

# HealthmateBot

Satyasai Mandlem

*Department of Data Science*

*University of Maryland, Baltimore County*

Baltimore, MD, US

{satyasm1}@umbc.edu

**Abstract**—A revolutionary amalgamation of technology and healthcare, emerged in response to the burgeoning demand for immediate, reliable health guidance. Designed to address limitations in accessing healthcare professionals, this interactive chatbot offers tailored health summaries, physician department recommendations, and specialized hospital services. Its inception involved meticulous data compilation from reputable sources like MedlinePlus and CMS Provider Data, coupled with advanced NLP techniques, resulting in a user-friendly interface within Dialogflow. Challenges, from ensuring data accuracy to sustaining user engagement, prompted insights emphasizing comprehensive data gathering and user privacy. Looking forward, HealthmateBot’s trajectory promises continuous expansion, including updates, personalized experiences, language support, and explorations into telemedicine integration, solidifying its role as a dynamic healthcare resource.

## I. INTRODUCTION

A new era in healthcare has emerged in recent years as a result of the convergence of technology and healthcare, with ground-breaking technologies like chatbot changing the face of patient care. Chatbots are becoming more and more popular in the healthcare industry. Intelligent virtual assistants called chatbots, like Molly, Florence, and Ada, have become popular. Their purpose is to provide prompt and trustworthy health advice. The creation of these sophisticated conversational agents has been fueled by the need for easily accessible healthcare resources and the difficulties in facilitating patient-provider connections [1].

### A. The Rise of Chatbots in Healthcare

With their interactive interfaces, chatbots offer users individualized health information, professional advice, and support. They are a groundbreaking fusion of technology and healthcare. These clever algorithms use artificial intelligence or simple principles to function through text messages, apps, or instant messaging. Chatbots are made to expedite medical procedures and provide patients and doctors with on-the-spot support [1].

### B. Roles of Chatbots in Clinical Settings

Chatbots present a potential remedy for the problems that come with electronic health records (EHRs) for practitioners. Research Fellow Liliana Laranjo of Macquarie University’s Centre for Health Informatics highlights how conversational interfaces that make use

of artificial intelligence, natural language processing, and speech recognition can reduce the workload associated with manual documentation. Thanks to these developments, physicians may now automatically record parts of spoken clinical encounters, which lowers burnout and boosts productivity [1].

### C. Patient-Centric Chatbot Applications

Chatbots are essential in patient-centered applications as well as in therapeutic settings. They take on the role of virtual assistants, assisting patients with things like scheduling appointments, finding out about medication interactions, and even diagnosing symptoms. Businesses like Babylon Health and Kore.ai, which help patients get in touch with the right people, renew prescriptions, and get useful health information, are prime examples of the various ways chatbots are being used in the healthcare industry [1].

chatbot stores data in a database, aiding in identifying sentence keywords and making query decisions for user inquiries. The system employs ranking and language similarity algorithms like n-gram, TFIDF, and cosine similarity to enhance response accuracy. Each sentence’s score is determined based on its resemblance to the input text, resulting in the retrieval of more relevant phrases for the given query. To ensure comprehensive coverage, a third-party expert program takes responsibility for delivering knowledgeable answers to unclear or unlisted database questions [2].

## II. RELATED WORK

In reviewing related work, insights from multiple papers contribute to the development of healthcare-focused chatbots. A study on Chatbot for Healthcare System Using Artificial Intelligence emphasizes the role of a database-stored chatbot in identifying sentence keywords, employing ranking and language similarity algorithms for accurate responses, and integrating a third-party expert program for comprehensive coverage [2]. AI Chatbot Technology in disease prediction, utilizing machine learning for enhanced detection speed and accuracy, with continuous research aimed at transformative impacts on healthcare delivery [3]. An E-Health Bot to Change the Face of Medicare highlights chatbots’ ability to assess user queries using real data,

although human intervention is crucial for configuration [4]. Conversational Artificial Intelligence utilizes Dialogflow for its natural language understanding, ease of integration, and language flexibility, aligning with the goal of post-COVID-19 tele-health support [5]. Each paper contributes unique perspectives to the evolving landscape of healthcare chatbot development, providing a foundation for the proposed bot.

### III. METHODOLOGY

We developed HealthmateBot, a consumer health information chatbot using Google's DialogFlow framework to assist users in communicating and receiving answers to their health-related queries in natural language. HealthmateBot can automatically respond to users' queries by searching for answers in its knowledge base and generating text responses. Additionally, it is equipped to handle speech input and provide a spoken response when users click an audio icon to activate speech output. The chatbot is accessible through its dedicated website: <https://sites.google.com/view/chatbot-healthmate/home>. This overview sets the stage for the detailed methodology section, where we delve into the processes of data collection, architecture design, training procedures, and ethical considerations, providing a comprehensive understanding of the development and functionality of HealthmateBot.

#### A. Summary of Data Collection Process

The data collection process for HealthmateBot adopted a comprehensive and iterative approach, ensuring the richness and accuracy of the information incorporated into the chatbot. The following summarizes the key steps involved:

- **Initial Data Extraction from MedlinePlus XML** The foundational health-related data for HealthmateBot was extracted from MedlinePlus XML. This primary dataset served as a starting point, encompassing a broad range of health information [6].
- **Integration of Physician Department Details** To enhance the depth of the dataset, we incorporated physician department details. This additional layer of information was obtained by scraping body part associations for various medical conditions, providing users with precise recommendations from relevant medical specialists [6].
- **Augmentation with Nearby Hospital Information** from CMS Data Ensuring alignment with specific medical specialists and offering users insights into nearby hospitals, we augmented our dataset by integrating information sourced from CMS data in Maryland. This step facilitated the alignment of HealthmateBot's recommendations with local healthcare resources [7].
- **Iterative Refinement Cycles** To validate and enhance the accuracy and relevance of the dataset, iterative

refinement cycles were conducted. These cycles involved thorough scrutiny of the data, addressing inconsistencies, and fine-tuning the information to meet the highest standards of reliability.

- **Culmination of the Dataset** The culminated dataset, refined through multiple stages, forms the bedrock for HealthmateBot's development. This robust dataset empowers the chatbot to provide users with concise health summaries, precise physician recommendations, and accurate insights into nearby hospitals. HealthmateBot, as a result, emerges as an accessible and reliable healthcare resource, delivering valuable information tailored to individual user needs.

#### B. System Architecture

HealthmateBot utilizes Dialogflow as its foundation due to its robust natural language understanding and easy integration. The platform's intuitive interface enables swift chatbot design, training, and deployment, supporting multiple languages for a user-friendly healthcare resource [8].

- **Intent-based Architecture:** Implemented within Dialogflow, HealthmateBot's intent-based design ensures precise responses to user queries. Intents like 'SummaryOfHealthCondition,' 'ProvidePhysician,' and 'NearbyHospitals' cater to specific needs, delivering concise health information, retrieving physician details, and locating specialized hospitals [8].
- **Intent Handling and Error Management:** A robust error-handling mechanism is integrated, utilizing the fallback intent 'Default Fallback Intent' for scenarios where user queries may not match predefined intents. This ensures a smooth interaction, providing guidance and maintaining helpful communication even with unforeseen queries or language variations [8].

This intent-based architecture in Dialogflow empowers HealthmateBot to be responsive and user-centric, proficient in understanding diverse queries and delivering accurate health information [8].

#### C. Integration with Google Sites

HealthmateBot seamlessly integrates with Google Sites, utilizing DialogFlow's versatile features. Leveraging DialogFlow's drag-and-drop website builder, we crafted a dedicated homepage for HealthmateBot. The client library, available in multiple programming languages, particularly JavaScript using the @google-cloud/dialogflow package, facilitated smooth integration [9].

DialogFlow's one-click integration feature played a pivotal role in embedding HealthmateBot onto our Google site. By providing a URL, we effortlessly integrated the chatbot, extending our mission to enhance

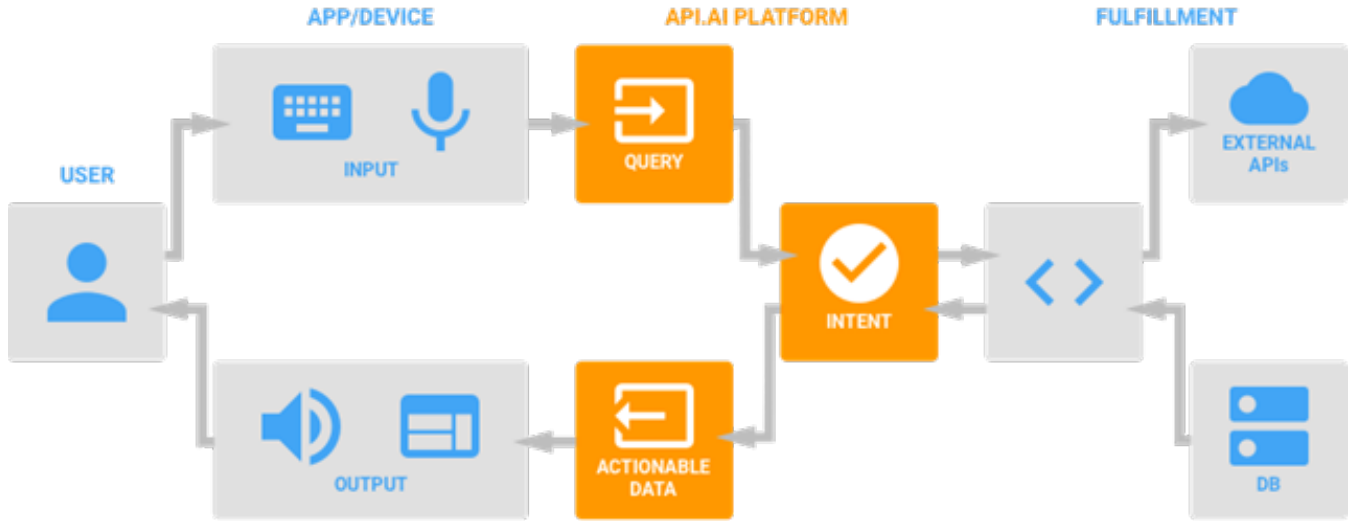


Fig. 1: Dialogflow Architecture [8]

accessibility to reliable healthcare information. This deployment on Google Sites serves as a natural extension, offering visitors an interactive and immediate health resource within the familiar Google interface [9] [8].

The integration allows users to access HealthmateBot’s capabilities seamlessly without navigating away from the site. This strategic deployment not only amplifies the reach of our healthcare companion but also aligns with our commitment to providing accessible, trustworthy health insights to a broader audience. The familiar interface of our Google site ensures a streamlined and convenient experience for users [9] [8].

#### D. Testing and Refinement

As part of our development process, a robust error-handling mechanism was integrated into the intents to enhance the overall user experience. The team conducted thorough testing directly on the HealthmateBot site, gathering valuable feedback to refine the logic and optimize performance.

In instances where user queries might not align with specific intents, the ‘Default Fallback Intent’ played a crucial role. This safety net ensured that even when users’ input didn’t precisely match predefined intents, HealthmateBot could provide guidance or rephrase requests. This approach guarantees a smooth interaction, particularly in scenarios involving unforeseen health information queries or variations in terminology.

The iterative testing and refinement process allowed us to address potential issues, improve the chatbot’s responsiveness, and enhance its ability to handle diverse user inputs effectively. By actively seeking and incorporating user feedback, we aimed to create a more reliable and user-friendly healthcare resource in HealthmateBot.

#### E. Exploration of Chatbot Development Platforms

In our project, we delved into the potential of utilizing a chatbot to address consumers’ health-related questions. Our exploration involved experimenting with diverse technologies, showcasing the evolution of chatbot development over the past decade. Ranging from JavaScript-based chatbots to those leveraging generative AI, we sought to understand the intricacies of each technology.

Among the platforms examined, Dialogflow emerged as a standout choice for several reasons. Boasting a user-friendly development interface, dataset-driven functionality, support for non-automated voice interactions, and seamless integration via Google Sites, Dialogflow simplified the development process by alleviating the complexities associated with scripts and coding errors. OpenAI, while also introducing a user-friendly interface recently, limits users to one free assistant. Both platforms offer analytics features, facilitating the monitoring and evaluation of chatbots’ usage and performance to identify areas for improvement.

The challenge of hosting and model costs loomed over all the chatbots developed, especially concerning their availability at any given time. Utilizing a large dataset with a Dialogflow-supported chatbot necessitated a subscription with SheetDB, a service converting data into a JSON API. In contrast, OpenAI-supported chatbots did not require additional subscriptions for processing large datasets. However, response time became an issue, which saw improvement by selecting a higher-tier OpenAI model. Fine-tuning the model for accuracy, though effective, incurred additional costs in its implementation. After comprehensive exploration and evaluation, we chose HealthmateBot, powered by Dialogflow, as the optimal solution for its 24/7 availability and user-friendly attributes, aligning perfectly with our project goals.

TABLE I: Chatbots Comparison for Proposed Work

Chatbot Name	Creator	Tech	Cost	Data Storage	Type	Output/Speech
HealthmateBot	Satya	DialogFlow/InlineEditor	Host. Costs	SheetDB	Rule-based	KB Answers, Speech
Medhealthbot	Srinivas Varshitha	DialogFlow/Webhook	Host. Costs	Fast APT	Rule-based	KB Answers, Speech
First Aid Scout	Lidia	OpenAI/GPT-3.5	Free	Github	Generative	KB, Speech (Input only)
Gesundi	Lidia	OpenAI/GPT-3.5	Token Cost	OpenAI	Generative	KB answers, Model
Nursebot	Lidia	JavaScript	Free	Personal site	Rule-based	KB answers
Emergencybot	Balaji	TensorFlow	Free	Document	Rule-based	KB answers
Geo Loc Bot1	Balaji	Google Api	API Costs	Google maps	Rule-based	Distance, Travel Time
Geo Loc Bot2	Balaji	Open geoloc Api	Free	Document	Rule-based	Distance, Travel Time

#### IV. RESULTS

HealthmateBot, our innovative healthcare chatbot, emerges as a user-centric and versatile solution for addressing health-related queries. Developed using Google's DialogFlow framework, the chatbot seamlessly communicates with users, providing automated and precise responses to their health inquiries. Its capabilities include generating concise health summaries as shown in Fig. 2 tailored to specific concerns, guiding users to the appropriate physician departments based on health issues as shown in Fig. 3, and assisting in locating nearby hospitals with specialized services as shown in Fig. ?? . For example, when a user seeks information on fever, HealthmateBot delivers a succinct summary, defining a fever as a body temperature higher than normal. Furthermore, it excels in recommending relevant physician departments, like endocrinology for diabetes treatment, and locates nearby hospitals based on user queries, offering detailed information about medical specialists and their services. HealthmateBot's user-friendly nature, language flexibility, and 24/7 availability make it an invaluable healthcare resource, providing immediate and reliable insights to users.

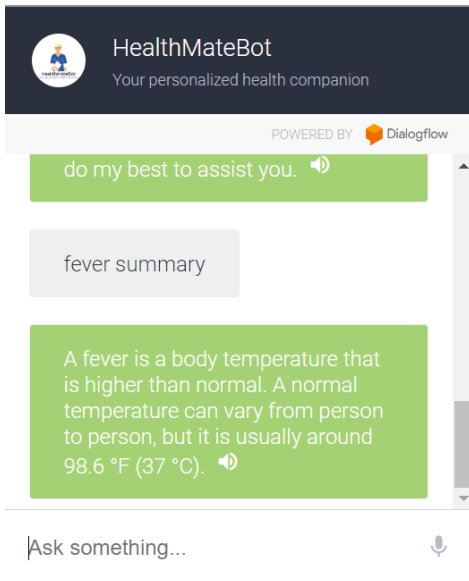


Fig. 2: Medical Condition Summary

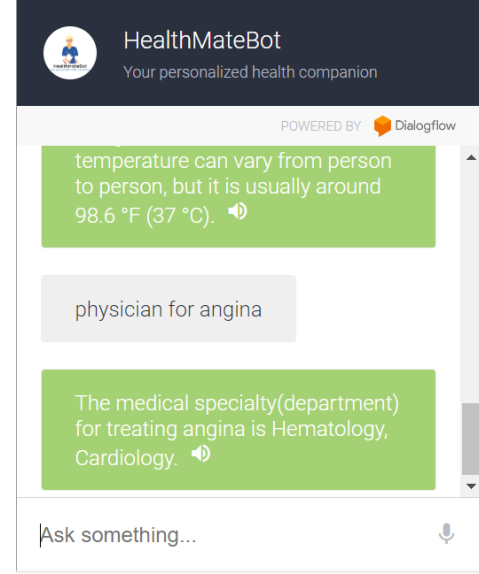


Fig. 3: Relevant Physician Departments

#### V. CONCLUSION

Our journey in developing HealthmateBot encountered a pivotal challenge when our initial vision of a symptom checker, leveraging user-provided symptoms for diagnoses, faced insurmountable complexities surrounding healthcare data sensitivity. Swiftly adapting to this roadblock, we pivoted to HealthmateBot, an existing platform that not only addressed our data access concerns but also offered expanded features crucial for our objectives. With voice input and output, round-the-clock availability, and a user-friendly interface, HealthmateBot became the cornerstone of our project, symbolizing our ability to turn challenges into opportunities for innovation.

In conclusion, our project not only exemplifies the dynamic nature of technology in healthcare but also underscores the delicate balance needed between technological aspirations and ethical considerations. Overcoming challenges and embracing HealthmateBot's capabilities, we propel ourselves into a future where healthcare technology continues to evolve, fueled by resilience and the commitment to delivering accessible and reliable healthcare solutions. HealthmateBot, born out of chal-

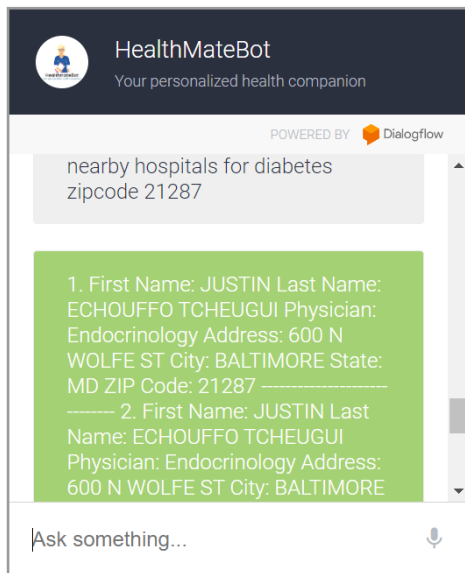


Fig. 4: Nearby Hospitals

lenges, stands as a testament to our perseverance and ingenuity in advancing the intersection of technology and healthcare.

#### SCOPE

Furthermore, we aspire to acknowledge the evolving landscape of healthcare policies, particularly in our efforts to incorporate hospital price transparency. By integrating hospital prices from nearby locations, we aim to enhance HealthmateBot's scope, providing users with a comprehensive understanding of healthcare costs and furthering the initiative for transparent and accessible healthcare information.

#### REFERENCES

- [1] M. I. U. Uddin, A. Hassan, and A. E. Saddik, "Deep learning-based social human-object interaction recognition using 3d skeletal information," *IEEE Transactions on Multimedia*, vol. 21, no. 11, pp. 2909–2921, 2019.
- [2] L. Athota, V. K. Shukla, N. Pandey, and A. Rana, "Chatbot for healthcare system using artificial intelligence," in *2020 8th International Conference on Reliability, Infocom Technologies and Optimization (Trends and Future Directions) (ICRITO)*, Noida, India, 2020, pp. 619–622.
- [3] V. Velasco, K. D. Setiawan, R. R. Sanjaya, M. S. Anggreainy, and A. Kurniawan, "Ai chatbot technology to predict disease: A systematic literature review," in *2023 4th International Conference on Artificial Intelligence and Data Sciences (AiDAS)*, IPOH, Malaysia, 2023, pp. 97–101.
- [4] T. Tanmay, A. Bhardwaj, and S. Sharma, "E-health bot to change the face of medicare," in *2020 Research, Innovation, Knowledge Management and Technology Application for Business Sustainability (INBUISH)*, Greater Noida, India, 2020, pp. 49–54.
- [5] U. Bharti, D. Bajaj, H. Batra, S. Lalit, and A. Gangwani, "Medbot: Conversational artificial intelligence powered chatbot for delivering tele-health after covid-19," in *2020 5th International Conference on Communication and Electronics Systems (ICCES)*, Coimbatore, India, 2020, pp. 870–875.
- [6] "Medlineplus," <https://medlineplus.gov/xml.html>, accessed: September 20, 2023.

- [7] "Centers for medicare medicaid services dataset," <https://data.cms.gov/provider-data/dataset/mj5m-pzi6>, accessed: Insert Access Date Here.
- [8] A. if available, "Google dialogflow agent architecture," [https://www.researchgate.net/figure/Google-Dialogflow-Agent-architecture\\_fig1\\_326922722](https://www.researchgate.net/figure/Google-Dialogflow-Agent-architecture_fig1_326922722), accessed: December 1, 2023.
- [9] "Google sites help center," <https://support.google.com/sites/answer/6372878?hl=en>, accessed: Insert Access Date Here.