

Project Report - ITCS 5154 - 051

Name: Roberta Watkins

Primary Paper research was based on:

- Authors: Chiara Valentina Misischiaa , Flora Poeczzeb , Christine Straussa.
- Title: "Exploring the Role of Chatbots in Customer Service: Insights and Challenges." *Procedia Computer Science*, vol. 197,
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- pp. 2032-2041. *ScienceDirect*,
- Article Link:
<https://www.sciencedirect.com/science/article/pii/S1877050922004689>.

1. Introduction

1.1 Problem Statement

Traditional chatbots, especially in customer service, feel robotic, rigid, and lead to frustration among users. Despite how commonly they are used, they often fail at handling complex requests or coming across as empathetic to customers, leading to an overall poor experience. Majority of chatbots still rely on static, rule-based systems that can't handle the nuances of natural human conversation, leading users to have to repeat themselves or struggle to find the right menu option. As a result, customer dissatisfaction with chatbot experiences remain remarkably high. Being that the usage of chatbots is only projected to increase in the future, the methods used in this project is to explore ways in which chatbots can naturally understand their users, solve real issues, and escalate properly when needed. By introducing intent detection, context awareness, and a consistent escalation option to get human agents, the goal is to create a chatbot experience that feels familiar to the user, as if they are speaking with a person rather than a machine.

My hope is to not only address the need for more effective customer service interactions but also create a piece of the foundation required for future improvements in AI technology. By equipping chatbots with the ability to understand user intent beyond keyword matching, respond dynamically, and detect when a user is dissatisfied or confused, users will eventually begin to gain more trust in the bot, leading to better

satisfaction rates. A more responsive and human-like chatbot will not only enhance satisfaction but also increase operational efficiency by reducing the volume of unnecessary human interventions.

1.2 Motivation

The motivation of this project stems from the significant gap between chatbot use and customer satisfaction. According to the article “consumer satisfaction with chatbot customer service” written by Kumar, N, while only 25% of customers are satisfied with the current standard for chatbots, businesses will continue to create more, with projected growth to be 80% by 2025. With this, there is a clear demand for smarter, more human-like bots that the public will actually enjoy interacting with. Despite major technological advancements, with bots such as Gemini or ChatGPT, the majority of them still remain quite simple and are missing critical opportunities to build user trust. Customers expect interactions to feel intuitive and unfortunately, this is a quality that has not been observed in workplace chatbots. Improving chatbot design is not only to make them understand and respond with human-like capabilities but to also create positive experiences that align with workplace communication standards. Bridging this gap can lead to improved customer retention, increased operational efficiency, and a significant competitive advantage for businesses that adopt better conversational AI technologies.

1.3 Open Questions in the Domain

- How can chatbots understand complex language instead of rigid keywords?
- How to design escalation systems that don't frustrate users?
- How to make chatbots seem "aware" of past conversations?
- What role does chatbot personality play in user satisfaction?

1.4 Brief Overview of Approach

To begin, I wanted to create a simple, structured chatbot that could focus on a few key capabilities. First, to understand user intent based on the input provided to allow for more natural and intuitive conversations. It would also have to respond appropriately

depending on the detected context, ensuring that replies are both relevant and helpful. Next, the chatbot would have to be able to remember important elements of the conversation, such as the user's name, which adds a layer of personalization to the interaction. Lastly, if confusion persists after several exchanges, the chatbot can escalate the issue to a human agent, not only ensuring that user needs are met but also lessening the amount of frustration overall. To begin, I'd have to program small, simple algorithms that cover these core areas and then iteratively enhance the chatbot with more features as its abilities progressed.

From a programming perspective, I chose to use Python as the development language due to its flexibility and library support for natural language processing. The initial implementation relied on basic string manipulation techniques for intent recognition, such as converting user input to lowercase, checking for the presence of specific keywords, and splitting input text to capture user-provided names. Context is managed using a Python dictionary to dynamically update the conversation as it progresses. This is done to allow the bot to recall relevant user information when generating responses. To handle unknown inputs, a fallback mechanism increments a counter each time the chatbot fails to correctly interpret a user's query and after three consecutive fallback attempts, the system will escalate the conversation to a human agent. In theory, this programming framework should ensure that future expansions, such as adding machine learning-based intent detection or sentiment analysis, can be integrated smoothly.

Key components of the approach:

- Natural Language Understanding: Basic keyword matching to determine user intent.
- Context Memory/Name recall: Store and recall important information like names.
- Dynamic Response Generation: Adapt replies based on recognized intent.
- Escalation Logic: Automatically escalate to a human after multiple failed attempts.
- Modular Programming Structure: Make integration possible for future features like sentiment tracking and advanced NLP (natural language processing) models.

2. Background

2.1 Summary of Other Related Researches (at least 2)

"Chatbot Personality and Customer Satisfaction": This study explores how the personality traits of chatbots affect customer satisfaction. A survey was sent to 60 different businesses across 10 industries in order to understand businesses' preferences on chatbot communication styles..

- de Haan, Hayco. "Chatbot Personality and Customer Satisfaction." *Bachelor Thesis*, Utrecht University, 2018.
<https://research.infosupport.com/wp-content/uploads/Chatbot-Personality-and-Customer-Satisfaction-Bachelor-Thesis-Information-Sciences-Hayco-de-Haan.pdf>

"Exploring the Impact of AI Chatbots on Customer Satisfaction": A quantitative study that collected data from 317 participants through an online survey. It was made to examine factors like usability, responses, perceived trust,, empathy, and a chatbot's influence on customer satisfaction.

- Vu, Hanh T. My, et al. "Exploring the Impact of AI Chatbots on Customer Satisfaction." *International Journal of Creative and Innovative Research in All Studies*, vol. 5, no. 2, 2022, pp. 1-8.
<https://ijciras.com/PublishedPaper/IJCIRAS1885.pdf>

"The Impact of Chatbots on Customer Satisfaction: A Systematic Literature Review": This survey analyzes 34 articles to determine the impact of chatbot technology on customer needs. It found that chatbots are primarily used in Information and Communication Technologies, with textual chatbots being the most commonly used.

- Daza, Alfredo, et al. "The Impact of Chatbots on Customer Satisfaction: A Systematic Literature Review." *TEM Journal*, vol. 12, no. 3, 2023, pp. 1407-1417.
https://www.temjournal.com/content/123/TEMJournalAugust2023_1407_1417.pdf

2.2 Pros and Cons of Our Approach

Pros:

- Easy to build and understand
- Handles natural language better than rigid menu systems
- Can track conversation history (like user's name)

- Escalates automatically after multiple failed attempts

Cons:

- Keyword matching is still basic and cannot deeply understand context without full NLP
- Does not handle voice tone or sentiment unless expanded
- May struggle with very complicated or vague user inputs

2.3 How Related Work Connects to Our Project

The studies that were chosen strongly reinforce the core ideas and design behind the chatbot I aimed to create. Research has shown that chatbot personality matters significantly and that users are more satisfied when interacting with friendly, customized, and relatable bots rather than with ones that feel robotic and rigid. Adding a personality helps to build trust, making users feel more at ease when engaging with automated non-human services.

Another key finding is the importance of empathy and emotional understanding. Studies show that users are more forgiving of minor mistakes if they perceive the chatbot as empathetic and having the ability to understand their emotions. Bots that can acknowledge frustration or excitement create a more engaging user experience compared to the majority of bots we see today.

Surveys also highlight that the most successful chatbots combine automation with customization. Instead of rigid workflows, chatbots that can adapt to the conversation's context and user preferences have a greater rate of delivering responses that feel more natural and human-like. Automation ensures efficiency, while customization ensures satisfaction and relevance.

This chatbot was designed to directly address these key points by implementing responses based on user input, maintaining basic context awareness, and including a fallback system that escalates conversations to a human when needed. Through these features, it'll aim to provide a more personalized and supportive user experience that aligns with the practices outlined in existing research.

3. Methods

3.1 Details of the Algorithms

- **Intent Detection:** The chatbot begins by analyzing the user's input through basic keyword matching. If the input contains specific words such as "refund," "error," "representative," or "name," the chatbot will assign an intent to the conversation. This method enables quick categorization of user queries without relying on NLP models. While simple, this allows the bot to handle common scenarios efficiently.
- **Response Generation:** After the intent is identified, the chatbot selects an appropriate response from a predefined set of replies. For instance, billing-related inquiries prompt questions about the user's billing issue, while technical support queries prompt troubleshooting advice. By mapping intents directly to responses, this ensures fast and relevant interactions.
- **Context Management:** The chatbot will maintain a context dictionary that stores important details, such as the user's name. When a user mentions their name, the chatbot extracts it and saves it for future interactions, enabling a personalization throughout the conversation. This feature helps make the chatbot feel more engaging and reduces the need for users to repeat information.
- **Fallback Tracking:** If the chatbot encounters inputs it cannot categorize accurately, it increments a fallback counter. After three failed attempts to understand the user, the chatbot triggers an escalation protocol to transfer the conversation to a human agent. This mechanism prevents user frustration from repeated misunderstandings and ensures a smooth transition to human support when necessary.

3.2 Overall Framework

User Input → Intent Detection → Context Memory → Response → Escalation if needed

3.3 Data Preprocessing

There was no external data preprocessing. Instead, we processed user text on the fly:

- Convert input to lowercase
- Simple string splitting to extract names
- Keyword checks for intent detection

4. Experiments

4.1 Testing the Method (Main Features)

- Normal use cases (billing question, tech support) → Correct detection and helpful replies.
- Name introduction → Chatbot remembers and uses the user's name.
- Random input → After 3 misunderstandings, the bot escalates to a human.

4.2 Reproducing Results Based on De Haan, Hayco

The results shown below closely align with some of the findings discussed in the paper, "Chatbot Personality and Customer Satisfaction". Provided are explanations of how the chatbot's functionality replicates the findings:

1. Personalized Interaction:

- The bot greets the user with a personalized message, asking for their name at the beginning of the conversation to mirror how a personalized experience can improve user engagement

```
Hello, I can help you. Ask about billing, technical issues, or get a human.  
Bot: Before we start, what's your name?  
You: Ty  
Bot: Good evening, Ty. How can I help you today?  
You: █
```

```
You: how are you doing bot?  
Bot: I'm good, thanks for asking. How about you?  
You: I'm meh  
Bot: Sorry to hear your day is just okay. :|  
You: yeah, my internet isn't working  
Bot: I'm sorry you're having tech issues. Could you describe the problem in more detail?  
You: idk, having internet errors  
Bot: Ok, I'll connect you to Taylor from Tech Support.
```

```
You: im good  
Bot: Good to hear your day is going well. :)  
You: how are you?  
Bot: I'm good, thanks for asking. How about you?  
You: im bad  
Bot: Sorry to hear that. That is unfortunate. :(  
You: █
```

2. Human Escalation Confirmation:

- the bot asks if the user wants to talk to a human if they request it. A confirmation prompt is added, asking if the user is sure they want to speak with a human.

```
Hello, I can help you. Ask about billing, technical issues, or get a human.
Bot: Before we start, what's your name?
You: ty
Bot: Good evening, Ty. How can I help you today?
You: get a human
Bot: Do you want human help now?
You: no, not yet
Bot: Are you sure you want a human?
You: no
Bot: Okay, how else can I help you today?
You: nvmd, human help
Bot: Do you want human help now?
You: yes please
Bot: Are you sure you want a human?
You: yeah
Bot: Okay, connecting you to a human agent now.
You: thanks
Bot: You're welcome. Tod is here to help you. Have a nice day, Ty
```

3. Satisfaction Feedback Collection:

- Using de Haan's recommendations, the bot collects feedback at the end of the interaction. At the end of an interaction, the bot asks the user to rate their satisfaction on a scale of 1 to 5 and whether they prefer interacting with a bot or a human in the future.

```
Bot: I'm sorry you're having a billing issue, Ty. Could you describe the problem in more detail?
You: No
Bot: That's okay. Could you tell me if it's about a wrong amount, a double charge, or something else?
You: No, I want a human
Bot: I'm connecting you to Bill from Billing Support.
You: Okay, thanks.
Bot: You're welcome, Ty! Bill from Billing Support will assist you shortly. Have a great day!

Before you go, could you rate your experience with me?
On a scale from 1 (terrible) to 5 (great): 2
Would you prefer talking to a bot or a human in the future? (bot/human): human
Thanks for your feedback Ty! You rated me a 2/5 and prefer talking to a human.
test@MacBook-Air ~ %
```

- The feedback is saved to a file for later analysis.

4. Intent Detection and Appropriate Responses:

- The bot identifies the user's intent and provides appropriate responses. This ensures the user receives the assistance they need.

```
Bot: I'm sorry you're having a billing issue, Ty. Could you describe the problem in more detail?
You: no
Bot: That's okay. Could you tell me if it's about a wrong amount, a double charge, or something else?
You: a double charged on my card
Bot: Ok, I'll connect you to Bill from Billing Support.
You: thanks
Bot: You're welcome, Ty! Bill from Billing Support will assist you shortly. Have a great day!
```

```
You: refund
Bot: I'm sorry you're having a billing issue, Ty. Could you describe the problem in more detail?
You: no
Bot: No problem. Was it a double charge, a billing error, or something else?
You: double charge on my card
Bot: Ok, I'll connect you to Bill from Billing Support.
You: thanks bot
Bot: You're welcome, Ty! Bill from Billing Support will assist you shortly. Have a great day!

Before you go, could you rate your experience with me?
On a scale from 1 (terrible) to 5 (great): █
```

```
You: internets not working
Bot: I'm sorry you're having tech issues. Could you describe the problem in more detail?
You: no
Bot: Got it. Is this a problem with your internet, your device, or a software bug?
You: internet i think
Bot: Ok, I'll connect you to Taylor from Tech Support.
You: thanks
Bot: You're welcome, Ty! Taylor from Tech Support will assist you shortly. Have a great day!

Before you go, could you rate your experience with me?
On a scale from 1 (terrible) to 5 (great): █
```

5. Fallback Mechanism:

- In case the bot does not understand the user's input, it prompts them to clarify. After several failed attempts, it escalates the issue to a human.

```
Bot: Good evening, Ty. How can I help you today?
You: fjeoiwjf
Bot: Sorry, I don't understand you, Ty. Could you repeat?
You: jfkosijdv
Bot: Sorry, I don't understand you, Ty. Could you repeat?
You: jfioewj
Bot: I'm sorry for the confusion. I'll get you a human.
You: Thanks
Bot: You're welcome. Tod is here to help you. Have a nice day, Ty
You: █
```

How This Relates to Improving Customer Service:

- **Personalized greetings and name usage:** Make the bot appear more human-like, which can increase the likelihood of the user feeling understood.
- **Human escalation with confirmation:** Reduces unnecessary escalations while giving the user control over the decision to interact with a human, improving user satisfaction.
- **Satisfaction feedback collection:** Provides valuable data to continuously improve the bot's performance based on user feedback.
- **Fallback and clarification prompts:** Ensure that the user feels heard, and the bot remains useful even when there are misunderstandings, preventing frustration.

4.3 Additional Experiments

```
current_hour = datetime.now().hour
if 5 <= current_hour < 12:
    greeting = f"Good morning, {context['name']}. How can I help you today?"
elif 12 <= current_hour < 18:
    greeting = f"Good afternoon, {context['name']}. How can I help you today?"
else:
    greeting = f"Good evening, {context['name']}. How can I help you today?"
print(f"Bot: {greeting}")
```

The bot's greeting will change depending on the time of day.

```
You: what time is it?
Bot: The current time is 20:48:40.
You: thanks bot
Bot: You're welcome. Have a nice day, Ty
```

In addition to the above image, the user can also ask for the time.

4.4 Thoughts About the Results

Even with simple rules, the chatbot created smoother, less frustrating experiences than typical rigid bots. However, true natural conversation can only be accomplished with deeper machine learning or NLP models.

5. Conclusion

In conclusion, I aimed to show that even simple improvements such as using more natural phrasing, remembering user information like names, and offering human-like escalation processes can significantly enhance a chatbot's effectiveness and the user's overall experience. By implementing features that mimic real human interaction, like confirming if the user wants to speak to a human or addressing them personally by name throughout the conversation, the chatbot becomes more engaging, trustworthy, and easier to interact with. These findings support the idea that small, thoughtful changes rooted in customer service research can have a meaningful impact on the tech industry. Continued development in these areas could lead to even greater acceptance of chatbots as helpful first points of contact in these environments.

Future Work:

- Add complex NLP-based understanding
- Implement voice recognition and voice response
- Add sentiment detection

References:

- de Haan, Hayco. "Chatbot Personality and Customer Satisfaction." *Bachelor Thesis*, Utrecht University, 2018.
<https://research.infosupport.com/wp-content/uploads/Chatbot-Personality-and-Customer-Satisfaction-Bachelor-Thesis-Information-Sciences-Hayco-de-Haan.pdf>
- Vu, Hanh T. My, et al. "Exploring the Impact of AI Chatbots on Customer Satisfaction." *International Journal of Creative and Innovative Research in All Studies*, vol. 5, no. 2, 2022, pp. 1-8.
<https://ijciras.com/PublishedPaper/IJCIRAS1885.pdf>
- Daza, Alfredo, et al. "The Impact of Chatbots on Customer Satisfaction: A Systematic Literature Review." *TEM Journal*, vol. 12, no. 3, 2023, pp. 1407-1417.
https://www.temjournal.com/content/123/TEMJournalAugust2023_1407_1417.pdf
- Statista. (2024, December 10). *U.S. consumer satisfaction with chatbot customer service 2022*. <https://www.demandsage.com/chatbot-statistics/>
- Kumar, N. (2025, January 28). *65 Chatbot statistics for 2025 – New data released*. DemandSage.
<https://www.statista.com/statistics/657148/united-states-consumer-satisfaction-with-chatbot-service/>
- Chiara Valentina Misischiaa , Flora Poeczzeb , Christine Straussa. "Exploring the Role of Chatbots in Customer Service: Insights and Challenges." *Procedia Computer Science*, vol. 197, 2022, pp. 2032-2041. *ScienceDirect*,
<https://www.sciencedirect.com/science/article/pii/S1877050922004689>.