**Designing an End-to-End NLP Restaurant Chatbot for Streamlined Food Delivery Systems**

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**1. INTRODUCTION**

In a world where technology shapes the way we interact with services, imagine a seamless dialogue with a chatbot that not only takes your food orders but understands your cravings. Welcome to the future of food delivery systems, where we embark on a transformative journey to build a restaurant chatbot from the ground up.

The growth of the mobile app market has made it popular among people who recommend relevant information about restaurants [1]. Eating out consumers use smartphone apps for finding restaurants, making reservations, and getting reviews and how to use them. As a result, the types of restaurants that recommend service apps are increasing, and various contents are being newly added.

In companies or public institutions in various industrial sectors, interactive services are added and functions are being expanded through the website, mobile apps, and SNS services. Interactive service based on artificial intelligence chatbots aims to secure better service competitiveness or internal work competitiveness within the same industry while providing users or customers with various access channels and allowing them to select and use them [2]. Research on information recommendation using user profile analysis, query language extension, collaborative filtering, and similar document clustering techniques has been carried out in many other areas than the restaurant recommendation service [3].

Recent years have seen a considerable breakthrough in chatbot systems, revolutionizing human-machine interactions and enabling seamless communication across multiple areas. They have developed into potent conversational agents that are altering how people engage with technology. As the field of chatbot research continues to evolve rapidly, this paper presents a comprehensive review of recent research papers, aiming to identify and analyze the latest trends, innovations, and proposals in the development and deployment of chatbot systems[4].

These intelligent software applications are designed to simulate human-like conversations and provide automated responses to user queries. By leveraging natural language processing (NLP)[5], machine learning (ML)[6], deep learning (DL)[7], and artificial intelligence (AI)[8] techniques, chatbots offer a range of functionalities across various industries and applications. As a result of advancements in AI and NLP technology, chatbots have evolved from straightforward rule-based systems to more intricate models capable of understanding and creating natural language. By providing immediate responses and customized experiences, they enable seamless and personalized interactions with users. They can manage numerous inquiries at once, lightening the load on human operators and speeding up response times. Additionally, chatbots deliver reliable information, ensuring great customer satisfaction and minimizing errors in everyday activities.

Today the use of chatbots is growing rapidly and are becoming popular in many sectors. A report of Businessinsider says that The rise in the market of chatbot is expected to grow from USD 2.6 billion in 2021 to USD 9.4 billion by the end of 2024, with a high growth rate of approximately 29.7%. According to the Outgrow it is expected that 80% of businesses will use some sort of chatbot automation by 2021[9].

Furthermore, in a context where businesses are compelled to make hard decisions with limited information [10], e-commerce seems to have expanded. The convenience of online purchases (in terms of overall evaluations or transactions) has been shown to enhance customer satisfaction and encourage positive e-WOM (electronic word of mouth) [11]. This is also why many companies have responded to such preferences by increasingly adopting new channels and digital touchpoints with the aim of improving customers’ experience [12]. Artificial Intelligence (AI) is the capability of a machine toreceive data, process it, and perform tasks based on the information extracted from the data received [13].

AI machines react by themselves according to the incoming data, and this reaction is adequate and similar to how a human would react to the same situation. Even the simplest chatbot is an AI machine because when it receives a message, it answers by itself according to the message received. Chatbot design techniques are broad. However, we can separate chatbots into two main types [14]: the deterministic and rule-based model, and the probabilistic and machine learning-based model. Some authors classify the rule-based approach as a non-AI method [15], [16]. However, the techniques applied in the rule-based approach also give AI capability to the chatbot.

For example, the Artificial Intelligence Markup Language (AIML) is one of the tools used in the rule-based approach [16] and as the name implies, it uses AI. Rule-based chatbots work with predefined rules [17]. The developer needs to list all possibilities in advance and the chatbot does not work if the input message differs from the predefined patterns, because the generalization is very limited. The conversation context is only understood if the developer programs it directly and objectively, and it works like a decision tree. On the other hand, machine learning-based chatbots are trained on datasets called knowledge bases [17].

The central challenge addressed in this project is the development of an end-to-end NLP-based restaurant chatbot that seamlessly integrates advanced technologies. The primary focus is on enhancing user interactions, particularly in the context of food ordering and retrieval processes. By leveraging Dialogflow for chatbot configuration and Fastapi for backend server implementation, the goal is to establish a dynamic and efficient conversational interface. Additionally, the integration with a MySQL database empowers the chatbot to proficiently handle order-related tasks. The ultimate objective is to provide users with a comprehensive experience—from engaging in natural language conversations to seamlessly navigating a dedicated food website for order placement and exploring culinary options. This methodology not only contributes to the advancement of NLP-driven chatbots but also offers a practical guide for businesses aiming to elevate their food delivery systems through intelligent and user-centric conversational interfaces.

**2. Related Works**

**2.1 AI Chatbot-Powered Restaurant Recommendation Services for Enhanced User Experience.**

In recent literature, there is a growing emphasis on enhancing the human-likeness of chatbots, evident in various research endeavors. M.J. Kim[1] highlights the transformative impact of AI chatbot-powered restaurant recommendation services, emphasizing the integration of collaborative filtering for tailored suggestions. D’Haro and Banchs[13] address the challenges in conversational agents, emphasizing the lack of annotated datasets for adequacy assessment, a crucial aspect for improving user interaction. Brunette, Flemmer, and Flemmer[8] explore the integration of swarm robots in CBRN decontamination, showcasing the potential of decentralized robots in improving efficiency and safety. Agarwal and Wadhwa[16] provide a comprehensive review of conversational agents, discussing their proliferation and role in simulating near-human intelligence. Sedoc et al.[20] contribute by introducing a unified framework for human evaluation of chatbots, aiming to standardize assessment procedures. These studies collectively contribute to the evolving landscape of chatbots, addressing issues from personalized recommendations to evaluation frameworks, and providing valuable insights for advancing human-like interactions with these AI-driven systems.

These papers have limitations such as potential privacy oversight in AI-powered recommendations, a focus on annotated datasets without addressing real-world conversational variability, scalability challenges in implementing swarm robots for decontamination, a lack of in-depth exploration of ethical considerations in the proliferation of conversational agents, and potential gaps in the proposed unified evaluation framework for chatbots. Acknowledging these limitations is crucial for refining methodologies and guiding future research in the dynamic field of chatbots.

## 2.2 User Experience and Customer Service Chatbots.

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The referenced papers by Negi and Katarya [4] and Nithuna and Laseena [14] lay the groundwork for the integration of novel features and services in the NLP-based restaurant chatbot. Negi and Katarya's work, which extends chatbot utilization for women's empowerment and emphasizes instant services, suggests the potential for incorporating socially impactful features in the restaurant chatbot. This aligns with the evolving expectations of users who seek more than just traditional customer queries.Similarly, Nithuna and Laseena's insight into the limitations of existing chatbots, which often lack versatility in creating authentic dialogues, provides a basis for enhancing the conversational capabilities of the restaurant chatbot. By leveraging AI and NLP algorithms, the restaurant chatbot can efficiently respond to user inquiries and offer more authentic and engaging interactions.Furthermore, the inclusion of references [5] through [9] on natural language processing (NLP) and machine learning trends provides a broader context for understanding the technological landscape. Integrating insights from these references can contribute to the development of a more sophisticated and capable restaurant chatbot that incorporates the latest advancements in NLP, machine learning, and deep learning. This holistic approach will not only address customer queries but also enhance the overall user experience, making the restaurant chatbot more intelligent, versatile, and user-centric.

The limitations of the referenced papers include a lack of specific details on how to adapt socially impactful features to the restaurant chatbot, a need for more concrete examples or case studies demonstrating the proposed enhancements, and a potential gap in addressing the challenges of implementing advanced NLP and machine learning trends in a real-world restaurant chatbot scenario. Clarifying these limitations is essential for refining the proposed methodologies and guiding practical implementations in restaurant chatbot development.

2.3 **Analysis of Customer Service Chatbot**

Dihyat and Hough's study [17] specifically addresses the challenges of rule-based and neural chatbots with limited training data, offering insights into the performance of AIML-based chatbots compared to Seq2Seq models. This research provides a valuable perspective on the trade-offs between task completion rates and ROUGE scores in different chatbot architectures.For restaurant chatbots, understanding the trade-offs between rule-based and neural models is crucial. Depending on the specific requirements of a restaurant chatbot, developers can weigh factors such as task completion rates and language generation capabilities.

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**2.4 Summary and Current Study**

The referenced papers contribute valuable insights to the field of chatbots, covering diverse aspects such as architecture comparison, entity extraction, design principles, cognitive modeling, and evaluation methodologies. Each paper provides a unique perspective, ranging from the comparison of rule-based and neural chatbots to the quantification of differences in entity extraction systems and the importance of cognitive modeling for user experience. Additionally, evaluation tools like ChatEval offer a standardized approach for assessing chatbot performance.

This study presents an innovative approach to develop a fully integrated NLP-based restaurant chatbot, emphasizing the seamless integration of advanced technologies. The process commences with configuring the chatbot using Dialogflow, Google's NLP platform, ensuring adept handling of user queries. Implementation includes a robust backend server in Python and Fastapi, integrated with a MySQL database for enhanced order management. The result is a chatbot seamlessly embedded into a dedicated food website, delivering users a comprehensive experience from natural language interactions to order handling and immersive culinary exploration. This methodology not only advances NLP-driven chatbots but also offers practical guidance for businesses seeking to elevate their food delivery systems through intelligent conversational interface

**REFERENCES**:

[1] M.J. Kim, “The Intention to Provide Personal Information among Location-Based Matjib App Service Users: A Privacy Calculus Perspective”, International Journal of Tourism Management and Sciences (KASTM), Vol. 33, No. 6, pp. 1-21, September 2018. DOI: 10.21719/IJTMS.33.6.1

[2] S.O. Yoon, “Issues of Public Service Using Artificial Intelligence: Focused on Chatbot Service”, Korean Public Management Review, Vol. 32, No. 2, pp. 83-104, June 2018. DOI: 10.24210/kapm.201 8.32.2.004

[3] S.H. Byun, C.H. Cho, “The Effect of the Anthropomorphism Level and Personalization Level on AI Financial Chatbot Recommendation Messages on Customer Response”, The Korean Journal of Advertising and Public Relations (KADPR), Vol. 22, No. 2, pp. 466-502, April 2020. DOI: 10.16914/ kadpr.2020.22.2.466

[4] Rohit Negi, Rahul Katarya, "Emerging Trends in Chatbot Development : A Recent Survey of Design, Development and Deployment", *2023 14th International Conference on Computing Communication and Networking Technologies (ICCCNT)*, pp.1-6, 2023.

[5] P. M. Nadkarni, L. Ohno-Machado, and W. W. Chapman, “Natural language processing: an introduction,” Journal of the American Medical Informatics Association, vol. 18, no. 5, pp. 544–551, Sep. 2011, doi: 10.1136/amiajnl2011-000464.

[6] M. I. Jordan and T. M. Mitchell, “Machine learning: Trends, perspectives, and prospects,” Science, vol. 349, no. 6245, pp. 255–260, 2015, doi: 10.1126/science.aaa8415.

[7] X. Hao, G. Zhang, and S. Ma, “Deep Learning,” International Journal of Semantic Computing, vol. 10, no. 03, pp. 417–439, 2016, doi: 10.1142/S1793351X16500045.

[8] E. S. Brunette, R. C. Flemmer, and C. L. Flemmer, “A review of artificial intelligence,” in 2009 4th International Conference on Autonomous Robots and Agents, Feb. 2009, pp. 385–392. doi: 10.1109/ICARA.2000.4804025.

[9] Mahere, Devashish, et al. "Chatbot Technology and its Impact on Customer Service." *Int. Res. J. Mod. Eng. Technol. Sci.* 3.7 (2021): 75-81.

[10] Ayittey, Foster K., et al. "Economic impacts of Wuhan 2019‐nCoV on China and the world." *Journal of medical virology* 92.5 (2020): 473.

[11] Duarte, Paulo, Susana Costa e Silva, and Margarida Bernardo Ferreira. "How convenient is it? Delivering online shopping convenience to enhance customer satisfaction and encourage e-WOM." *Journal of Retailing and Consumer Services* 44 (2018): 161-169.

[12] Reinartz, Werner, Nico Wiegand, and Monika Imschloss. "The impact of digital transformation on the retailing value chain." *International Journal of Research in Marketing* 36.3 (2019): 350-366.

[13] L. F. D’Haro and R. E. Banchs, ‘‘Learning to predict the adequacy of answers in chat-oriented human agent dialogs,’’ in Proc. IEEE Region 10 Conf. (TENCON), Nov. 2017, pp. 455–460.

[14] S. Nithuna and C. A. Laseena, ‘‘Review on implementation techniques of chatbot,’’ in Proc. Int. Conf. Commun. Signal Process. (ICCSP), Jul. 2020, pp. 157–161.

[15] S. Hussain, O. A. Sianaki, and N. Ababneh, ‘‘A survey on conversational agents/chatbots classification and design techniques,’’ in Proc. Workshops Int. Conf. Adv. Inf. Netw. Appl. Cham, Switzerland: Springer, 2019, pp. 946–956.

[16] R. Agarwal and M. Wadhwa, ‘‘Review of state-of-the-art design techniques for chatbots,’’ Social Netw. Comput. Sci., vol. 1, no. 5, pp. 1–12, Sep. 2020.

[17] M. M. H. Dihyat and J. Hough, ‘‘Can rule-based chatbots outperform neural models without pre-training in small data situations: A preliminary comparison of AIML and Seq2Seq,’’ in Proc. 25th Workshop Semantics Pragmatics Dialogue, 2021, pp. 1–3.

[18] E. Michiels, ‘‘Modelling chatbots with a cognitive system allows for a differentiating user experience,’’ in Proc. PoEM Doctoral Consortium, 2017, pp. 70–78.

[19] L. Derczynski, ‘‘Complementarity, F-score, and NLP evaluation,’’ in Proc. 10th Int. Conf. Lang. Resour. Eval. (LREC), 2016, pp. 261–266.

[20] J. Sedoc, D. Ippolito, A. Kirubarajan, J. Thirani, L. Ungar, and C. Callison-Burch, ‘‘ChatEval: A tool for chatbot evaluation,’’ in Proc. Conf. North Amer. Chapter Assoc. Comput. Linguistics (Demonstrations), 2019, pp. 60–65.