

# Customer Service Chatbot With ML

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## Abstract

In the modern business landscape, customer support plays a critical role in shaping customer experiences and building brand loyalty. With the growing demand for instant responses and 24/7 availability, organizations are increasingly exploring artificial intelligence (AI) solutions to enhance the efficiency and effectiveness of their customer service operations. This work aims to design and develop an intelligent customer support chatbot that leverages machine learning (ML) and natural language processing (NLP) techniques to deliver automated, yet personalized, customer assistance. The core objective is to build a machine learning-based chatbot capable of understanding and responding to a wide array of customer queries in real-time. Traditional customer service models often require significant human resources, leading to high operational costs and long response times. By integrating an AI powered chatbot into the customer support process, businesses can streamline operations, reduce response time, and provide customers with timely, accurate information.

## Keywords:

- Natural Language Understanding (NLU):  
The chatbot uses NLTK and Speech recognition to process and understand the user's input in natural language. It can identify the intent and extract key details from user queries to provide relevant responses[6].
- Integration in Flask Backend  
Flask supports the light-weight fast backend with requests that routes those to the correct machine learning model. It manages all the interactions with the users by processing inputs and passing on[4].
- Model Training of Machine Learning Model:

The OpenAI models are trained on labelled data for the improvement in recognizing intents of the chatbot. user and giving suitable responses of the model keeps learning and evolving as it processes new data of the users[3].

- Real-Time Error Handling:  
The system handles errors such as unrecognized queries or technical issues efficiently. It logs errors and provides feedback to the user, ensuring a smooth experience[2].
- Sentiment Analysis:  
Based on NLTK, it analysis the sentiment of all user inputs to establish possible emotions such as frustration and satisfaction. This will provide the chatbot with means to respond in addition to adjusting its tone[4].

## I. Introduction

With major evolution in the artificial intelligence field, human beings are getting closer towards building a society in which machines will be responsible for solving complex issues. Recent years have seen an increased development and usage of Chatbots for aiding communication. A chatbot can be described as a computer software that uses NLP system that interacts or communicates with humans to full fill their needs [1]. The integration of machine learning with customer support chatbots is indeed a great advancement in terms of how businesses address customers' inquiries and enhance service efficiency. ML-based chatbots are a dynamic alternative compared to traditional rule based systems through the use of advanced algorithms that analyze and understand human language through Natural Language Processing (NLP). Thus, these chatbots can recognize customer queries, identify their intent, and provide answers in real-time, all of which are accurate and

context-aware responses that enhance the overall customer experience[2]. By automating routine inquiries and enabling 24/7 support, they reduce response times and operational costs while ensuring seamless assistance during peak periods. Furthermore, machine learning models continuously improve by learning from past interactions, enabling chatbots to handle increasingly complex and varied queries with precision. Despite these advantages, deploying ML-powered chatbots has been a challenge in terms of the modern digital businesses are always keen to meet customer expectations of getting quick, personalized, and seamless interaction. Using NLP and ML, customer service chatbots have emerged as the solution[1]. This paper intends to study how the revolution in chatbots reduces costs, improves efficiency, and enhances customer satisfaction in customer service.

## II. Proposed System

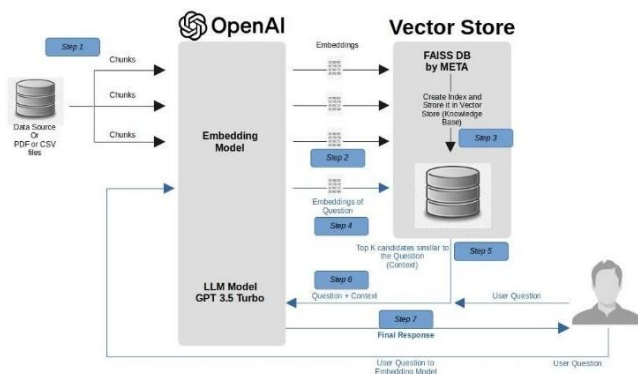


Fig-1 Work-Flow Prototype[3]

### High level Approach

The approach in the diagram above has 7 main steps. Below is the brief on each step and we will talk more on each steps in coming sections. What we are about to read is a multi step approach which has many components so to keep the learning simple and structured, dividing this writing in 2 milestones. Milestone 1 deals with the creation of index (step 1, step 2 and step 3)[5]. Milestone will cover rest of the steps.

#### Milestone 1:

- Access Data: Access to the database where the queries/tickets with resolutions are stored. To keep it simple, in our case some product specific(Insurance Plans) general queries and answers are stored in a csv files. Data can be stored in the database tables or in the form of PDFs or any other client specific format.
- Generate Embedding (Masterdata): Pair of each

question and answer is passed to the OpenAI embedding model (text-embedding-ada-002) for the creation of embedding.

- Create Index: Embedding are converted to Indexes with Vector library like FAISS. There are many methods available in the document but we will utilise Index Flat IP method for index creation. Check the document here for more details.

#### Milestone 2:

- Generate Embedding(Question): Convert the user question into Embedding with the same OpenAI embedding model (text-embedding-ada-002)[3].
- Generate Context: Do the similarity search with FAISS index (generated from the embedding of the input file) and extract the top K similar question and answers from the database which are similar to the user question. This context will be passed to the OpenAI api along with the user question. LLM will be instructed to answer the user question inline with the context instead of the random response.
- Hit OpenAI API for response: Save the search result in the above step as the context and pass it to the OpenAI gpt-3.5-turbo or gpt-4 model for more relevant response.
- Display the result on UI: Display the LLM response in the front end. Old conversations will also be stored in the UI(same as ChatGPT)

## III. Project Structure

This, in our system, consists of an intelligent chatbot that is designed to operate on customer queries efficiently and accurately using NLP techniques and ML. The overall architecture of the chatbot is modular to ensure strong robustness, scalability, and ease of use in the system. The developed system is based on streamlit server and OpenAI, LLMs for user input processing and understanding. Below is the detailed breakdown of the architecture and operational flow of the chatbot system

[Fig-2]:

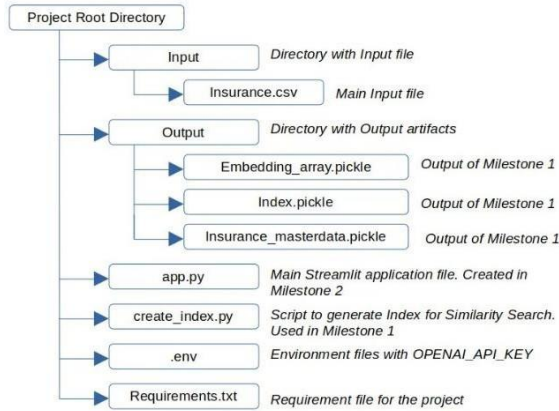


Fig-2 Project Structure.

The modular architecture consists of several components[3]:

#### 1. User Interface: User Interface:

- It captures plain-text user queries in a chatbot interface hosted on the front page. It provides an intuitive interface for seamless interaction with the chatbot.

2. It displays responses from the chatbot to the users clearly and promptly.

#### 3. Input Processing Module:

- It validates user inputs to ensure they are in a format suitable for further processing. Identifies ambiguities in inputs and suggests refinements

#### 4. Code Generation Module:

- Generates contextually relevant and accurate responses using the pre-trained speech recognition.

### IV. Customer Service Applications

- E-commerce**  
They give product-based recommendations, track orders and processing returns.
- Banking**  
They track accounts alert frauds, update transactions
- 3 Healthcare**  
Chatbots book appointments, track symptoms and follow with patients.
- 4 Travel and Hospitality**  
They book, track, and answer queries about travel.

### V. Benefits

- Cost-Effective:**  
Chatbots remove redundancy, thereby decreasing the operational costs.
- 24/7 Operation:**  
Continuous service causes maximum customer satisfaction.
- Scalability:**  
They do multiple interactions at once.
- Personalization:**  
Because the user information is integrated, it becomes much easier to respond accordingly.

### VI. Limitations

- Understanding of Complex Questions:**  
Despite all those developments, the chatbots can't understand the complex or confusing questions. Data Security and Law Compliance like GDPR.
- User frustration:**  
There will be frustration among users since the issue is to be solved with the intervention of humans as capability is not much.

### VII. Case Studies

- Amazon Alexa:**  
Amazon is resorting to AI chatbots that solve the problem of inquiries through customers so that it can get a solution faster.
- HDFC Bank's Eva:**  
Eva is an AI chatbot responding to millions of queries and elevating user engagement in banking.

### VIII. Emerging Trends

- Voice Interaction:**  
Voice-enabled chatbots are highly used for free-hand interactions
- Emotionally Intelligent Chatbots:**  
The system can sense the emotions of users and respond according.

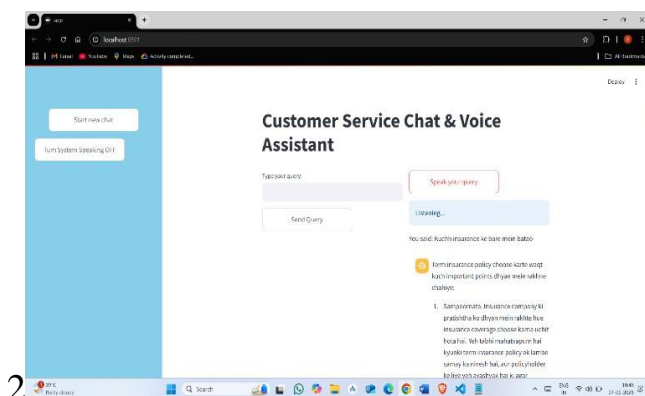
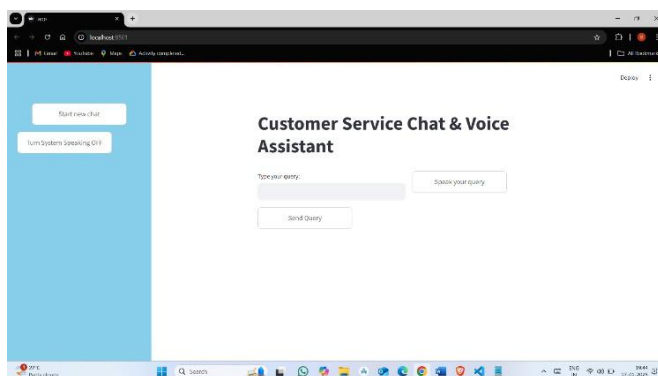
- Integrating with IoT:  
It increases abilities when used along with smart devices.

## IX. Conclusion

Customer service chatbots is one of the fast and effective solution-changing faces of service, and yet it needs to be developed and contemporary; to this effect, the lines that should be followed: technical boundaries, improvements that may take place through enhancements in the experience of the user, and ethical practices. As for AI, it will be an indispensable piece of the approach in order to connect the customer to what it will be moving in[7]. There are numerous benefits to the development of customer support chatbots that are based programmed in in Python, I as solutions. With the aid on ML. and NLP. opposed to traditional rule-based of ML, these chatbots can learn and improve with time, incorporating the insights garnered from every user interaction and

## X. Outputs

### XI.1.



feedback. That gives a very impressive nature to the chatbot as it can handle such a vast range of inquiries with increased accuracy, not to mention even when posed ambiguously, using slangs, or less used phrases. Therefore, customer needs are better taken care of, making the chatbot an invaluable asset for the support system.

NLP techniques are significantly responsible for the effectiveness of interpretation and comprehension by the chatbot in regard to customers intent. Unlike scripts dependent traditional systems, NLP allows the chatbot not only to recognize the keyword but to understand what's going on in the conversation as a whole. This would lead the chatbot into much more meaningful, dynamic, and personalized dialogues with usen.

Consequently, the chatbot can offer more accurate, contextually relevant responses, which elevates the overall customer experience, leading to higher satisfaction levels and fostering greater brand loyalty. Customers feel valued when their inquiries.

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