CHATBOT: “DR. RECEPTIONIST”

A Capstone Project Report
Submitted to the Faculty
of the
Bennett University

By

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E16CSE043

In Partial Fulfillment of the Requirements
for the Degree of
Bachelor of Technology

Major Department: Computer Science Engineering
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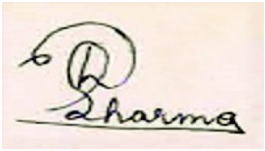
Greater Noida-201310, Uttar Pradesh, India

CERTIFICATE

I hereby certify that the work which is being presented in the B.Tech. Capstone Project Report entitled **"Chatbot: Doctor's Receptionist",** in partial fulfillment of the requirements for the award of the **Bachelor of Technology in Computer Science & Engineering** and submitted to the Department of Computer Science & Engineering of Bennett University Greater Noida UP is an authentic record of my own work carried out during a period from July 2019 to November 2019.

The matter presented in this thesis has not been submitted by me for the award of any other degree elsewhere.



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This is to certify that the above statement made by the candidate is correct to the best of my knowledge.

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ABSTRACT

Ever went to a hospital's reception and had difficulty booking appointments and getting your queries resolved due to long queues and waiting lists of doctors? All worries end here as Our "E-Reception Chatbot" aims to respond to patient's queries and book/cancel appointments with doctors online in an efficient and effective manner. You can access our chat bot easily using the web demo link: https://bot.dialogflow.com/99245b5c-0c42-46b8-9efb-13f0bec00de4. A feature will be launched soon where you can talk to "Dr. Receptionist" using your android phones through google assistant just by saying "OK Google, talk to doctor receptionist" where you can interact with our chatbot using text/voice. One can even use SMS services to interact with the chatbot for booking appointments using the number "+14843242649". "Dr. Receptionist" can also be accessed via Skype.

Chatbot will respond to customer calls by deciding if the customer is trying to set up an appointment or has a question or query using NLP, and then direct the customer respectively to the specified triggered intent. The set of actions performed by my chat bot are:

- Decide if the customer is trying to set up an appointment or has a question or query or something else
- take a message from the customer along with other details
- book appointments or cancel appointments by checking the appointments calendar using webservice call / Integrate with google calendar.
- Use of Natural language processing to be able to respond to customer and interpret customers request.
- In case of question send questions to appropriate person who can respond by voice or email and send the response back to customer.

ACKNOWLEDGEMENTS

As a Bachelor program student, I would like to express my profound gratitude to all those who helped me in completing this project. Without their counsel and guidance, I would not have made a headway in this project.

Firstly, I would like to express my heartfelt regard to Dr. Deepak Garg for granting us this golden opportunity to endeavor in NLP, Machine Learning for his guidance during the project. Without his unparalleled support and help the completion of this project was almost impossible.

I am ineffably indebted to my project mentor and guide Dr. Kanad Kishore Biswas for his mentorship throughout the project. I would like to thank him for helping me counter personal and professional barriers efficiently. I feel really privileged to have a mentor like him.

Besides, I would not forget to thank Dr. Sridhar Swaminathan for inspiring me and boosting my morale till the very last stage of this project.

At last, I would like to thank all the Teaching Staff of Computer Science Department, Bennett University for their guidance and constant support and helping me in completing my project successfully. Also, I would like to express my heartfelt gratitude to all the staff in the laboratory for their timely support.

I would also like to thank my friends for their unconditional support not only during academic education but throughout my life and motivating me time to time in completion of this project.

Deepak Sharma

DEDICATION

I DEDICATE THIS PROJECT TO MY FAMILY FOR THEIR ENDLESS SUPPORT AND MAKING ME WHO I AM TODAY. NONE OF THIS WOULD HAVE BEEN POSSIBLE WITHOUT THEIR LOVE AND PRAYERS. MY PARENTS HAVE NEVER FAILED TO SUPPORT ME FINANCIALLY AS WELL EMOTIONALLY. THEY HAVE BEEN THERE FOR ME IN MY BAD TIMES.

THIS PROJECT IS ALSO DEDICATED TO MY PROJECT MENTOR DR. KANAD KISHORE BISWAS, WITHOUT HIS CONSTANT SUPPORT AND GUIDANCE THE COMPLETION OF THIS PROJECT WAS REALLY DIFFICULT. HE IS THE REASON BEHIND MY ACCOMPLISHMENT.

I ALSO DEDICATE THIS CAPSTONE PROJECT TO THE COMPUTER SCIENCE DEPARTMENT, BENNETT UNIVERSITY FOR THEIR TIMELY SUPPORT AND GUIDANCE.

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LIST OF ABBREVIATIONS

[NLP]……..…….....Natural Language Processing

[GCP]……..Google Cloud Platform

[AOG]…….Actions on Google

[NLU]…….Natural language Understanding

1. INTRODUCTION

“Approximately 1.4 Billion People Use Messaging Apps and are willing to talk to Chatbots.” Humans are always adapting and improving their lifestyle. Chatbot is the best platform to do this, as it provides a better way to connect users/customers to businesses. Chatbots are starting to take over most of the business processes as they are becoming more human-like. Also, companies like Google, Amazon, Microsoft, Apple are helping companies interact with their customers on their AI voice-based platforms such as Google Assistant, Amazon Alexa, Siri etc.

1.1. Problem Statement

Ever went to a hospital's reception and had difficulty booking appointments and getting your queries resolved? Long waiting lists and queues in hospitals makes it difficult and time consuming to get an appointment. Also, common queries of doctors aren't solved affectively since there is no efficient way to doing it since it takes a lot of time to manually forward user’s query via a receptionist and get your questions resolved. The whole point of the manual approach and unnecessary human intervention to the process makes it inefficient and time consuming.

2. BACKGROUND RESEARCH

Initially, I went across through various previously created chatbot to get idea on the features and ways to implement it. Here are a few of them:

- **Ticketmaster's bot using Dialogflow to provide faster services for ticket buyers.**

  https://dialogflow.com/case-studies/ticketmaster/

  Ticketmaster used Dialogflow's innovation to give proficient and progressively customized services for ticket purchasers and users. Ticketmaster keeps refining the system framework. The Company keeps on improving the user journey and experience using DialogFlow.

- **KLM builds booking and packing bot 'BB' with Dialogflow**

  https://dialogflow.com/case-studies/klm/

  The airline company's first project was a booking bot for Facebook Messenger. They nicknamed it as Blue Bot (BB). If a user wants to make a booking through Messenger, BB will approach the user for their destination, when they need to fly, etc. The bot shows users the options, and user can buy, fill out their personal details, and get their booking affirmation, all right there on the conversational application. A human operator can without much of a stretch take over, if she can't reply, by interfacing BB with KLM's CRM framework.

Since, Google's DialogFlow offers more advantage in terms of integrations and deployment over a wide range of users on android using "actions-on-google" Google Assistant. Also, it was easy to integrate with Calendar and Twilio APIs using the webhook fulfillment tool of Dialogflow and Google Cloud Platform.

Dialogflow has documentation which explained intents, follow-up intents, contexts, user and system entities, fulfillment etc. in detail. Refer the documentation HERE.

I started looking for online tutorials and ways to implement my chatbot. I got to access this playlist of series of videos by Google Cloud Platform on YouTube named "Deconstructing Chatbots". The playlist helped me in integrating the chatbot with google calendar and add event in calendar using webhook call for the specified date, time, and appointment type of user. Also, I was able to get hands-on experience on how using intents work, entities, fulfillment, and integrations with Dialogflow Phone Gateway, Twilio Text Messaging and Google Assistant. Link to the playlist is HERE.

I also referred to a YouTube video https://youtu.be/NB71vyCj2X4 that guided me in integrating NodeMailer library in node.js to send emails using webhook fulfillments on Dialogflow.

I needed to know more about follow-up intents and contexts in order to get the desired conversational flow, so I researched about it and came across various articles and practical examples which helped me in implementing the desired conversational flow. The links of those articles are:

- https://chatbotslife.com/how-to-handle-context-with-dialogflow-part-1-knock-knock-jokes
- https://blog.dialogflow.com/post/how-contexts-and-followup-intents-work/
- https://medium.com/analytics-vidhya/understanding-chatbot-context-using-dialogflow

I was able to successfully add functionalities of booking appointments of user using Google calendar and get user query forward to email-ID of doctor to get it resolved.

- https://github.com/priyankavergadia/AppointmentScheduler-GoogleCalendar
- https://github.com/priyankavergadia/AppointmentScheduler-BigQuery

2.1. Proposed System

"Doc Receptionist" aims to respond to customer by booking/cancelling their appointment and send their questions/query to doctors over mail. Using NLP & machine learning with tools of Dialogflow and fulfillment webhook on Node.js and integrations on Twilio messaging services, Skype, and Web Demo App, I was able to successfully able to implement the chatbot online. Simple conversations between bot and patient can now make the process of booking/cancelling appointments and asking queries trivial.

2.2. Goals and Objectives

Objective of my chatbot project have been clearly defined in the table below:

Table 1: Goal and Objectives

#	Goal or Objective
1	Decide if the customer is trying to set up an appointment or has a question or query.
2	Get appointment date, time and purpose with other user details if the customer is trying to set an appointment
3	take a message from the customer along with other user details
4	Book/cancel appointments by checking the appointments calendar using integration with google calendar.
5	In case of question/query, send it to appropriate person who can respond by voice or email to send the response back to customer.
6	Have fun in the conversation between user and chatbot.

3. PROJECT PLANNING

This section covers the details of the project planning. Selecting the lifecycle of the development, project stakeholders, resources required, assumptions made (if any) are detailed in the sections below.

3.1. Project Lifecycle

I decided on using the project life cycle as Agile Approach since the conversational flow of my chatbot is adaptive and can be improved rapidly. Also, integrating different parts of my project requires agility, thus enhanced iterative approach would be best for my project. Implementation of the project is segregated in phases. As each phase is independent, it can be delivered exclusively. This can help in getting feedback to re-enhance the application when delivering the next phase and from time to time. Also, the architecture of the project is simple which makes it more suitable for Agile approach of life cycle.

3.2. Project Setup

"Dr. Receptionist" needs basic setup since there are no dependencies on OS, hardware, web browser etc. The chatbot is available on Web Browser, Skype, Phone calling and text messages. Coding has been done using node.js for webhook calls and GCP for all round support.

Table 2: Setup

#	Decision Description
1	Windows 10, Any browser, Web demo, Skype, Call on a number, SMS Text chat.
2	Dialogflow, Google Calendar, BigQuery, NodeMailer, GCP
3	Free to use, Will be open sourced.
4	Intent will be matched according to the user's input and conversation will happen accordingly.

3.3. Stakeholders

Hospitals, patients, clinics, and all medical healthcare can be stakeholder for this application. Also Dr. K.K. Biswas (Professor, B. Tech CSE), my mentor, and Dr. Deepak Garg (HOD, B.Tech CSE) from Bennett University are accountable for the outcome of this project.

Table 3: Stakeholders

Stakeholder	Role
Dr. Deepak Garg	Supervisor
Dr. K. K. Biswas	Mentor
Sridhar Swaminathan	Instructor
Deepak Sharma	Team member

3.4. Project Resources

Blaze Plan of Firebase is required in order to use BigQuery, NodeMailer for sending mail etc. as it falls under the premium plan of GCP package. One person can develop the project in the specified time including integration on Google Assistant using AOG. Any web browser, Skype, Phone calling, SMS Text.

Table 4: Resources

Resource	Resource Description	Quantity
Database Server	Firebase database server is provided by the GCP.	1
Capstone Team	Our team of students who will be the primary developers of the project.	4
Dr. KK Biswas	The mentor who will be able to provide us with technical assistance.	1
Mac Workstation	A Windows OS workstation with Dialogflow premium account, Code for developing the release version of the software.	1
Android Phone	An Android phone to be used as test hardware for the mobile version of the software.	2

3.5. Assumptions

Sample chat transcripts to be created in order to set conversational flow and use the data for training the model.

Table 5: Assumptions table

#	Assumption
A1	There has been direct interaction with mentor once a week.
A2	Dialogflow will be available for free to work upon
A3	Watch tutorials & documents to get idea on how to implement the project on Dialogflow.
A4	Team will have sufficient time to complete the project to present by end-semester
A5	Machine Learning model will be completed in time to test on new training dataset.
A6	The test data provided will be sufficient to create an accurate prediction of user input and the corresponding triggered intent.
A7	The chatbot developed will be easily extended to other forms within the time frame

4. PROJECT TRACKING

4.1. Tracking

The project has been updated on public repository GitHub. All the changes, regular code commits, data, metadata, Project documentation, design documents such as poster, presentation, report etc. are updated in the repository from time to time. This helps in keeping a proper track of the project so that information can be viewed effectively.

Table 6: Project Tracking Information and Description

Information	Description	Link
Code Storage	Project code will be stored in GitHub repository.	https://github.com/DeepHardy/Dr_Receptionist
Project Documents and Assignments	Weekly reports, specification and design documents, etc. will be stored in our GitHub repository.	https://github.com/DeepHardy/Dr_Receptionist

4.2. Communication Plan

My mentor, Dr. KK Biswas and I had regular conversations and communication via email, text, phone to help me in designing the model, conversational flow and implementation of the project. Also, many faculties helped me in improving my project by their advice. My batch mates also helped me in enhancing the project workflow as we discussed about our projects.

Table 7: Regularly Scheduled Meetings

Meeting Type	Frequency/Schedule	Who Attends
Audio Call	Weekly	Project team and mentor
Meeting to discuss progress	Weekly	Project team and mentor
Short Meeting	Weekly in class	Project team

Table 8: Information to Be Provided To Other Groups

Who?	What Information?	When?	How?
Supervisor and mentor	Final deliverables	At completion of project	Project specification doc., code, Power Point presentation, GitHub repo
Supervisor and mentor	Weekly report	Weekly	Email and text

4.3. Deliverables

This project will deliver the functionalities of booking appointments and asking queries to doctors. It will create a natural conversation with end user so that it is trivial for patients to access it. All the documentation needed for the project is also delivered with the working project demo.

Table 9: Deliverables

#	Deliverable
1	Milestone one report
2	Milestone two report
3	Prototype
4	Code

5	Poster
6	Project Video
7	Working chatbot on Web Demo, Skype etc.
8	Final Project Report

5. SYSTEM ANALYSIS AND DESIGN

This section describes in detail about the design part of the system.

5.1. Overall Description

This chatbot is the result of application of NLP, NLU and machine learning capabilities of Dialogflow platform to process an intent and get the required intent response using simple conversational flows. Using Google Calendar integration, the chatbot is able to book appointment for the desired date and time. Using NodeMailer node.js library, emails are sent to the doctor with the query of the user. BigQuery is used to fetch the data in database and get visual representation of it. Sample chat transcripts provide the required training data and decide how the flow of conversation should happen. Fulfillment of the above functionalities is done using webhook calls using Node.js and package.json.

So, first, the user tells whether they want to book an appointment or get their query resolved. Chatbot triggers the specified intent and then confirms about the functionality which has been triggered using a follow-up intent. After when the user approves of it, chatbot asks for essential details such as Name, email-ID, Phone number. After that, ask for appointment date, time and type if the intent matches with set Appointment functionality else ask for query to send the doctor if the intent matches with ask query functionality. Book appointment or send mail of query according to

the triggered intent and intimidate the user with the successful completion of the job. Provide relevant information to user and close the conversation.

Simple conversational flow, wide accessibility, easy processing of intents makes the project a feasible and application based. Implementing the chatbot is trivial and efficient.

5.2. Users and Roles

Types of users for my project will be developer, mentor, Doctors and patients.

Table 10: Users and their roles

User	Description
Developer	A capstone team member who task is to create the train & test data, creating initial conversational transcripts, and ultimately developing a firm chatbot for applying techniques to fulfill user's request. This is used for sub-stories and task needed to fulfill the true end user use cases.
Mentor	Mentor's task was to manage the project and to verify whether developer is making the project right or not. The main role of mentor was to suggest idea to implement in the model to make it better.
Doctors	End benefactor of the application. Can help in giving feedback for improvement of project.
Patients/People	An end user of the chatbot who will be generating the new data and give feedback for enhancement of the project.

5.3. Design diagrams/ UML diagrams/ Flow Charts/ E-R diagrams

5.3.1. Use Case Diagrams

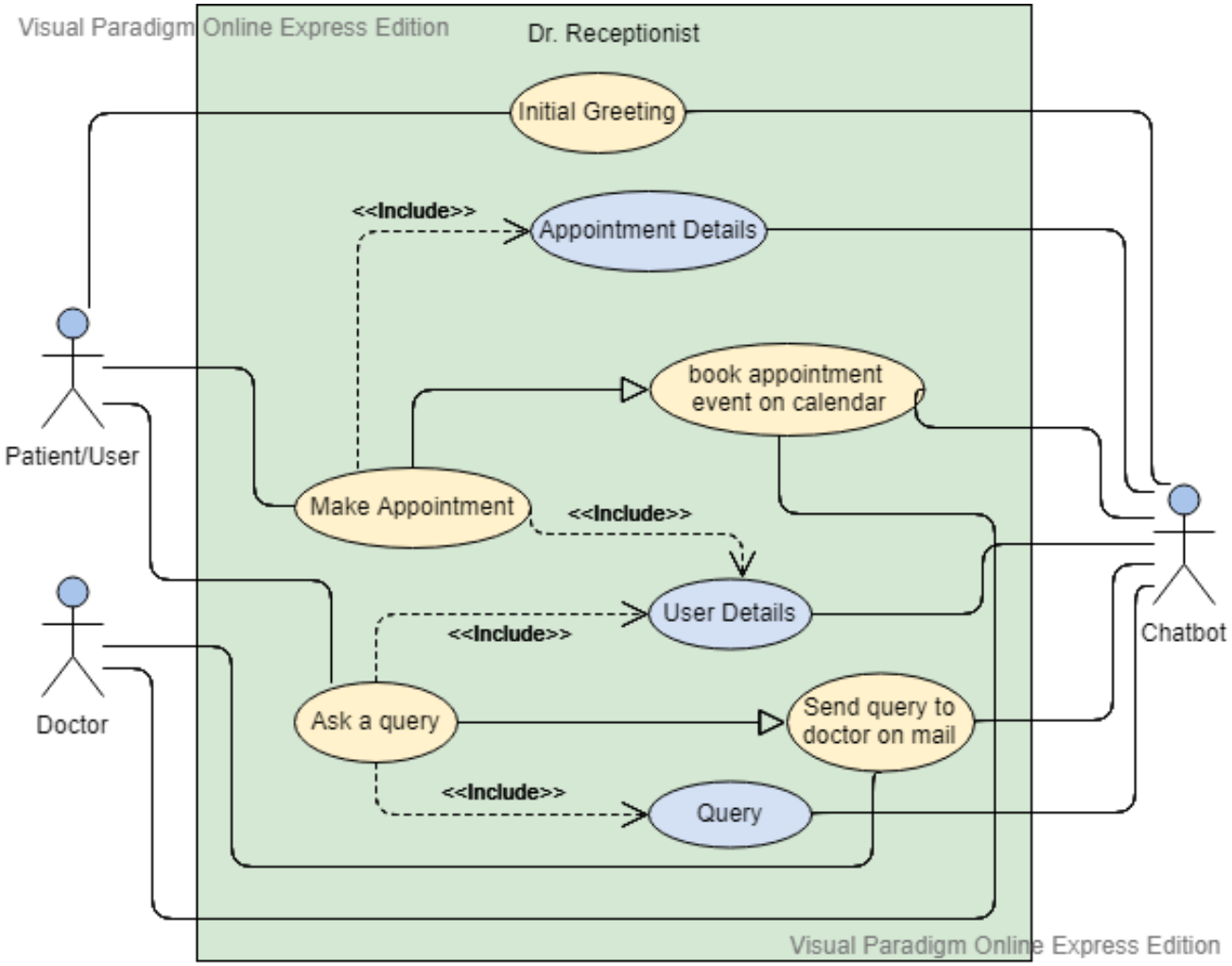

Figure 1: Use-case diagram

5.3.2. Data Flow Diagram

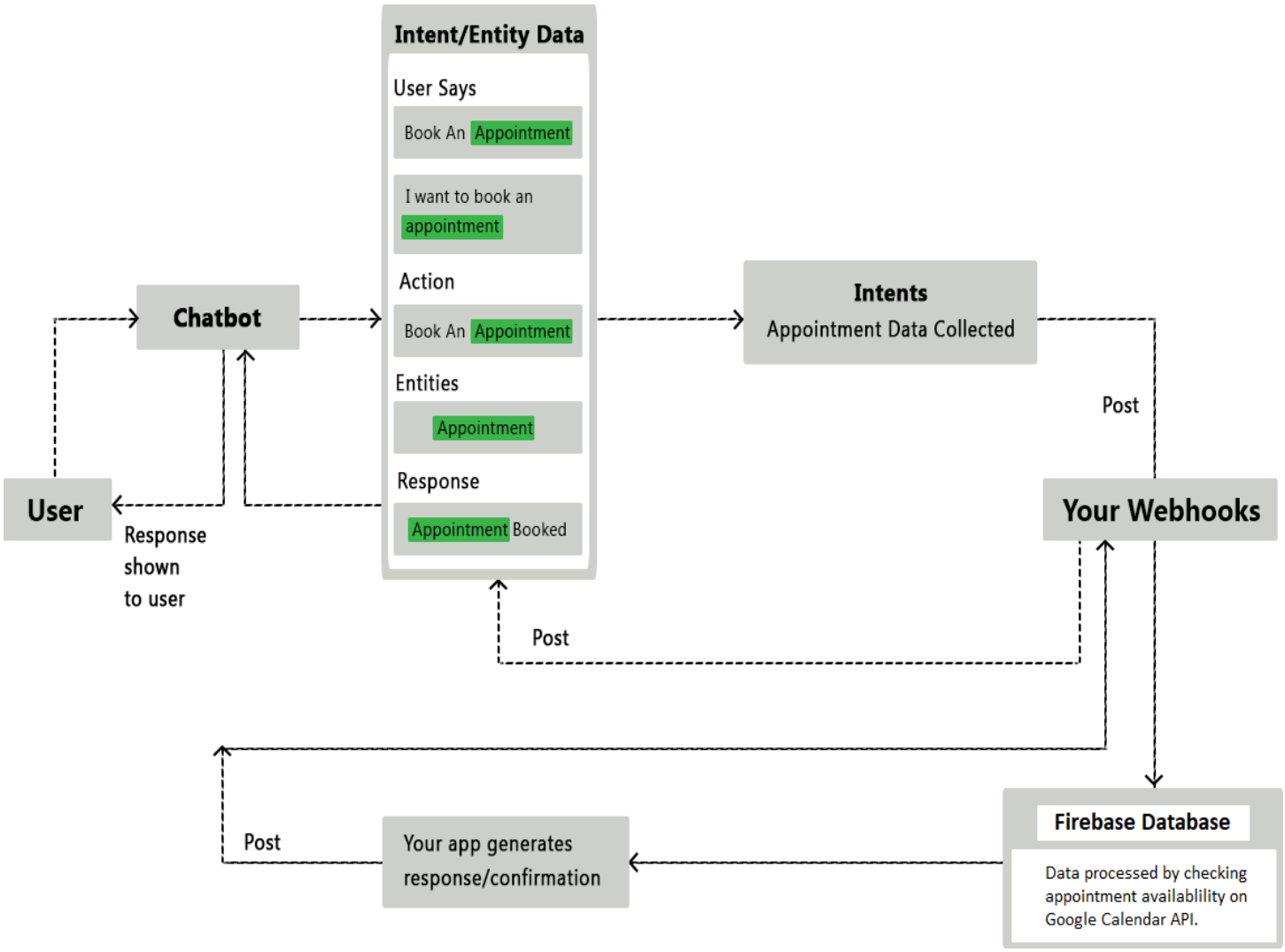

Figure 2: Data Flow Diagram

https://www.brihaspatitech.com/blog/how-make-chatbot-google-dialogflow/

5.3.3. Activity Diagrams

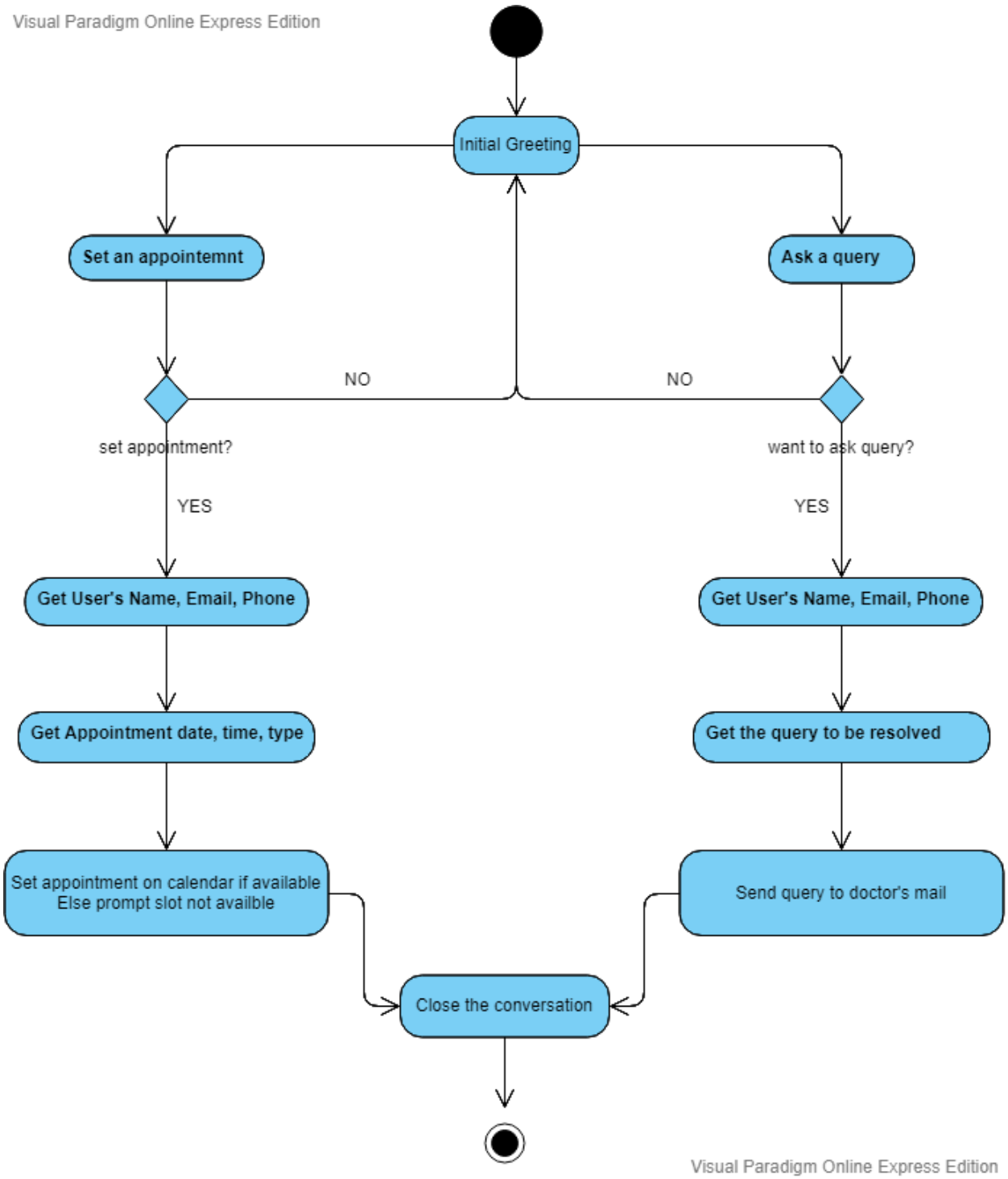

Figure 3: Activity Diagram

5.3.4. Sequence Diagram

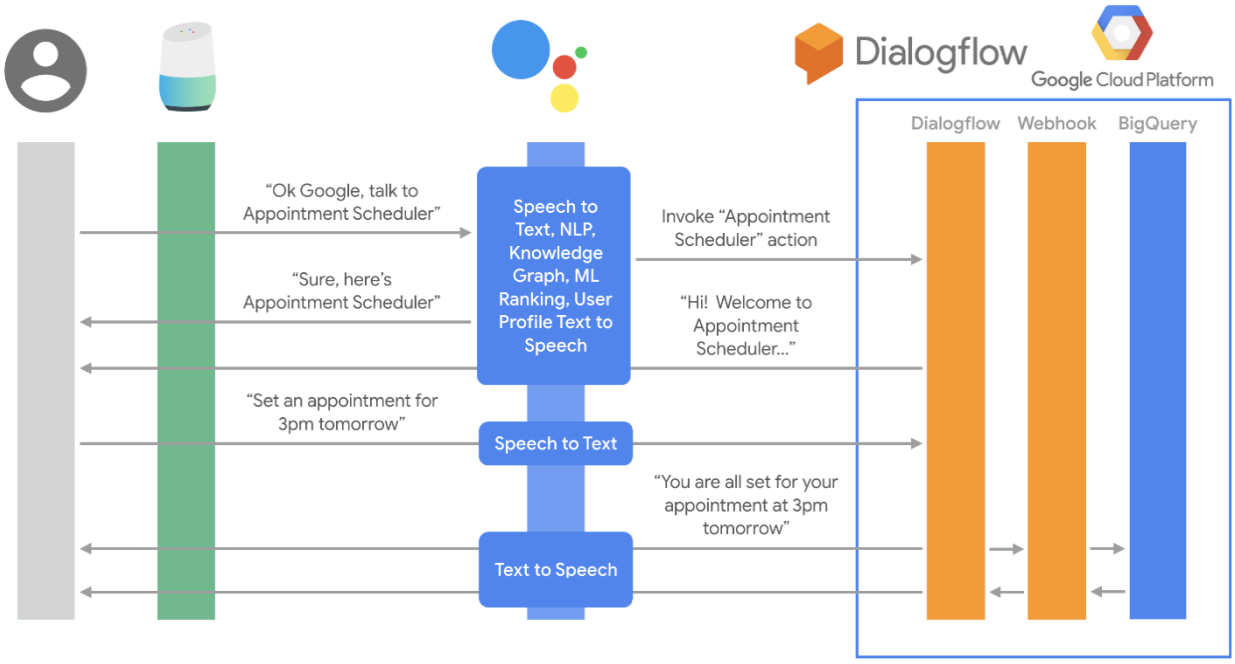

Figure 4: Sequence Diagram

https://medium.com/google-cloud/deconstructing-chatbots-how-to-integrate-dialogflow-bigquery

5.3.5. Data Architecture

BigQuery database is being created which keeps on updating using webhook fulfillment.

Database name: Appointment_Info

Table name: A_I

Schema has the following fields:

1. Appointment Date: Type "String"

2. Appointment Time: Type "String"

3. Appointment Type: Type "String"

6. USER INTERFACE

6.1. UI Description

The chatbot is being created on Dialogflow which is powered by Google and can be accessed from the web link https://bot.dialogflow.com/4c05cff4-4544-4351-874d-5d3e3eb17c65. The user interface of the website is simple. User can type/speak on their devices through microphone to interact with the chat bot. The chat bot greets you with all the features and functionalities it can perform and assists if the user is not able to type correctly or use the Chabot's functionality. Customer can also use the chatbot through phone by calling on "+14843242649". This feature would allow even non-technical and poor people who don't have access to smartphones to use the chatbot easily just by calling. All requirements of User Centered Design and User Interface are taken by integrations of Google using Google Assistant, Web Demo, Dialogflow Phone Gateway and Twilio.

6.2. UI Mockup

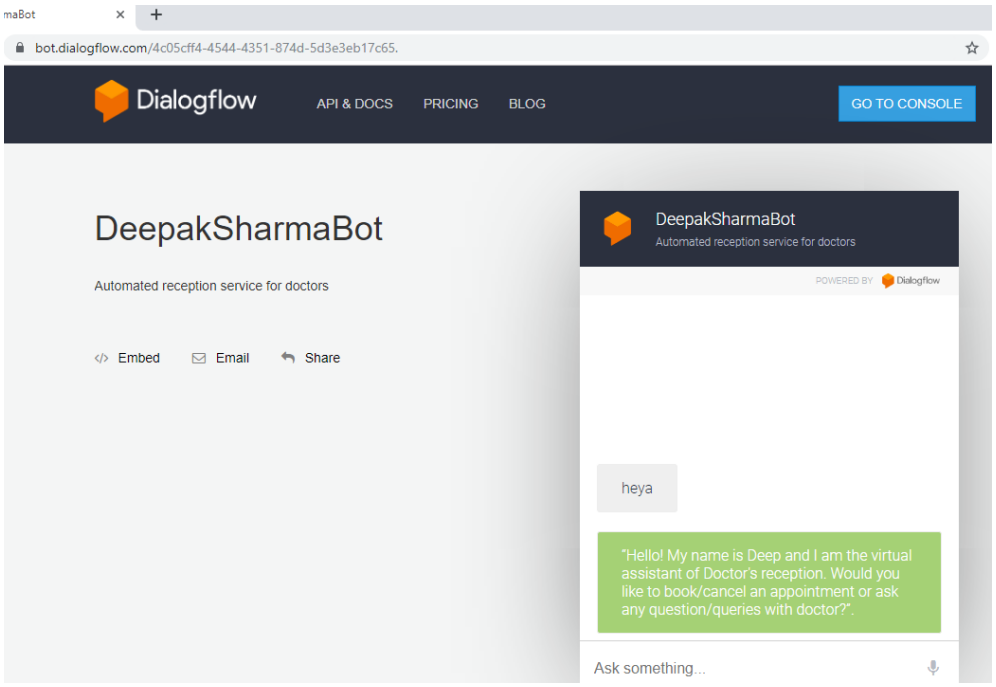

Figure 5: Web demo of chatbot "Dr. Receptionist"

7. ALGORITHMS/PSEUDO CODE

Used NLP & machine learning tools of Dialogflow and Google Cloud Platform to build the chatbot.

Fulfillment webhook call via Node.js and integrations on Twilio API messaging, Skype, Dialogflow Phone Gateway and Web Demo App.

BigQuery and Firebase on GCP for database and maintaining logs respectively.

Intents, follow-up intents, contexts, entities were used to get the desired conversational flow between chatbot and the user.

Following is the conversational flow/ algorithm:

- User tells whether they want to book an appointment or get their query resolved. Chatbot triggers the specified intent and then confirms about the functionality which has been triggered using a follow-up intent.
- When the user approves of it, chatbot asks for essential details such as Name, email-ID, Phone number.
- After that, ask for appointment date, time and type if the intent matches with set Appointment functionality else ask for query to send the doctor if the intent matches with ask query functionality.
- Book appointment or send mail of query according to the triggered intent and intimidate the user with the successful completion of the job.

8. PROJECT CLOSURE

This section elucidates the overall lookup at the project and some of the future works that may enhance the solution.

8.1. Goals / Vision

Office tasks such as booking appointments and responding to queries using NLP and deep learning in automated chat bot is the novelty proposed by my project. This will replace traditional secretaries as the chat bot could automate the process of appointment management and ask the queries directly to the concerned doctors through the software conveniently. Hence, it would be also being bringing in efficiency and customer satisfaction as the whole process gets automated and fast.

The vision behind this project is enabling efficiency, automation of repetitive and trivial tasks, and handling business processes using technology. This will enhance the customer's experience and business processes.

8.2. Delivered Solution

Our solution primarily consisted of allowing users to book appointments & cancel appointments using Google Calendar, asking queries to doctors and respond via email. This was to be done using Dialogflow, integrations with Twilio, Phone Gateway, Skype and Google Assistant. Bigquery and firebase on GCP were to be used for database management and maintaining queries etc.

Book appointments, asking queries features were implemented successfully using Google calendar and NodeMailer integration in the project.

I was not able to implement the cancel appointments feature due to time constraints and busy schedule because of placements.

8.3. Remaining Work

We need to improvise the conversational workflow as it becomes more user friendly and deploy the chatbot on Google Assistant using AOG. Also implement it on amazon Alexa. Also, canceling appointments feature needs to be appended to the chatbot too. Finally, the website based final prototype to be deployed on a functioning domain on the web.

REFERENCES

Dialogflow Documentation: https://cloud.google.com/dialogflow/docs/.

GCP Documentation: https://cloud.google.com/docs/.

Priyanka Vergadia, Google chatbot Developer's Github: https://github.com/priyankavergadia.

**********END**********