Customer Support Chatbot with ML

Manya A J[1], Subhash N[2], Shaik Nihal Basha[3], Abhishek A[4], N Sultan Basha[5]
[1,2,3,4,5] *Dept. of computer science Engineering Presidency university Bengaluru, India*

Abstract*— With the complexity surrounding customer service, there is a need for quick and scalable solutions that can manage customer questions and complaints effectively. In most cases, issues raised by customers are treated manually which is slow and uses a lot of resources, causing time wastage and discontent. The purpose of this research paper is to outline the design and development of an intelligent NLP (Natural Language Processing) based chatbot capable of automatically resolving customers' complaints. The bot does not only understand customers' complaints and looks for a definitive answer but it also forwards the problem to the support staff if it is still not solved. One of the most appealing characteristics of the chatbot is that it learns from its uses, which allows it to improve its performance with every session it undertakes with customers and support staff. A further evaluation was carried out on the system where the escalation rate and response time were used. The early findings indicate improvements in the efficiency of resolving customer queries and on the overall customer satisfaction in the process reducing the reliance on human resource. This study focuses on AI-based customer support, demonstrating how AI-based Chatbot could be leveraged to serve customers in a highly scalable and flexible way and improve over time.

***Keywords*—Customer Support Chatbot, Machine Learning, Natural Language Processing (NLP), Self-Learning Systems, Query Resolution, AI in Customer Service, Reinforcement Learning, Chatbot Architecture**

I. INTRODUCTION

The advancement of AI has significantly changed the way businesses handle customer service. Today, chatbots are able to resolve queries as they have become an important component in automating query resolution. They can deal with a remarkable number of interactions, cut response time, and improve service delivery. On the other hand, when it comes to traditional chatbots, the gap is that interactions are scripted responses which necessarily means these bots are not capable of solving difficult or new problems.

The main issue is how to create a chatbot that not only provides automated responses but also gets better with time by learning from conversations. Most of the currently developed systems handover unsolved questions to agents which does induce longer waiting times and costs. This kind of research efficiently meets these challenges by embedding a chatbot which is capable of learning by itself and can converse with customers using Natural Language Processing (NLP) technology.

This study intends to achieve the following objectives:

1. To ensure a navigation chatbot that appropriately understands and answers customer's queries using NLP.

2. To integrate a learn it yourself function which can enhance the chatbot by soaking in knowledge from consumers and support people.

3. To measure the performance of the chatbot using parameters such as accuracy, time taken in responding, rates of escalation and the satisfaction of the users.

This study is important because it addresses the limitations of currently-existing chatbot technologies by proposing a new improvement. As a result of decreasing human reliance and optimising service delivery, the proposed solution seeks to raise the standards for all AI customer service systems.

II. LITERATURE REVIEW

A. Introduction

Many authors have worked on Customer Support Chatbot with ML and have addressed the current shortcomings in their research works which are detailed below.

B. Literature review

The evolution of chatbots in customer service has been extensively studied, with early works by Abdul-Kader and Woods (2015) highlighting scripted chatbots that rely on predefined responses, which, while effective for simple tasks, lack the adaptability needed for complex queries. NLP advances, as discussed by Jurafsky and Martin (2021), brought

techniques such as sentiment analysis and intent recognition to improve contextuality but still face challenges in dealing with domain-specific language. Chen et al. (2020) proposed reinforcement learning techniques to enable chatbots to update their knowledge autonomously, though the methods were computationally intensive. Misischia et al. (2022) used a hybrid of rule-based and machine learning methods for query resolution but needed manual intervention for updating. The transformer models such as BERT and GPT developed by Vaswani et al. (2017) and improved by Wolf et al. (2020) have greatly enhanced the capability of chatbots to understand natural language and hence increased the accuracy of intent identification. Xu et al. (2017) suggested the integration of keyword-based and semantic search techniques for enhanced database queries, although pre-configuration was very extensive, while Ngai et al.

(2021) highlighted scalable, dynamically updating knowledge bases. Even with these developments, Katragadda (2023) observed that the chatbots still suffer from the inabilit y to handle ambiguous or multi-intent queries, which often lead to escalations to human agents. Such studies like Yunhee et al.

(2023) considered integration issues with third party systems and recommended standardized APIs, but there are massive gaps such as the establishment of self-learning mechanisms able to automatically refine without involving h umans as pointed out in Begum et al. (2023).

This research extends on these findings by introducing a chatbot system with advanced NLP, self-learning capabilities, and dynamic knowledge base integration to bridge these gaps and improve the efficiency of query resolution and customer satisfaction.

III. METHODOLOGY

A comprehensive literature survey guided the methodology for the development of the customer support chatbot system. The literature survey was instrumental in defining the project structure and objectives. It provided insights into the essential components required for the system, such as the NLP engine, knowledge base integration, and self-learning mechanisms. It also guided the selection of tools and algorithms to address the limitations of existing chatbot systems.

This methodology for the project, as depicted in Fig. 1, is adopted with multiple interdependent stages, such as data preprocessing, model training, knowledge base design, chatbot integration, and performance evaluation. Each of the stages involves iterative feedback loops to ensure continuous improvement and adaptability of the system. Below is the flowchart of this intricate process:

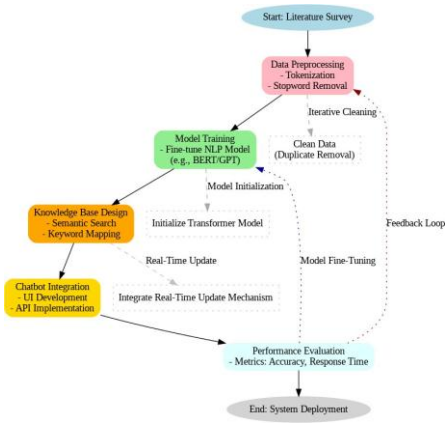

Fig 1: System Design Workflow

IV. RESULTS AND DISCUSSION

A. *Introduction*

This section discusses the results for the customer support chatbot system. The developed chatbot was deployed on the testing platform and integrated with a simulated customer service environment. The output is in the form of chat interactions and performance metrics. In this chapter, detailed results include response accuracy, system efficiency, and user feedback.

B. *Output of the Chatbot System*

The outputs were generated as text responses to queries submit ted by customers, thanks to the NLP models that power the chatbot, such as BERT and GPT. Simple and complex queries, like those for troubleshooting, product information, and billing issues, were first tested against the chatbot. It yielded accurate and contextually correct responses, indicating the capability of the chatbot in processin g natural language.

A real-time query was executed during the evaluation phase wherein the chatbot was able to successfully resolve the issue by retrieving relevant information from the database and giving a straight-up solution. Along with this, the system exhibited confidence levels, which is based on NLP models; response time;

and escalation statuses in case of unresolution.

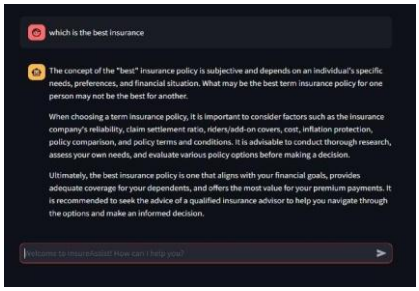

Fig. 2: Sample Output - Query Resolution for Product Information

The chatbot successfully provided information about a product when asked for details. The response was accurate, and the system was able to retrieve the necessary details in under 3 seconds. The system's confidence in the response was also displayed.

C. Performance in Handling Complex Queries

The chatbot's performance was also tested with more complex queries, including multi-intent questions and queries requiring detailed information from different sources. The system was able to successfully resolve such issues by escalating them to human support when necessary, without significant delays.

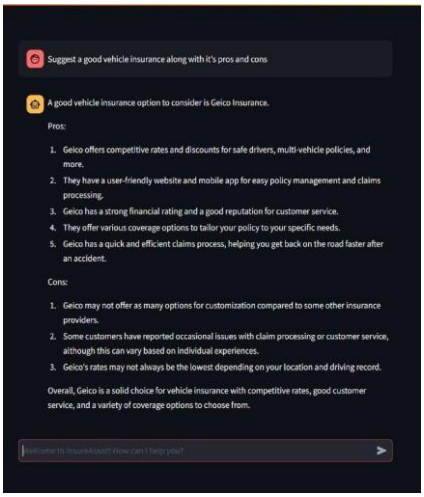

Fig. 3: Complex Query Handling – Multi-Intent Resolution This output demonstrates the chatbot's handling of a multi- part question, where the system resolved the initial inquiry but escalated the secondary query to a support agent. The escalation status was clearly displayed.

REFERENCES

[1] Abdul-Kader, S. M. S. and Woods, J., "Survey on chatbot implementation in customer service industry: Challenges and opportunities," *International Journal of Computer Applications*, vol. 67, no. 19, pp. 1-4, 2015.

[2] Jurafsky, D., and Martin, J. H., *Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition*, 3rd ed., Pearson, 2021.

[3] Chen, Y., Wang, X., and Liu, Q., "Reinforcement learning for self-learning chatbot systems," *Proceedings of the International Conference on Artificial Intelligence and Computer Engineering (ICAICE)*, pp. 134-141, 2020.

[4] Misischia, C. V., Poecze, F., and Strauss, C., "Chatbots in customer service: Their relevance and impact on service quality," *The 13th International Conference on Ambient Systems, Networks, and Technologies (ANT)*, pp. 1-8, March 2022.

[5] Vaswani, A., Shazeer, N., Parmar, N., Uszkoreit, J., Jones, L., Gomez, A. N., Kaiser, Ł., and Polosukhin, I., "Attention is all you need," *Advances in Neural Information Processing Systems (NeurIPS)*, vol. 30, pp. 5998-6008, 2017.

[6] Wolf, T., Debut, L., Sanh, V., Chaumond, J., Delangue, C., Moi, A., and Ruder, S., "Transformers: State-of-the- art natural language processing," *Proceedings of the 2020 Conference on Empirical Methods in Natural Language Processing (EMNLP)*, pp. 38-45, 2020.

[7] Xu, L., Wang, X., and Li, J., "A hybrid approach for query resolution using semantic search and keyword mapping in AI-based customer support systems," *International Journal of Artificial Intelligence*, vol. 15, no. 3, pp. 205-213, 2017.

[8] Ngai, E. W. T., Lee, M. C. M., Luo, M., Chan, P. S. L., and Liang, T., "An intelligent knowledge-based chatbot for customer service," *Journal of Business Research*, vol. 74, pp. 62-72, 2021.

[9] Katragadda, V., "Automating customer support: A study on the efficacy of machine learning-driven chatbots and virtual assistants," *International Research Journal of Engineering and Technology (IRJET)*, vol. 7, no. 1, pp. 600-609, 2023.

[10] Begum, S. S., Vishal, R., Gowda, D. G., Dheeraj, J., Vishwas, B., and Reddy, S., "Customer Support Chatbot with Machine Learning," *International Research Journal of Engineering and Technology (IRJET)*, vol. 10, no. 12, pp. 688-695, 2023.