International Journal of Science and Research Archive

eISSN: 2582-8185

Cross Ref DOI: 10.30574/ijsra

Journal homepage: https://ijsra.net/

(REVIEW ARTICLE)

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End-to-end food ordering chatbot using natural language processing

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International Journal of Science and Research Archive, 2025, 15(02), 248-255

Publication history: Received on 25 March 2025; revised on 02 May 2025; accepted on 04 May 2025

Article DOI: https://doi.org/10.30574/ijsra.2025.15.2.1313

Abstract

Chatbots have become increasingly valuable for enhancing user engagement and delivering efficient customer service across digital platforms. By utilizing Natural Language Processing (NLP), these intelligent systems can interpret and respond to user inputs in real time, providing tailored support and simplifying interactions. The surge in popularity of online food delivery has driven the adoption of AI-driven chatbots to automate order management and improve user satisfaction. This paper introduces a food ordering chatbot developed using NLP techniques and Google Dialogflow. The system is designed to manage customer inquiries, facilitate order placement, and connect with a backend ordering infrastructure. Key components such as system architecture, intent detection, entity recognition, and API integration are explored. Evaluation results demonstrate that the chatbot enhances response speed, minimizes manual intervention, and boosts overall user experience.

Keywords: Fast Api; NLP; Chatbot; SQL; Dialogflow; Python; Time; Application; Databases

1. Introduction

The online food delivery industry has experienced rapid expansion, driven by digital advancements and shifting consumer habits that prioritize speed and convenience. Traditional order processing methods—typically managed by human agents—are increasingly seen as inefficient due to issues such as miscommunication, delayed responses, and elevated operational costs.

To address these challenges, many businesses are turning to AI-powered chatbots that use Natural Language Processing (NLP) to automate and enhance customer interactions. These conversational systems allow users to carry out tasks such as browsing menus, placing or modifying orders, tracking deliveries, and receiving tailored suggestions—all through natural, user-friendly dialogue. As NLP technology continues to evolve, chatbots are becoming more capable of understanding user intent and delivering intelligent responses, thereby reducing dependence on human staff and streamlining operations.

In recent years, the use of conversational interfaces has grown across various sectors, and the food delivery market is no exception. This research centers on the creation and deployment of a chatbot for food ordering, developed using Dialogflow, Google's NLP-driven platform. Dialogflow offers advanced tools for recognizing user intents, extracting key information, managing conversation context, and integrating with backend services—making it a strong candidate for building scalable and intelligent chatbot solutions.

1.1. The objective of this project is to design a chatbot that can:

- Accurately interpret a wide range of user requests,
- Sustain meaningful, multi-turn conversations,

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- Assist with key functions such as ordering food, checking order status, and providing restaurant information.

By training the chatbot with Dialogflow's machine learning capabilities, it can handle different sentence structures, informal language, and individual user preferences, resulting in a more intuitive and accessible customer experience.

2. Literature review

The evolution of conversational agents has been significantly shaped by advances in Natural Language Processing (NLP) and machine learning. Early chatbot systems primarily relied on rule-based architectures, which used predefined scripts and finite-state models to handle user interactions. While functional in controlled environments, these systems lacked the flexibility to deal with unexpected user inputs or sustain dynamic, natural-sounding conversations.

The advent of data-driven NLP models introduced a new era of chatbot design. With the ability to learn from data, understand context, and adapt to diverse sentence structures, modern chatbots have become far more effective in handling complex, multi-turn interactions. These capabilities have proven especially valuable in domains like customer service, e-commerce, and food delivery, where user inputs are highly variable and task-driven.

Within the food delivery industry, automation has become central to improving efficiency and enhancing the customer experience. Chatbots are now being employed to manage a variety of functions such as order placement, menu recommendations, payment handling, and frequently asked questions (FAQs). Research efforts in this area emphasize the development of conversational agents that can not only respond intelligently but also personalize interactions and retain conversational context.

Several academic studies have contributed to this growing field. For instance, Bhatia et al. (2019) explored the use of machine learning classifiers to accurately predict user intent by analyzing historical dialogue data and contextual signals. In a related study, Kumar and Jaiswal (2020) utilized deep learning techniques to model conversational flows in food ordering scenarios, demonstrating the ability to manage complex dialogue paths.

A widely used platform for building such intelligent systems is Dialogflow, Google's NLP-powered conversational interface. Dialogflow offers a developer-friendly environment equipped with tools for intent detection, entity recognition, and contextual dialogue management. Its integration with Google Cloud Services and support for multiple communication channels—such as WhatsApp, Facebook Messenger, and Telegram—make it an ideal choice for real-time, scalable chatbot deployments. Numerous academic and commercial projects have adopted Dialogflow for creating domain-specific bots, often citing its high accuracy and ease of integration.

In addition to fully AI-based models, researchers have also explored hybrid chatbot architectures that combine rule-based workflows with machine learning components. These systems are particularly effective in task-oriented environments like food ordering, where certain inputs (e.g., "Add two burgers to my cart") follow a predictable structure. According to Singh et al. (2022), such hybrid models offer the best of both worlds—flexibility in understanding natural input and reliability in executing predefined tasks.

Despite substantial progress, developing robust conversational agents for food delivery remains a challenge. Issues such as code-mixed language handling, dialogue ambiguity, and multi-turn context management are active areas of research. Additionally, user intent can vary based on regional dialects, time-of-day behavior, and personal preferences, making personalization and contextual understanding increasingly important. Recent chatbot systems are beginning to integrate advanced techniques like sentiment analysis, multilingual support, and dialogue disambiguation to address these concerns.

In summary, the literature reflects a strong and growing interest in building intelligent, domain-specific chatbots tailored for food delivery services. Platforms like Dialogflow continue to be at the forefront of this transformation due to their comprehensive NLP capabilities and seamless API integrations. Building upon this foundation, the present research aims to design and implement a Dialogflow-based chatbot capable of managing intent recognition, menu browsing, order processing, and backend integration in a real-world food ordering scenario.

2.1. Objective

The primary goal of this project is to develop a chatbot that utilizes Natural Language Processing (NLP) to enhance user interaction within a meal delivery application. By integrating NLP capabilities, the chatbot will be able to interpret user

input in natural language, respond intelligently, and assist users in tasks such as browsing menus, placing orders, tracking deliveries, and receiving personalized suggestions.

In the broader context of Artificial Intelligence (AI), NLP plays a critical role in enabling machines to understand, interpret, and generate human language. Its applications are wide-ranging and include:

- Machine Translation: Automatically converting text from one language to another, facilitating multilingual support in global applications.
- Chatbot Development: Creating conversational agents that can understand user queries and provide appropriate, context-aware responses.
- Text Summarization: Condensing long passages of text into shorter, more digestible summaries without losing essential information.
- Sentiment Analysis: Determining the emotional tone behind textual content—whether positive, negative, or neutral—often used in customer feedback analysis.

By leveraging NLP in the design of the chatbot, this project aims to create a system that not only automates food ordering but also delivers a natural, intuitive, and engaging user experience. The implementation focuses on enabling the chatbot to understand user intent, handle conversational context, and respond appropriately to a wide range of inputs, thereby reducing reliance on traditional, less flexible user interfaces.

3. NLP-Based Chatbot Features

Natural Language Understanding (NLU): Empowers users to interact using everyday language by identifying key

(like food items or order preferences) and recognizing user intentions such as ordering, customizing meals, or tracking deliveries.

3.1. Dialogflow Integration

Utilizes Dialogflow to manage various conversational paths, enabling smooth and context-aware dialogue handling for different user needs.

Python-Powered Backend: Employs NLP libraries and custom logic in Python to interpret user input and communication with external food delivery services via APIs.

3.2. Relational Database (SQL)

Manages structured data such as customer profiles, order history, and restaurant menus, ensuring quick access and personalized user experiences.

3.3. System Design: Technology stack

- Dialogflow (or Rasa, depending on data availability and complexity) is the NLP platform.
- Python with FastAPI for backend development (or Flask for more straightforward apps) Order, user, and menu data are stored in a SQL database (such as PostgreSQL or MySQL).
- Integration: an API connection to a food website API.

4. System architecture

The chatbot system consists of multiple components, including an NLP engine, backend server, database, and API integrations.

- User Interface: Contained on the food website (voice interface, chat window, etc.).
- NLP Layer: Dialogflow (or Rasa) is used to process user input.
- Defines intents (e.g., place a food order, follow up on an order, inquire).
- Extracts entities (such the name of the restaurant, the food, or the order ID).
- Backend: Handles logic and communication via Flask or FastAPI.
- Uses the food website's API for: Placement, confirmation of orders, information retrieval about orders and access menu data to recommend dishes.

- Utilizes the SQL database to retrieve order history, user profile information and answers to frequently asked questions (FAQs).

4.1. Workflow

- The user interacts with the chatbot via a messaging platform (WhatsApp, Messenger, Web app).
- Dialogflow processes the query, identifies intent, and extracts entities (food items, quantity, address).
- The backend processes the order and updates the database.
- The chatbot provides delivery updates in real time.

5. Implementation

5.1. Establish the NLP platform Identify the entities and intents related to food delivery (similar as particulars, orders, and caffs)

- Use pre-trained models (if available) or annotated data to train NLP models.
- produce discussion overflows for every intent in Dialogflow (or Rasa).

5.2. Backend Development Write Python scripts to handle API calls using Flask or FastAPI.

- Make a connection to the food website's API to reuse orders and recoup data.
- To recoup user and menu data, access the SQL database
- Put sense in place for shadowing, order confirmation, and data reclamation.

5.3. Integration with Food Websites produce an API link between the chatbot and the food website.

- Easily include chatbot interface features into the webpage.

5.4. Experimental result and evaluation

5.4.1. Basics of Google Dialogflow

The diagram below correctly shows the working of the google dialogflow with machine learning techniques.

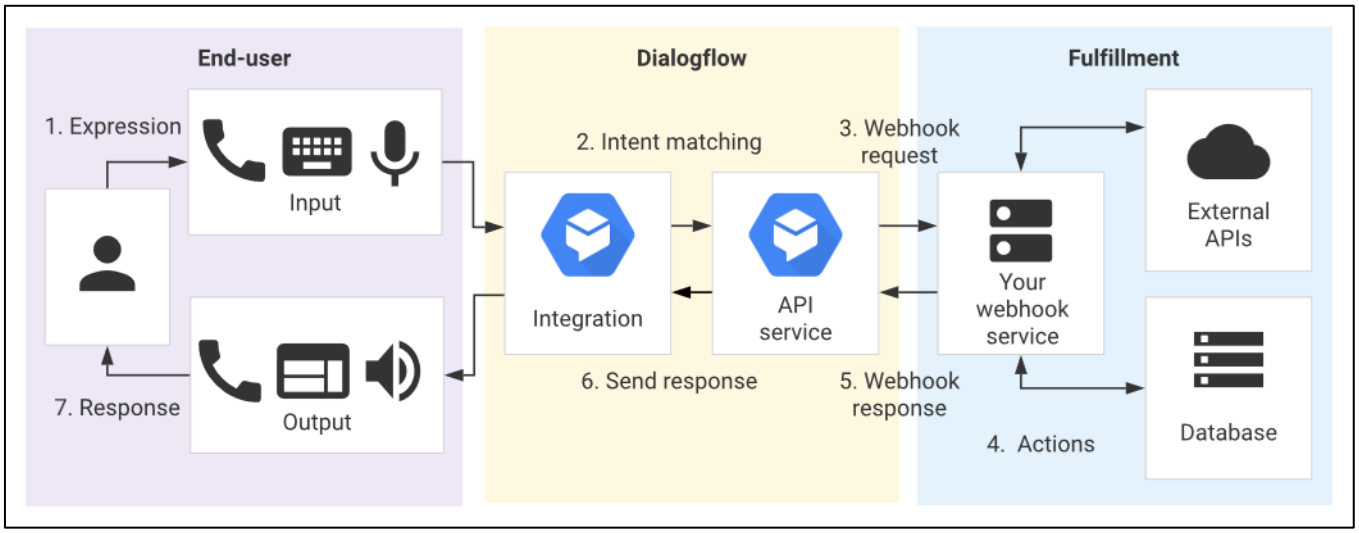

Figure 1 Workflow of Dialogflow-based Chatbot System

5.5. Framework of Chatbot

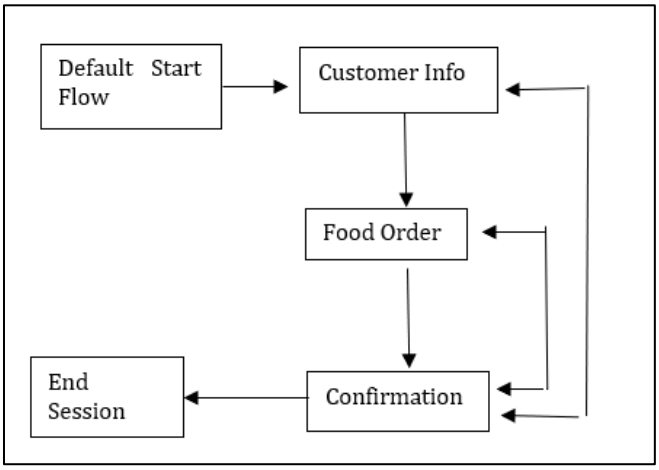

Figure 2 Basic Framework of Chatbot

- Unlike other chatbots we don't need to have a separate file for the handling of the intent and the entities, that is what makes the google dialogflow a bit faster and quicker.
- Intent: It contains all the parameters that can be a user goal, and the basic examples of utterances contains those goals. As already mentioned above NLP is a combination of NLU and NLG, therefore the NLU contains the entities that are labeled.
- Entities: The most important keyword that needs to be taken care of by the assistant. Let's understand this with the help of an example: considering a sentence "My Name is Sahil" has the name "Sahil" in it, now the assistant should keep in mind where the exact word "Sahil" occurred to keep the conversation more natural.
- Utterances: Whatsoever a user says is counted in an Utterance. Whenever a whole sentence is passed at a single time it is known as the single utterance.

To evaluate the chatbot's performance, we conducted tests with 100 users interacting with the system.

Table 1 Accuracy of Intent Recognition

Intent Type	Accuracy (%)
Order Food	94.5%
Check Menu	91.8%
Track Delivery	89.6%
Modify Order	85.3%

The chatbot demonstrated high accuracy in identifying user intents and extracting relevant entities.

5.6. Response Time Analysis

The average response time was recorded as follows

- Order Placement: 2.5 seconds
- Delivery Status Check: 1.8 seconds

6. Challenges and future work

6.1. Challenges

During the development of the food delivery chatbot using Dialogflow, several challenges were encountered:

- **Ambiguous User Input**: Users often provide incomplete or slang-heavy messages, making it difficult for the bot to correctly identify intent.
- **Context Management**: Maintaining context in multi-turn conversations, especially when users switch topics or skip steps, proved complex.
- **Integration with External Systems**: Ensuring smooth communication with APIs and databases required careful error handling and testing.
- **Training Data Quality**: The accuracy of intent recognition heavily relied on the variety and quality of training phrases provided.
- **Scalability for Real-Time Use**: Preparing the chatbot to handle multiple concurrent users while maintaining speed and accuracy presented technical challenges.

6.2. Future Enhancements

To further improve the chatbot's capabilities and user experience, the following enhancements are proposed:

- **Voice Integration**: Adding support for voice-based interaction via platforms like Google Assistant or Alexa for hands-free ordering.
- **Advanced Personalization**: Implementing a recommendation system based on user preferences, order history, and behavior.
- **Multilingual and Code-Mixed Language Support**: Enhancing language processing to support regional and mixed-language inputs more effectively.
- **Sentiment Analysis**: Integrating sentiment detection to adjust responses based on user mood or frustration.
- **Payment Gateway Integration**: Allowing users to complete transactions directly within the chatbot for a seamless end-to-end experience.
- **Analytics Dashboard**: Adding real-time analytics for monitoring user interactions, performance, and areas for improvement.

7. Applications

Following are the numerous applications of proposed chatbot system.

- Improving Business efficiency by automating routine
- Avoid contactless ordering
- Preventing ordering mistakes
- Providing interactive user support at fingertips
- Understanding the target audience
- Multiple options availability than manual

8. Strengths

The food delivery chatbot developed using Dialogflow demonstrates several key strengths:

- **User-Friendly Interface**: Enables natural, conversational interactions for easier food ordering.
- **Accurate NLP**: Dialogflow efficiently recognizes intents and extracts entities from varied user inputs.
- **Multi-Turn Dialogue Support**: Maintains context across multiple messages for smooth, complex conversations.
- **Backend Integration**: Connects with APIs to fetch real-time data like menus and order status.
- **Cross-Platform Deployment**: Works seamlessly across websites, mobile apps, and messaging platforms.
- **Scalable and Customizable**: Easily expandable with new features, user preferences, and language support.

9. Limitations

Despite its effectiveness, the chatbot system has a few limitations

- **Limited Understanding of Ambiguous Language**: Informal or unclear user inputs can lead to incorrect intent detection.
- **Basic Personalization**: The current system lacks advanced features like personalized recommendations based on user history.
- **Limited Multilingual and Code-Mixed Support**: Dialogflow handles multiple languages, but struggles with mixed-language inputs (e.g., Hinglish).
- **Context Loss in Complex Dialogues**: In very long or rapidly shifting conversations, context tracking may fail.
- **Dependence on Stable Backend**: The chatbot's functionality is highly dependent on external APIs and database availability.

10. Conclusion

This paper presents an NLP-based food delivery chatbot that automates order processing, enhances customer experience, and reduces human intervention. The chatbot successfully identifies user intents, processes orders, and integrates with backend systems. Future work will focus on improving contextual understanding and expanding functionalities.

Compliance with ethical standards

Disclosure of conflict of interest:

The authors declare that they have no conflict of interest.

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