

For confirmation please enter the following details...

Please enter your full name

Saurabh Mehta

Please enter your phone number

9899999899

Appointment Confirmed!

Your Appointment ID is 120210814104

Ask something...

Fig 4.34: Sample Conversation with AI using Dialogflow Messenger

CHAPTER 5
CONCLUSION AND FUTURE SCOPE OF WORK

This chapter shall conclude the project and summarise the work done in the past six months.

5.1 CONCLUSION

This project saw the successful creation of a Conversational AI incorporating IVR for the healthcare industry. Various platforms like Google Dialogflow, Amazon AWS, and Amazon DynamoDB were deployed to develop and train the AI. The Avaya Aura Experience Portal has been used for the IVR application.

5.2 FUTURE SCOPE

1. **Outpatient Journey:**

   After the treatments, engagement with patients is exceedingly crucial. The need of the hour is more emphasis on preventive care than the day-to-day operations of healthcare staff revolving more around treatment than prevention. After treatment, patients can often relapse into a condition and end up worse than before, requiring more intensive treatment. With the exponential development of smart devices and IoT devices, conversational AI systems will enable healthcare providers to care for patients in their homes before they even need to visit.

2. **AI-Enabled Counselling:**

   When we think about AI, we only look at physical ailments, chronic diseases, and injuries. However, we should not ignore the growing problem of mental health. We can expect to see more conversational AI systems becoming the first layer of emotional support like outpatient care which could be daily check-ins, notifications, or gamification of positive habits. Qualified psychiatrists can then handle the more extreme cases.

3. **Empathetic AI:**

   So far, the applications of conversational AI have been intended at automating repetitive tasks effectively. However, healthcare is not just about effectiveness. Care, empathy, compassion, and humanity are all attributes that are essential in any healthcare service provider. Conversational AI systems are no longer ordinary monotonous robots. The advanced systems today have interesting personalities embedded into them and are sounding more human every day. As AI systems get better at automating repetitive tasks with better accuracy, the next frontier will be perfecting these bots’ humanity.

REFERENCES

1. Lee H, Friedman ME, Cukor P, Ahern D, '*Interactive Voice Response System (IVRS) in Health Care Services,'* Nurs Outlook. 2003 Nov-Dec;51(6):277-83. Doi: 10.1016/s0029-6554(03)00161-1. PMID: 14688763.
2. Mouza AM, '*IVR and administrative operations in healthcare and hospitals*' Journal of healthcare information management: 2003 Winter;17(1):68-71. PMID: 12553225.
3. Tudor Car L, Dhinagaran DA, Kyaw BM, Kowatsch T, Joty S, Theng YL, Atun R.' *Conversational Agents in Health Care: Scoping Review and Conceptual Analysis*'. J Med Internet Res. 2020 Aug 7;22(8): e17158. Doi: 10.2196/17158. PMID: 32763886; PMCID: PMC7442948.
4. Google Dialogflow documentation
5. Amazon Web Services documentation
6. Conversational AI, interactions.com
7. Conversational AI: Your Best Agent (every time), interactions.com
8. Why Conversational AI Is Key to Customer Service in the Customer Experience Era, interactions.com
9. Artificial Intelligence In IVR: A Step Towards Faster Customer Services, analyticsinsight.net
10. Conversational AI vs chatbot, boost.ai
11. The Ultimate Guide to Conversational AI in Healthcare, keyreply.com
12. What is the Difference Between Standard & Conversational IVR? cognigy.com

PROJECT DETAILS

Student Details			
Student Name	**Chahat Segan**		
Register Number	170921038	Section / Roll No	B/09
Email Address	chahatsegan@gmail.com	Phone No (M)	8660616118
Student Name			
Register Number		Section / Roll No	
Email Address		Phone No (M)	
Project Details			
Project Title	**Building Conversational AI for Healthcare Industry**		
Project Duration	6 months	Date of reporting	08 February 2021
Expected date of completion of project	08 August 2021		
Organisation Details			
Organisation Name	**SNUG Technologies Private Limited**		
Full postal address with pin code	403, 4th Floor, Tower B, Global Business Park, Mehrauli-Gurgaon Road, Gurugram, Haryana-122002, India		
Website address	http://www.snug.in		
Supervisor Details			
Supervisor Name	**Mr Rajat Verma**		
Designation	Director		
Full contact address with pin code	Director's Office, SNUG Technologies Private Limited 403, 4th Floor, Tower B, Global Business Park, Mehrauli-Gurgaon Road, Gurugram, Haryana-122002, India		
Email address	rajat.verma@snug.in	Phone No (M)	7838289827
Internal Guide Details			
Faculty Name	**Ms Preeti Mohanty**		
Full contact address with pin code	Dept. of Instrumentation & Control Engineering, Manipal Institute of Technology, Manipal – 576 104 (Karnataka State), INDIA		
Email address	Mohanty.preeti@manipal.edu		
Co- Guide Details (if any)			
Faculty Name			
Full contact address with pin code	Dept. of Instrumentation & Control Engineering, Manipal Institute of Technology, Manipal – 576 104 (Karnataka State), INDIA		
Email address			