Design Thinking Lab (CS237L) Report

PromptForge: Prompt Improvement Tool

Faculty Mentor:

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RV COLLEGE OF ENGINEERING®, BENGALURU-59

(Autonomous Institution Affiliated to VTU, Belagavi)

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

CERTIFICATE

Certified that the Design thinking Laboratory work titled ***"PromptForge: Prompt Refining Bot"*** is carried out by in partial fulfilment for the requirement of degree of **Bachelor of Engineering in Computer Science and Engineering** of the Visvesvaraya Technological University, Belagavi during the year 2024-2025. It is certified that all corrections/suggestions indicated for the Internal Assessment have been incorporated in the report.

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Declaration

This report has been prepared on the basis of our own work. Where other published and unpublished source materials have been used, those have been acknowledged.

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Abstract

In the rapidly evolving landscape of conversational AI, users frequently encounter challenges when attempting to communicate effectively with chatbots. This often leads to frustration, misunderstandings, and decreased productivity. Our research, grounded in a comprehensive design thinking approach, focuses on the theme of Digital Humanities and specifically addresses the intricacies of prompt engineering.

The primary stakeholders in our study were students, ranging from undergraduates to seniors, who provided invaluable insights through surveys and interviews. Their involvement was crucial in shaping the direction of our research, as they represent the primary users of the outcomes we aim to achieve. Additionally, we consulted industry professionals who offered expert perspectives, bridging the gap between academic learning and real-world applications. This combination of student input and expert advice significantly enhanced the credibility and applicability of our findings.

Through our research, we identified several key challenges faced by users when interacting with chatbots. A significant portion of respondents reported difficulties in constructing clear and effective prompts, which often resulted in vague or nonsensical answers from the chatbot. Our findings revealed that 51.2% of users modify the length and quality of their prompts based on the specific tasks at hand, indicating a lack of confidence in their ability to refine prompts for optimal results. Many users expressed frustration when chatbots misinterpreted their intent, highlighting the need for a more intuitive understanding from these AI systems.

To address these challenges, we propose the development of an innovative chatbot designed to dynamically enhance user prompts. Our solution aims to provide real-time recommendations that guide users in rephrasing their prompts, adding contextual details, and utilizing advanced prompting techniques. By offering immediate, intelligent feedback, our chatbot seeks to bridge the communication gap between human users and AI systems, ultimately enhancing interaction efficiency and user satisfaction.

In conclusion, our project aims to empower users by equipping them with the tools and techniques necessary to improve their prompt engineering skills. By fostering a more effective dialogue between users and chatbots, we aspire to create a more seamless and productive interaction experience in the digital humanities domain.

Acknowledgement

Any achievement, be it scholastic or otherwise does not depend solely on the individual efforts but on the guidance, encouragement and cooperation of intellectuals, elders and friends. A number of personalities, in their own capacities have helped us in carrying out this Design Thinking Laboratory work. We would like to take this opportunity to thank them all.

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Table of Contents

Chapter 1: **Empathy**

1.1 Introduction to Empathy

The empathy phase is a crucial component of our design thinking process, particularly in the context of our project focused on prompt engineering within the realm of digital humanities. This phase aims to deeply understand the experiences, challenges, and needs of our primary stakeholders—students and working professionals—who interact with chatbots in their educational and professional environments.

In our research, we identified that students, ranging from first-year undergraduates to seniors, constitute approximately 90% of our stakeholders. Their insights were gathered through surveys and in-depth interviews, allowing us to capture a diverse range of perspectives on the challenges they face when using chatbots. Additionally, we consulted industry professionals, whose expertise provided valuable context and helped bridge the gap between academic theory and practical application.

Through our engagement with stakeholders, we discovered several key challenges that hinder effective communication with chatbots. Many students reported difficulties in constructing clear and precise prompts, leading to misunderstandings and vague responses from the AI. Common frustrations included the chatbot's inability to grasp the full context of their queries, resulting in inaccurate or irrelevant answers. This disconnect not only affects the learning experience but also diminishes overall productivity.

Moreover, we recognized that students often encounter distractions in their home environments, which can further complicate their ability to focus and engage with chatbots effectively. The lack of real-time feedback and interaction exacerbates these issues, leaving students feeling isolated and unsupported in their learning journeys.

To address these challenges, our empathy phase involved collecting qualitative data through open-ended questions that allowed stakeholders to express their thoughts and feelings in their own words. This approach enabled us to gain a deeper understanding of their frustrations and aspirations regarding chatbot interactions. By synthesizing these insights, we aim to develop innovative solutions that enhance the user experience, improve prompt engineering skills, and ultimately foster a more effective dialogue between users and chatbots.

In summary, the empathy phase serves as the foundation for our project, guiding us to identify the core issues faced by our stakeholders and informing the design of a more intuitive and responsive chatbot system. By prioritizing user needs and experiences, we aspire to create a solution that not only addresses current challenges but also enhances the overall educational experience in a digital landscape.

1.2 Customer Persona and Environment

Customer Persona usually represents the key characteristics of all the people we empathize with. It refers to the group of people who we hope should benefit at the end of our design thinking journey. Customer Persona and Environment is vital to starting our design thinking journey. It lays the groundwork, and is the first essential step to building a good design thinking model. Empathizing with the right group of stakeholders, helps in reaching an idea that is highly beneficial to them, helps in understanding the gravity of problems faced by them, and also in obtaining their valuable feedback in every subsequent step henceforth.

To build a good Customer Persona, we must be able to lay out their problems, motivations and frustrations. Customer Personas are integral to the design thinking process. They bridge the understanding between users and designers, ensuring that the final product effectively meets the needs of the intended audience. By emphasizing empathy and aligning team efforts, personas pave the way for a more user-centered design approach. Keeping all this in mind, we have decided to take our Customer Persona as Students, Teachers and Working Professionals.

The decision to focus on students and working professionals as customer personas stems from their significant roles in the context of prompt engineering and chatbot interactions. Students, particularly undergraduates and seniors, represent the majority of our stakeholders, comprising about 90% of the respondents. Their active involvement through surveys and interviews is crucial, as they are the primary users of chatbot technology. They face unique challenges, such as difficulty in formulating prompts that yield accurate responses, which underscores the need for tools that enhance their interaction with chatbots. Empathizing with students involves recognizing their frustrations when chatbots misunderstand their intent or fail to provide satisfactory answers. They often struggle with knowing the right keywords to use and may feel overwhelmed when their queries are not addressed effectively.

On the other hand, working professionals bring valuable insights from their industry experience, particularly in the IT sector. Their expertise helps bridge the gap between academic learning and real-world applications, ensuring that our research remains relevant and practical. They also encounter challenges, such as vague responses from chatbots, which can hinder their productivity. Empathy towards working professionals means understanding their need for efficiency and clarity in chatbot interactions, as they often deal with complex tasks that require precise information. Both groups desire tools that can provide real-time recommendations and improve their prompt engineering skills, which can significantly enhance their overall experience. By focusing on these personas, the research aims to develop solutions that address their specific challenges and improve their interactions with chatbots, ultimately leading to a more user-centered design process.

In conclusion, the customer personas identified in this study—students and working professionals—represent critical stakeholders in the realm of prompt engineering and chatbot interactions. By recognizing their specific challenges, we can develop targeted solutions that enhance their interactions with chatbots and improve their overall experience. The insights gained from these personas will guide our design thinking process, ensuring that the outcomes of our research are user-centered and effectively address the needs of both students and working professionals. Ultimately, this approach aims not only to improve the usability of chatbots but also to empower users by enhancing their prompt engineering skills, leading to more productive and satisfying interactions.

1.3 Customer Journey Map

Customer Journey Map is a visualization depicting the various stages that the customers go through while interacting with an application developed.

In the Customer Journey Map we depict 6 segments namely Customer Phases, Customer Journey, Customer Needs, Emotion Curve, Potential opportunities, Proposed ideas.

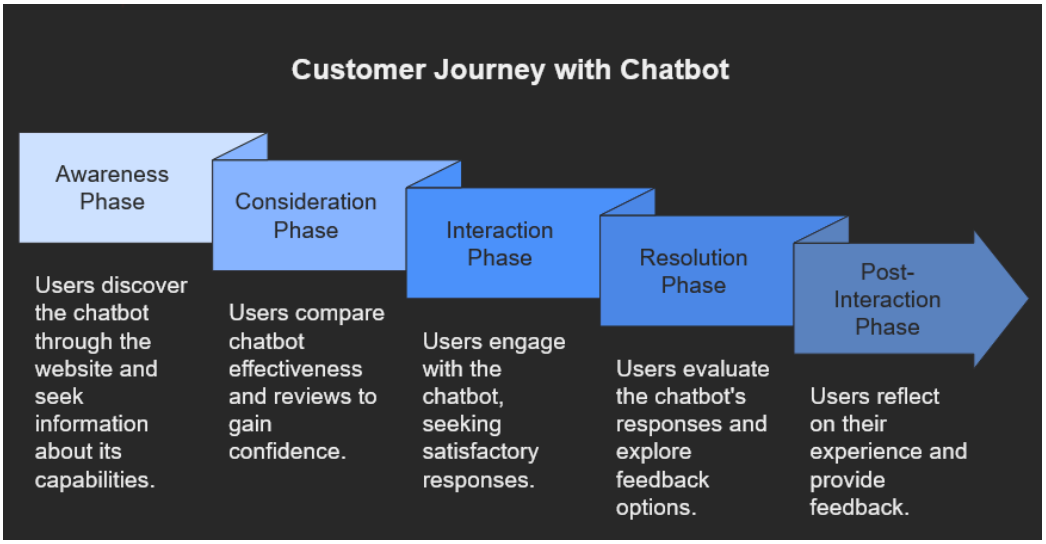


Figure 1. Customer Journey Map

The 5 phases that students and teachers go through in an online class are:

1. Awareness Phase: The customer journey when using chatbots typically begins with the **Awareness Phase**, where users first encounter the chatbot as a potential solution for their queries. During this phase, users may feel curious and hopeful about the chatbot's capabilities. However, they often face challenges in understanding how to effectively interact with the chatbot, particularly if they are unfamiliar with its functionalities. This lack of clarity can lead to initial frustrations, especially if users have high expectations for immediate and accurate responses.

2. As users transition into the **Consideration Phase**, they start engaging with the chatbot by inputting their queries. Here, they may experience significant difficulties, particularly in phrasing their prompts effectively. Many users struggle to articulate their questions clearly, leading to misunderstandings or vague responses from the chatbot. This phase can be marked by frustration, as users may feel that their intent is not being accurately interpreted, which can hinder their ability to obtain the information they need.

3. In the **Interaction Phase**, users actively communicate with the chatbot, asking questions and seeking assistance. However, this phase often reveals deeper issues, such as the chatbot's inability to handle complex queries or its reliance on outdated information. Users frequently report dissatisfaction with the chatbot's responses, which may be vague, incomplete, or irrelevant. This can lead to a cycle of repeated questioning, where users must refine their prompts multiple times to achieve satisfactory answers, further exacerbating their frustration.

4. Once users receive responses, they enter the **Resolution Phase**, where they assess the effectiveness of the chatbot's answers. If the responses are inadequate, users may feel compelled to reformulate their questions, adding more context or simplifying their requests. This iterative process can be time-consuming and may lead to a sense of

inefficiency, as users often find themselves spending more time clarifying their needs rather than receiving direct assistance. The lack of intuitive understanding from the chatbot can significantly detract from the overall user experience.

5. Finally, in the **Post-Interaction Phase**, users reflect on their experience with the chatbot. Many express a desire for better tools or resources that could help them improve their prompting skills. The feedback collected indicates that users often feel uncertain about their ability to generate effective prompts, which can diminish their confidence in using chatbots for future inquiries. Overall, the journey through these phases highlights the critical need for enhanced chatbot capabilities and user support to bridge the gap between user intent and the chatbot's interpretative abilities.

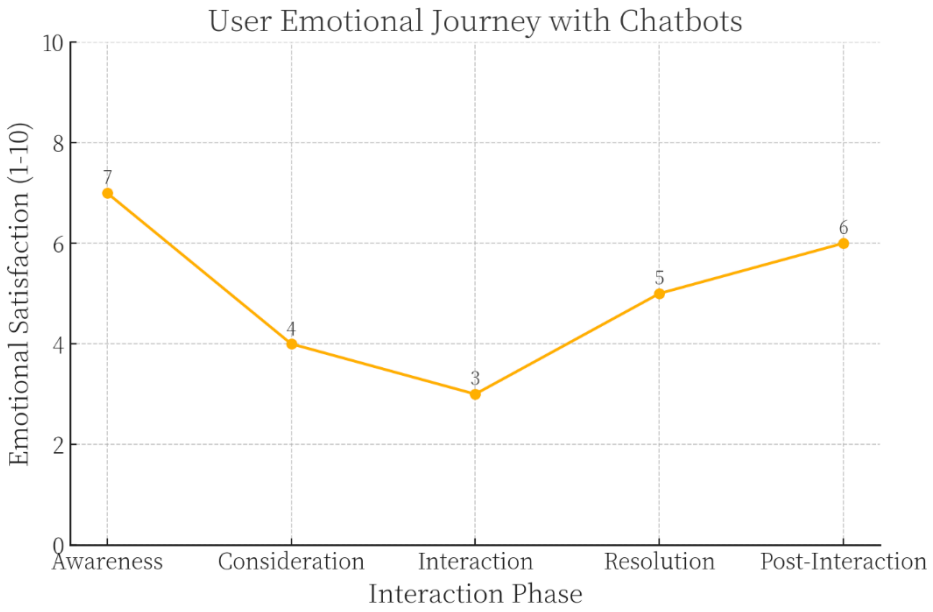


Figure 2. Customer Emotion Curve

The emotional journey of users interacting with chatbots reveals significant fluctuations in feelings, primarily driven by the challenges they face in prompt engineering. Users often experience frustration, confusion, and disappointment due to their difficulties in articulating clear and effective prompts. This highlights a critical need for tools and resources that simplify the process of prompt creation. By making prompt engineering easier and more intuitive, we can bridge the gap between user intent and chatbot interpretation, ultimately enhancing user satisfaction and reducing the time spent on clarifying queries. Simplifying this process can lead to more accurate responses, improved user experiences, and greater confidence in utilizing chatbot technology for various tasks.

In summary, addressing the complexities of prompt engineering is essential for improving chatbot interactions and ensuring that users can effectively communicate their needs without unnecessary frustration.

1.4 Customer Empathy Maps

Customer Empathy Maps are used to gain perspective on the problem at hand, via the eyes of our Customer personas. It captures what the customer says, does, feels, and thinks, about the situation they've been presented with. Customer Journey Maps are especially important for understanding what are the most common problems faced by customers, and what they think could be a solution to said problem. Although it isn't feasible to inculcate every solution suggested by every customer, it does provide an insight into what could be worked on, to ensure that the maximum possible ideas are acquired, for a deeper understanding of the problem.

Empathy Map for Students

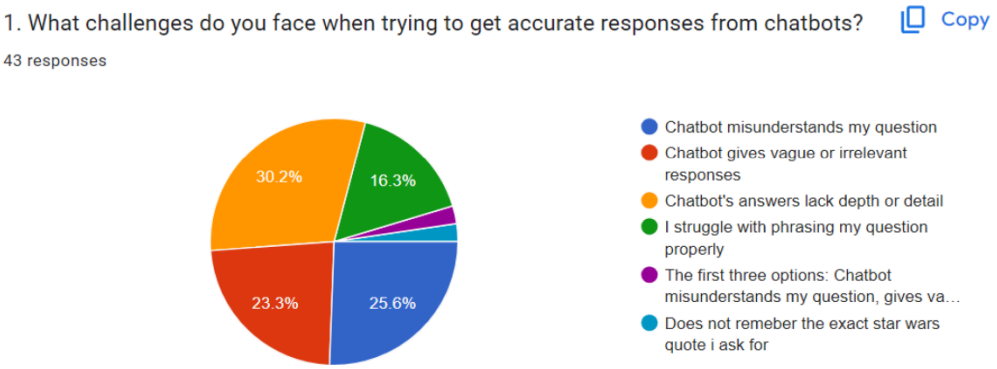
Empathy Map for Working Professionals

Conducting these interviews helped us see problems, which we might've never known, had we only worked from our perspective. It shed light on many matters, which may seem trivial on the surface, but by talking to working professionals and students, we understood the gravity of the problems. It helped us identify the issues that are prevailing.

From our empathy maps, we took the most commonly suggested solutions by both the stakeholders, we filtered out the feasible and viable solutions and from there went on to generate ideas for the same.

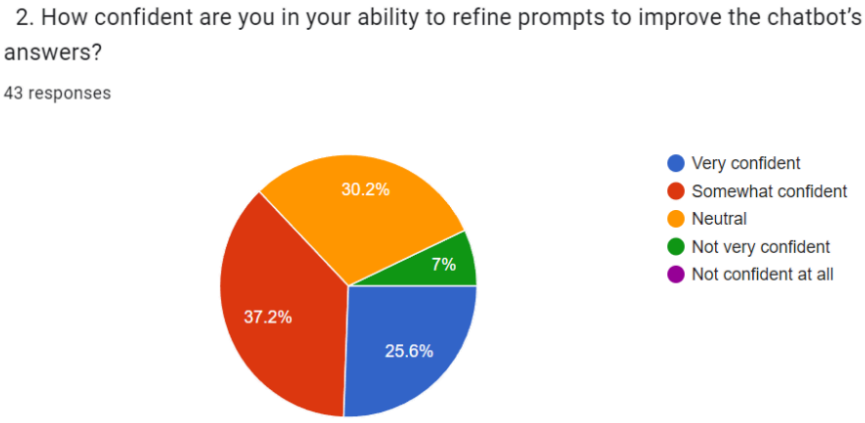
1.5 Tools used for Empathy

1.5.1 Customer Survey and Analysis

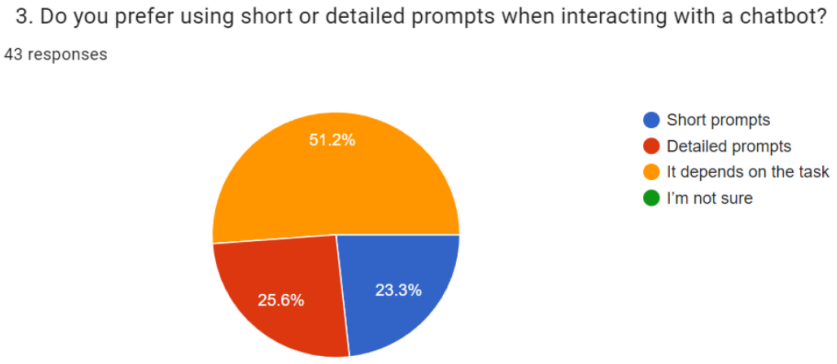


We conducted a survey in which we received a total of 43 responses.

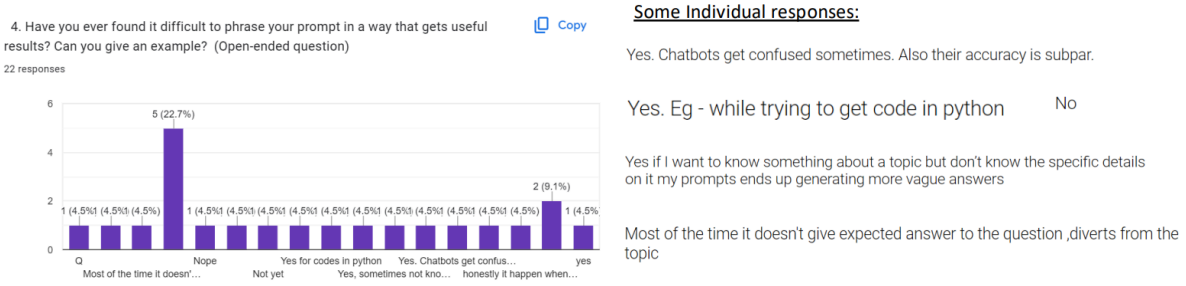
The displayed graphs suggest that people were unable to communicate effectively using the chatbots. Common problems among them include: Misunderstandings or vague and nonsensical answers, Lack of detail in answers, Failure to phrase meaningful questions.



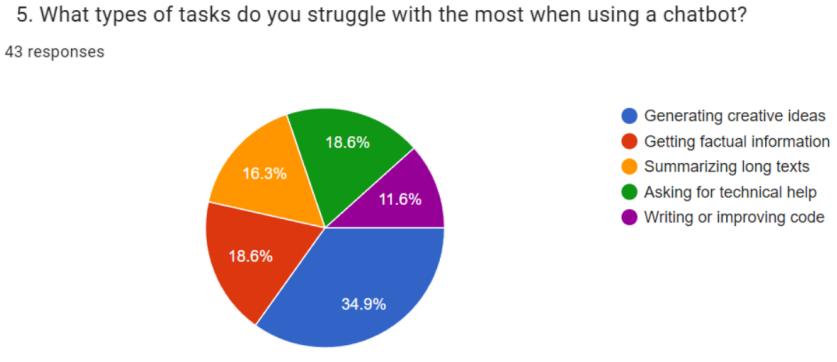
As the survey has shown, most respondents are confident at least to some extent in fine-tuning prompts and thus better answers to questions by the chatbot. At the same time, a significant part of respondents reported themselves as being uncertain or incompetent.



By looking at the graph we can ascertain that an overwhelming majority of the people (51.2%) modify the length and quality of their prompts depending on the task which they have at hand. There are also some percentage of the stakeholders that prefer to use only short or detailed prompts for all tasks.



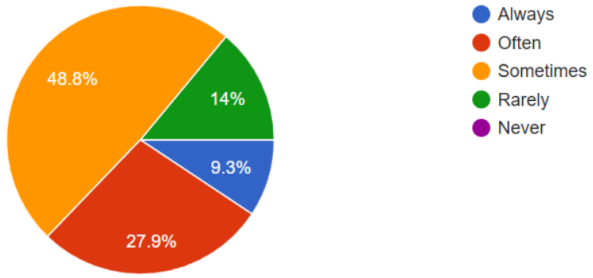
It is obvious in the open-ended question of how often respondents experience difficulties with the framing of prompts in ways that get them useful results. Most of the respondents, in fact, reported not having such problems, yet quite a few of them did. Some of these kinds of challenges include how to phrase programming tasks in prompts, how chatbots mishear or get confused, and also how the chatbots fail to give accurate responses and diverts from the topic at hand.



The chart shows the result of a survey on which problems people have with using a chatbot, whether they cannot do certain things while applying it. People are probably incompetent in composing or developing their code, inventing creative ideas, and finding factual information. Other problems which people experienced in applying a chatbot included summarizing long texts and finding technical support.

7. How often do you feel frustrated with a chatbot's responses because it misunderstood your intent?

43 responses

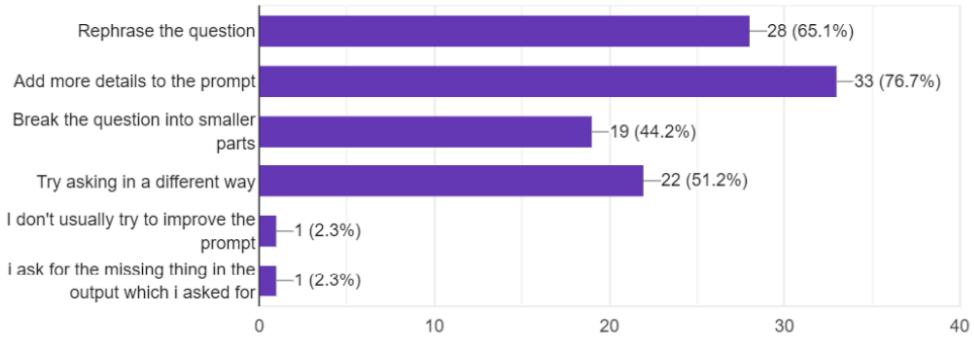


Actually, the study demonstrated a significant percentage of respondents get frustrated with chatbots which do not interpret their intent. Of course, there are respondents who rarely or never encounter the problem, but for many users, it happens rather frequently.

9. How do you approach improving your prompts when you receive unsatisfactory responses from the chatbot?
(Multiple Choice, select all that apply)

Copy

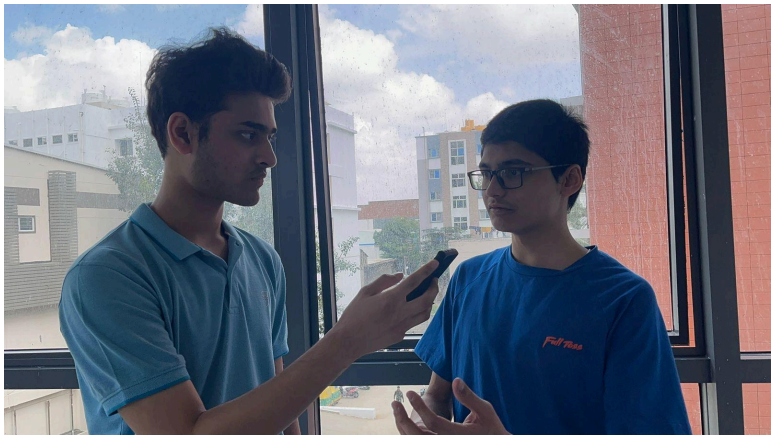
43 responses



Here we see how users reformulate their questions when the chatbot does not respond appropriately. Among these three were most prominent: reformulating the question itself, adding more context to the prompt, and asking it otherwise. Fewer respondents divided their question into little pieces, and almost no percent did nothing to enhance their prompts.

1.5.2 Customer Interaction Photos with descriptions

These are some of the pictures of our team interacting with a few students in interviews



1.5.3 Customer Interview's details

We gathered a total of 51 responses from google forms and physical interviews combined.

Questionnaire for Student:

1. Challenges faced when trying to get accurate responses from chatbots.
2. How confident are you in your ability to refine prompts to improve the chatbot's answers?
3. Do you prefer using short or detailed prompts when interacting with a chatbot?
4. What types of tasks do you struggle with the most when using a chatbot?
5. How often do you feel frustrated with a chatbot's responses because it misunderstood your intent?
6. How do you approach improving your prompts when you receive unsatisfactory responses from the chatbot?

Questionnaire for Working Professionals:

1. Have you ever found it difficult to phrase your prompt in a way that gets useful results? Can you give an example?
2. What features or tips do you think would help you structure better prompts when interacting with a chatbot
3. How often do you use LLM (eg - ChatGPT and Google Gemini) for help or to learn something.
4. What difficulties do you experience when the chatbot provides vague or incomplete answers?
5. In what ways do you think a practice chatbot could help you improve your prompt engineering skills?

We used google forms to gather information as well as performed various physical interviews.

Chapter 2: **Define**

2.1 problem definition

The problem definition phase is crucial in understanding the challenges users face when interacting with chatbots, particularly in the context of prompt engineering. This phase builds on insights gathered during the empathy phase, where we engaged with primary stakeholders—students and working professionals—through surveys and interviews. Their feedback has been instrumental in identifying the core issues that hinder effective communication with chatbots.

Users often struggle to articulate their questions clearly. This challenge is particularly pronounced among students, who may lack experience in formulating precise prompts. For instance, students reported issues with generating specific outputs, such as images, due to uncertainty about the right keywords and details to include. This aligns with the empathy phase, where we learned that students feel frustrated when their intent is misunderstood.

Many users experience frustration when chatbots provide vague or nonsensical answers. This issue was highlighted in the empathy phase, where stakeholders expressed a desire for chatbots to better understand context and intent. The lack of clarity in responses can lead to repeated attempts to refine prompts, further exacerbating user frustration.

While a significant portion of respondents indicated some confidence in their ability to refine prompts, many still reported feeling uncertain or inadequate. This reflects the empathy phase's findings, where users expressed a need for guidance and tools to help them improve their prompting skills.

The core problem statement emerging from this synthesis is that users face significant challenges in clearly expressing their tasks or queries to chatbots. This difficulty often leads to misunderstandings, inefficiencies, and frustration, as users may need to rephrase their prompts multiple times to achieve the desired outcome. The empathy phase has provided valuable insights into these user experiences, emphasizing the need for solutions that bridge the gap between user intent and the chatbot's ability to interpret and respond accurately.

In conclusion, the problem definition phase, informed by the empathy phase, highlights the critical need for improved communication strategies and tools that empower users to interact more effectively with chatbots. By addressing these challenges, we can enhance user satisfaction and productivity, ultimately leading to more successful interactions with chatbot technology.

2.2 Design thinking challenge/s identified

Final Problem Statement:
The key challenges faced by users when interacting with chatbots is the difficulty in clearly expressing the task or query at hand. Users often find it tough to construct well-phrased and efficient prompts that lead to meaningful, accurate, and desired responses from chatbots. This difficulty can result in frustration, misunderstandings, and inefficiencies, as users may need to rephrase or refine their prompts multiple times to obtain the required outcome. The challenge lies in bridging the gap between user intent and the chatbot's ability to interpret and respond accurately.

Challenges Faced by Students

1. **Difficulty in Expressing Queries**: Students often struggle to articulate their questions clearly, particularly when they lack the right keywords or details needed for effective chatbot interaction.

2. **Misunderstandings and Vague Responses**: Many students experience frustration when chatbots misinterpret their intent, leading to vague or irrelevant answers that do not address their needs.

3. **Confidence in Prompt Refinement**: While some students feel confident in refining their prompts, many report feeling uncertain or inadequate, which affects their ability to get satisfactory responses.

4. **Complexity of Tasks**: Students find it challenging to use chatbots for complex tasks, such as generating images or summarizing texts, due to a lack of intuitive guidance on how to phrase their requests.

5. **Need for Real-Time Recommendations**: There is a strong desire among students for tools or features that provide real-time suggestions on how to improve their prompts, helping them communicate more effectively with chatbots.

Challenges Faced by Working Professionals

1. **Difficulty in Phrasing Prompts**: Working professionals often find it challenging to phrase their prompts in a way that yields useful results, leading to inefficiencies in their work.

2. **Vague or Incomplete Answers**: Many professionals experience frustration when chatbots provide vague or incomplete responses, which can hinder their productivity and decision-making processes.

3. **Need for Structured Guidance**: Professionals express a need for features or tips that help them structure better prompts, as they often lack the time to experiment with different phrasing.

4. **Confidence in Using Chatbots**: While some professionals use chatbots regularly, they often feel uncertain about their ability to generate effective prompts, which can lead to reliance on traditional methods instead.

5. **Desire for Skill Improvement**: There is a clear interest among working professionals in using practice chatbots to enhance their prompt engineering skills, indicating a need for training and resources in this area.

Chapter 3: **Ideate**

3.1 Introduction to ideation

The ideation phase is a critical step in the design thinking process, where we generate creative solutions to the challenges identified in the problem definition phase. Building on the insights gained from our stakeholders—primarily students and working professionals—we aim to explore innovative ideas that can enhance the effectiveness of chatbot interactions, particularly in the context of prompt engineering.

During the empathy phase, we gathered valuable feedback from students and industry experts, which highlighted the common difficulties users face when trying to communicate effectively with chatbots. These challenges include unclear responses, misunderstandings of user intent, and the struggle to formulate precise prompts. As we move into the ideation phase, our goal is to brainstorm and develop potential solutions that address these issues, ultimately improving user experiences and outcomes.

In this phase, we will encourage open-mindedness and creativity, allowing for a wide range of ideas without immediate judgment. We will explore various strategies, tools, and features that could assist users in crafting better prompts, such as real-time recommendations, intuitive interfaces, and educational resources. By fostering collaboration and leveraging diverse perspectives, we aim to generate a robust set of ideas that can be further refined and tested in subsequent phases of our project.

The ideation phase will not only focus on generating solutions but also on prioritizing them based on feasibility, impact, and alignment with user needs. By synthesizing the insights from our research and the creative ideas generated during this phase, we hope to develop effective strategies that empower users to interact more successfully with chatbots, ultimately bridging the gap between user intent and chatbot interpretation.

In summary, the ideation phase is an opportunity to transform the challenges identified in the problem definition phase into actionable solutions. By harnessing the collective creativity of our team and the insights from our stakeholders, we aim to create a more intuitive and effective chatbot experience for both students and working professionals.

3.2 Brainstorming and Storyboarding

There are a variety of ideation techniques that can be used for generation of ideas. Ideation techniques help in creative flow, and help in generation of a variety of ideas. Not all of these ideas may be good, but every idea in turn could lead to a better idea, and hence none of them can be neglected. During our brainstorming sessions, we focused on generating a variety of innovative ideas aimed at improving interactions between users and chatbots. The environment was collaborative and encouraged participants to share their thoughts freely, helping us surface a diverse range of solutions. Below are some of the key ideas we developed along with their associated drawbacks, which ultimately led us to decide against their implementation.

1. Educating Users on Prompting Techniques

- **Idea**: Create a web app that provides blog tutorials on how users can improve their prompting skills.
- **Drawbacks**:
    - **Not Interactive**: This approach lacks direct interaction, making it less engaging for users who might benefit from hands-on practice.
    - **No Real-Time Teachings**: The absence of real-time feedback limits the opportunity for users to learn and adapt their prompting techniques immediately.

  Reason for Not Choosing: We recognized that while educational resources are valuable, users benefit more from interactive, practical experiences that allow for immediate application of what they learn.

2. Prompt Score System

- **Idea**: Develop a website that scores users' prompts based on their effectiveness.
- **Drawbacks**:
    - **Simply a Scoring System**: This idea risks being overly simplistic, as it may not provide users with deeper insights or actionable feedback.
    - **Does Not Improve the Prompt**: Without guidance on how to enhance the prompts, users may remain stuck with ineffective phrasing.

  Reason for Not Choosing: Although providing a score could offer some feedback, the lack of actionable advice rendered this idea less useful for fostering real improvement in prompt engineering**.**

3. Keyword Suggestion Bot

- **Idea:** Create a chatbot that identifies key topics in the user's prompt and suggests additional keywords to make prompts more comprehensive.
- **Drawbacks:**
    - Doesn't Provide Guidance for Improvement: While it may assist in expanding keywords, the bot wouldn't help users understand the nuances of effective prompting.
    - Limited to Keyword Expansion: This concept is focused primarily on keyword suggestions and fails to address other critical aspects of prompt formulation.

  Reason for Not Choosing: The limited scope of this idea would not comprehensively meet user needs. We sought solutions that could improve overall communication effectiveness, not just keyword relevance.

Final Solution: PromptForge - Prompt Refining Bot:
After an extensive brainstorming phase and careful consideration of various ideas, we developed our final solution: **PromptForge**, a Prompt Refining Bot designed to enhance user interactions with chatbots. This tool aims to address the common challenges faced by both students and working professionals when formulating prompts.

Key Features of PromptForge

1. **Real-Time Assistance**:
    - **Dynamic Feedback and Suggestions**: PromptForge will provide users with immediate feedback as they formulate their prompts, helping them refine their questions on the spot.
2. **Suggestions for Improvement**:
    - **Adding Specific Context or Details**: The bot will guide users on how to enrich their prompts by incorporating relevant details, ensuring clearer communication with chatbots.
3. **Examples and Comparisons**:
    - **Side-by-Side Examples of "Before" and "After" Prompts**: Users will see practical examples demonstrating the difference between their original prompts and improved versions, reinforcing effective prompt formulation.
4. **Customizable Guidance**:
    - **Level of Detail and Type of Feedback**: Users can select how much detail they want in the feedback, allowing for a tailored learning experience that meets their specific needs

The creation of PromptForge stemmed from an understanding of the specific needs and challenges identified during the empathy and problem definition phases. By focusing on interactivity and real-time support, we aimed to provide users with a solution that not only equips them with knowledge but actively assists them in the moment. Through brainstorming, we weighed the benefits of various ideas and recognized the need for a solution that combined feedback, suggestions, and practical examples. The decision to develop an interactive bot was influenced by the challenges highlighted in our previous discussions, where users expressed a desire for more dynamic support.

Storyboard:

Chapter 4: **Prototyping and Testing**

4.1 Introduction to Prototyping

Prototyping is an essential part of the Design Thinking process. It is the culmination of all the techniques and ideas that have been implemented so far. Prototyping refers to testing the ideas that we came up with during the ideation, and making quick changes to cater to our customers.

Prototyping employs a set of tools and approaches for testing out ideas before putting in actual resources, time and effort. It's like a mock-up of the final product that one intends to put out in the market. It's a sample experiment of a proposed solution, for testing and validation of ideas. It usually refers to bringing the ideas to life and exploring their impact in the real world, before their final execution. Regardless of how well a person has researched a particular idea, without studying the real life implications of the proposed idea, there is always scope for improvement, and testing is crucial to the success of the design thinking process.

Prototyping helps in clearing out assumptions and biases that a person may have about their proposed solution. Sometimes the developer may become too fixated on the ideas generated during the ideation phase, without considering the negatives and disadvantages of the same on their customer base. Therefore prototyping is essential, as it assesses the product from the point of view of the consumer, without exhausting resources for the same. It can be quick and rough, or well elaborated and thought out, depending on the stage of prototype development.

4.2 Prototyping implementation and Testing

In the prototype phase of **PromptForge**, we developed multiple iterations of the chatbot to enhance its functionality and user experience. Each version built upon the previous one, incorporating feedback and improvements based on our research and stakeholder input. Here's a detailed explanation of each prototype version:

2. Second Prototype:

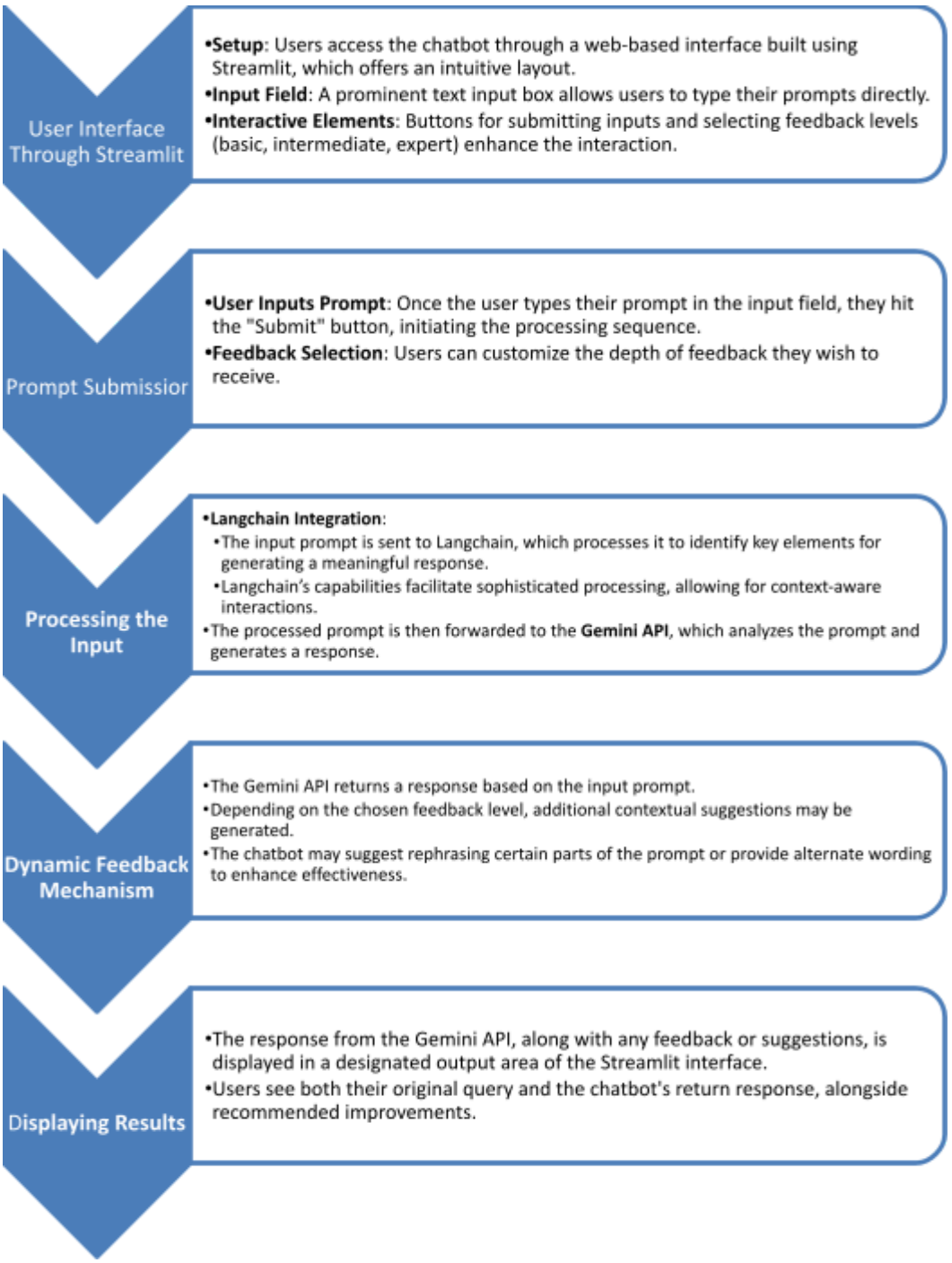
- **Overview**: The second iteration integrated Langchain with the Gemini API to improve the quality of responses and enhance the interaction process.
- **Functionality**:
    - **Enhanced Processing**: Langchain allowed for better handling of user inputs, enabling the chatbot to analyze prompts more effectively and generate more relevant responses.
    - **Contextual Understanding**: This version aimed to provide a more nuanced understanding of user queries, addressing some of the misunderstandings reported by stakeholders.
- **Improvements**:
    - **R1. First Prototype:**
- **Overview**: The initial version of the chatbot utilized the Gemini API to generate responses, which were displayed directly in the terminal.
- **Functionality**:
    - **Basic Interaction**: Users could input prompts directly into the terminal, and the chatbot would return responses based on the input.
    - **Simplicity**: This version focused on establishing a foundational understanding of how the Gemini API processes prompts and generates responses.
- **Limitations**:
    - **User Experience**: The terminal interface was not user-friendly, lacking visual elements that could enhance user engagement and understanding.
    - **Limited Feedback**: Users received responses without any contextual guidance or suggestions for improving their prompts, which did not address the challenges identified during the empathy phase.
    - **esponse Quality**: The integration led to more accurate and contextually appropriate responses, reducing the frequency of vague or nonsensical answers.
    - **Feedback Mechanism**: Although still limited, this version began to incorporate basic feedback on user prompts, helping users understand how to refine their queries.

3. Final Prototype:

- **Overview**: The final prototype combined Langchain, the Gemini API, and Streamlit to create a fully interactive and user-friendly chatbot interface.
- **Functionality**:
    - **User Interface**: Streamlit provided a visually appealing web interface where users could easily input prompts and view responses in real-time. This significantly improved user engagement and accessibility.
    - **Real-Time Feedback**: The chatbot offered dynamic feedback on user prompts, suggesting improvements and providing examples of better phrasing. This feature directly addressed the challenges identified in the empathy phase, such as users struggling to express their queries clearly.

- **Customizable Options**: Users could select the level of detail in the feedback they received, allowing for a tailored experience based on their expertise and needs.

- **Working:**



- **Key Features**:
  - **Interactive Elements**: The Streamlit interface included buttons, sliders, and text input fields, making it easy for users to interact with the chatbot.
  - **Learning Resources**: The final prototype also incorporated links to tutorials and tips on effective prompting techniques, further empowering users to enhance their skills

Chapter 5. Validation and Iterative Improvement

We tested our innovative chatbot, designed to enhance user prompts dynamically, with two distinct user groups: **students** and **industry professionals**. The insights from these tests provided valuable feedback for refining our solution.

a. **Student User**: Students, including undergraduates and seniors, provided feedback based on their academic and personal experiences with conversational AI:

   i. **Provide Examples of Effective Prompts**: Students expressed a need for the chatbot to display sample prompts for specific tasks, helping them understand the structure of an ideal query.

   ii. **Offer Contextual Tips**: Many users recommended real-time suggestions tailored to their input, such as guiding phrases to clarify intent.

   iii. **Intuitive Learning Features**: A request for tooltips or hover-over descriptions of advanced features to facilitate onboarding.

   iv. **Integration with Academic Tasks**: Students preferred options for automating repetitive academic interactions, such as summarizing research or generating structured essay outlines

   v. **Accessible Knowledge Base**: Students desired a repository of frequently asked questions and related topics to enhance learning.

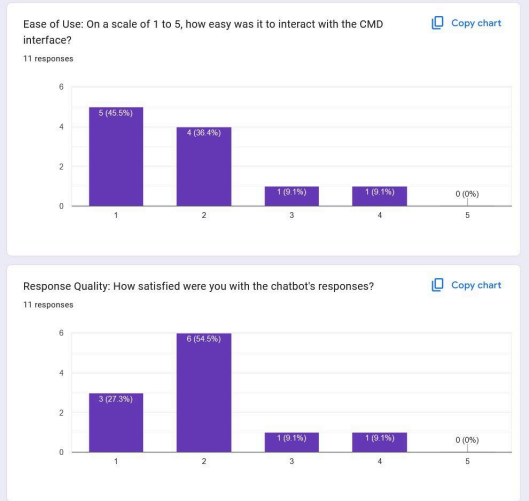
b. Industry experts: Industry professionals shared viewpoints founded on their utilization of chatbots for professional and business use:

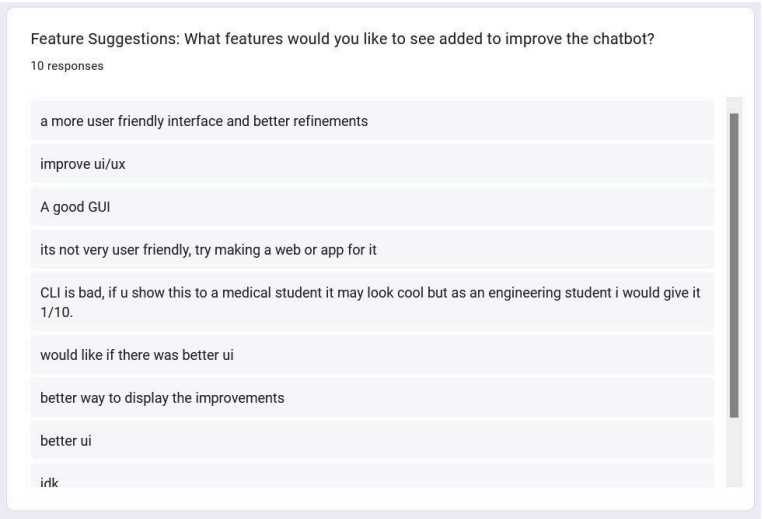
- **Personalized Feedback:** Professionals emphasized the need for tailored prompt refinement based on domain-specific language, such as technical or business jargon.
- **Advanced Debugging Features**: They asked for a way to detect and clarify ambiguities in prompts that could trip up AI.
- **Batch Processing Capability**: Users suggested enabling multiple queries to be optimized simultaneously for workflow efficiency.
- **Performance Metrics**: A feature to analyze the effectiveness of crafted prompts over time, helping users improve their interaction quality.
- **Enhanced Context Sensitivity**: Experts have pointed out the need to make the chatbot respond dynamically to varied user intents, not giving generic or irrelevant responses.

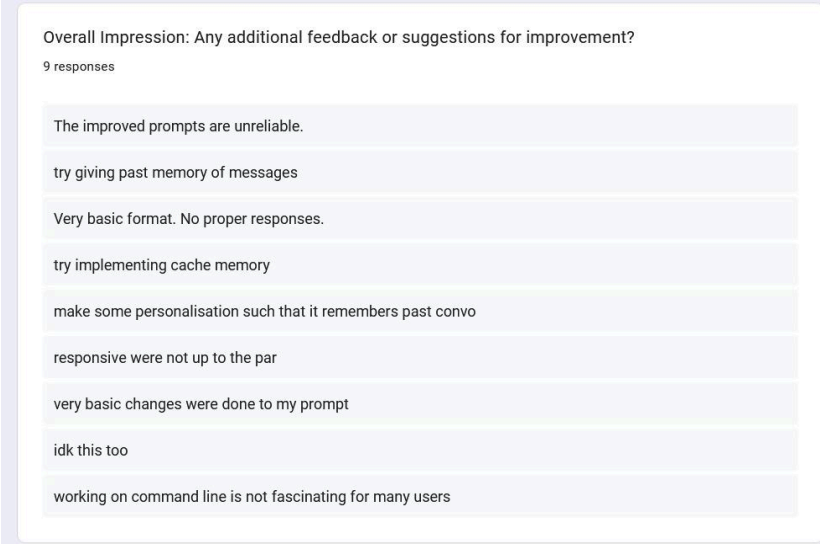
In order to ensure our chatbot develops with real user feedback, we employed Google Forms after each demonstration of the prototypes. The responses provided us with a way of validation of the work and prioritizing improvements. Here's a summary of the responses by the users for each of the prototypes

along with the improvements incorporated.

Prototype 1: Basic CMD Interface







Summary of the Feedback: Average rating of the prototype by users in terms of usability and response quality was 1-2 stars.

Major Concerns:

Lack of GUI: The interface was considered old-fashioned and clunky.

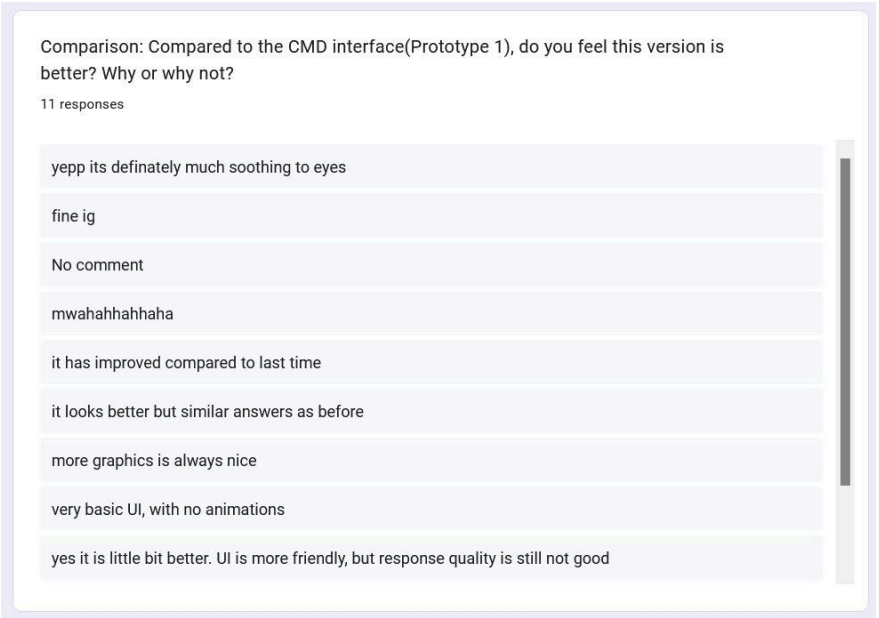
Response Quality: Responses from the chatbot were not clear or irrelevant.

Action Taken:

We worked on the feedback received and made a GUI-based version of the chatbot, which made it more user-friendly.

We also began experimenting with different methods to make the chatbot's responses better and more relevant.

Prototype 2: Streamlit - Based Chatbot



Feedback Summary: Users rated the prototype with an average of 3 stars.

Improvements noted:

GUI Added: Users appreciated having a GUI (Streamlit) and found the use of the chatbot more convenient.

Local-only Access: The users mentioned that they had to run it on localhost, and it was not available at any online host.

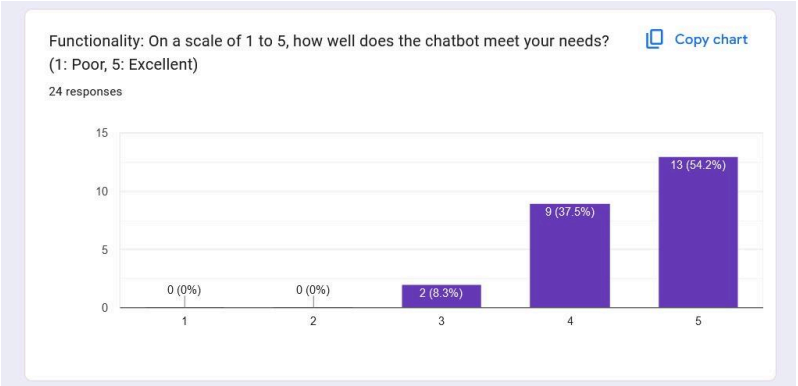
Response Quality: Slightly better than Prototype 1 but still not reaching user expectations.

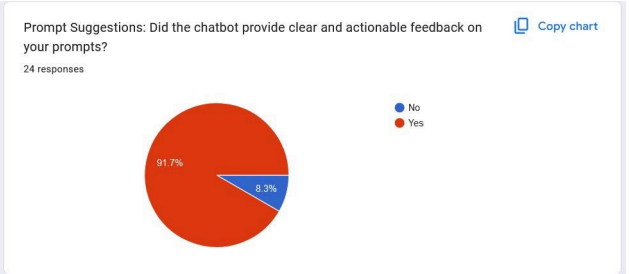
Action Taken:

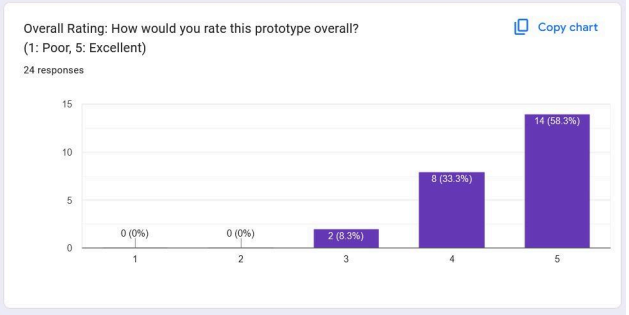
We addressed the quality of responses by incorporating the LangChain framework to better manage prompts and enhance the content generated by the AI. We initiated planning for

prospective online hosting solutions in subsequent iterations to improve accessibility.

Prototype 3: LangChain-Integrated Chatbot







Summary of Feedback:

Users gave the prototype an average rating of 4-5 stars, meaning they were highly satisfied.

Improvements:

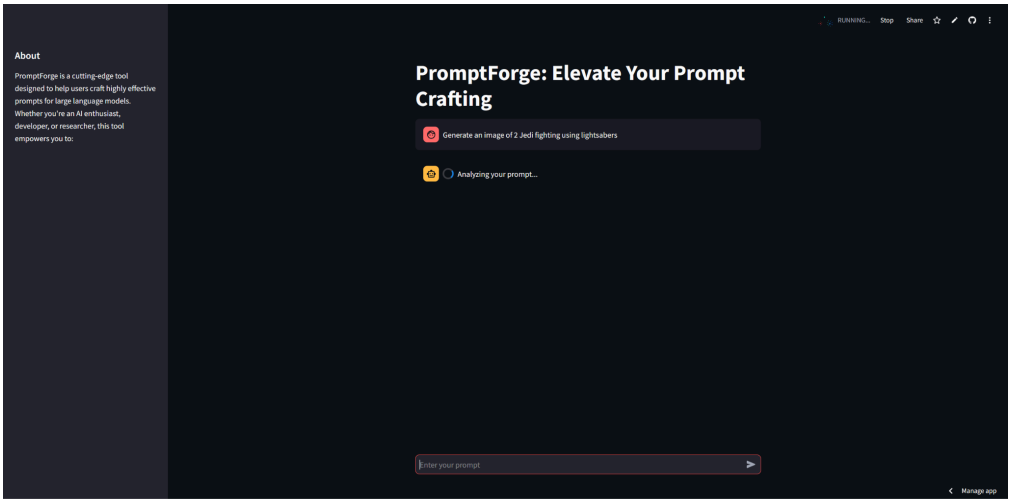
Better Response Quality: The LangChain integration made the chatbot much better at understanding and responding to the question with relevance.

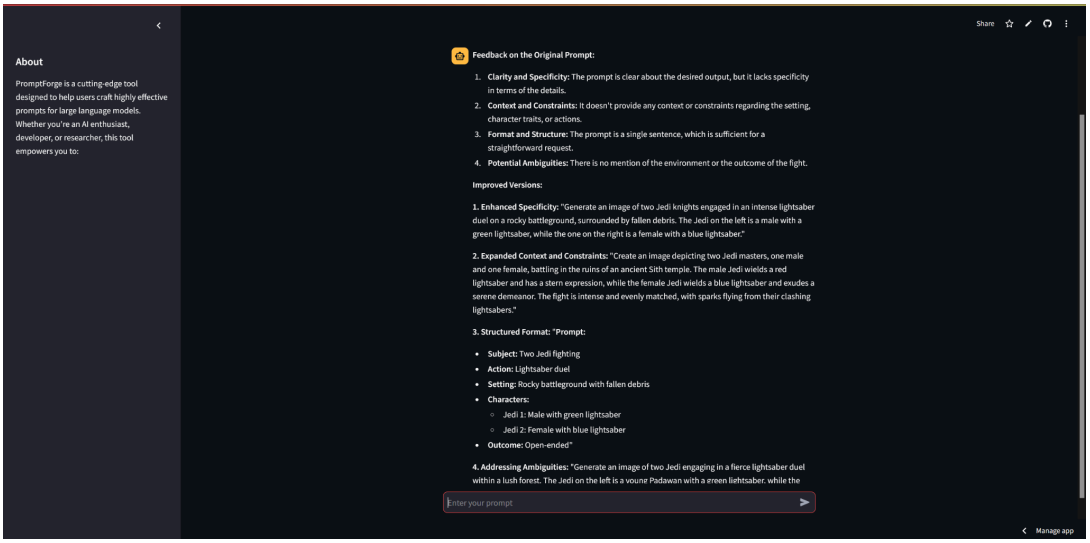
GUI Improvements: The user interface became much more polished and intuitive, making interactions smoother.

Prompt Analysis Feature: The intelligent prompt refinement feature, through LangChain and Gemini, added value and utility.

Action Taken:

Given the overwhelmingly positive feedback, we decided that this version could be a foundational model for further enhancements, such as deploying online, incorporating multilingual support, or introducing voice-based interaction.





Through user validation, we transformed the chatbot from a basic command-line tool into a feature-rich, GUI-based application powered by advanced AI techniques. The iterative improvements highlight the importance of user feedback in creating a solution that meets real-world needs effectively.

Chapter 6: **Conclusion and Reflection**

6.1 Conclusion

The **PromptForge** project has successfully created a powerful chatbot tool aimed at improving how users interact with artificial intelligence by helping them formulate effective prompts. By using advanced technologies such as **Langchain**, the **Gemini API**, and the **Streamlit** framework, we developed a prototype that meets the specific needs of students and professionals alike. This final version of the prototype not only offers users immediate feedback but also provides thoughtful suggestions that enhance their prompt quality. This innovation helps bridge the gap between what users intend to ask and how well the chatbot understands their queries, ultimately leading to more productive interactions.

This achievement would not have been possible without utilizing the design thinking process. At the heart of this method is a strong focus on empathy and understanding the users we aimed to help. By engaging directly with students and professionals, we gathered valuable insights into their struggles with expressing their ideas clearly when working with chatbots. This understanding shaped every stage of our project, guiding us from brainstorming concepts to designing the user interface. The iterative nature of design thinking allowed us to create multiple prototypes, enabling us to test and refine our ideas continuously. Each round of feedback was crucial, ensuring that our final product truly resonated with users' needs and expectations.

By following the design thinking approach, we fostered a team environment that encouraged collaboration and open communication. We learned from the users, which sparked innovation and led us to solutions that were both functional and easy to use. As a result, we are proud to present a tool that not only enhances how people interact with AI but also sets a standard for future developments in prompt refinement. The success of PromptForge emphasizes the importance of empathy and user involvement in creating effective technological solutions, showing that understanding the user is key to any successful project.

6.2 Reflection

The development of the **PromptForge** project has been an invaluable learning experience that highlighted the importance of understanding user needs in creating effective technological solutions. Engaging with students and professionals revealed their specific challenges when interacting with chatbots, particularly their difficulties in crafting effective prompts and receiving clear feedback. This insight was crucial in shaping the features of PromptForge, ensuring that the final prototype directly addressed real-world issues faced by end users. The iterative process of gathering feedback and refining our prototypes taught us the significance of empathy in design and how essential it is to involve users in the development process to create a product that truly meets their needs.

Collaboration was another key aspect of our success in this project. Working closely within a diverse team allowed for a rich exchange of ideas and perspectives, fostering creativity and innovation in our approach. The iterative design process not only enhanced our problem-solving skills but also reinforced the need for flexibility in adapting to feedback and refining our solutions. This experience has expanded my technical skills, particularly in using tools like **Langchain**, the **Gemini API**, and **Streamlit**. Overall, the insights gained from this project will greatly influence my future endeavors in technology development, emphasizing the importance of user-centered design and collaboration in creating impactful solutions.

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