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Enhancing Art Museum Experience With a Chatbot Tour Guide

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Chatbots are a user-friendly approach for interacting in natural language that museums have embraced to improve visitor experiences. ChatGPT, as a language module, starts changing chatbots more flexible and smarter. However, it remains underexplored how chatGPT influence visitors' experience and interaction at art museums in terms of finding information, engagement, and enjoyment compared to existing museum tour-guide applications. This project utilized a chatbot based on chatGPT as a tour guide, that can detect artwork, generate information about artworks, and help visitors to locate themselves in the exhibition space. The introduction of artworks was AI-generated based on the knowledge base of collections. To evaluate the visitors' museum experience, I conducted a field experiment (N = 30) at the Swedish National Museum, comparing the chatbot with the app provided by the museum. The results show that using the chatbot to explore the exhibition was more informative and engaging. Moreover, they enjoyed an interactive experience using the chatbot to learn about the art collection and have equally preferred textual and auditory content presentation.

SAMMANFATTNING

Chatbottar är ett användarvänligt tillvägagångssätt för att interagera på ett naturligt språk som museer har omfamnat för att förbättra besökarnas upplevelser. ChatGPT, som ett språkmodul, börjar förändra användbarheten hos chatbot. Det är dock fortfarande underutforskat hur chatGPT påverkar besökarnas upplevelse och interaktion på konstmuseer när det gällerengagemang att hitta information jämfört med befintliga applikationer för museiguider. I det projekt användes en chatbot baserad på chatGPT som en guide, som kan upptäcka konstverk, generera information om konstverk och hjälpa besökare att lokalisera sig i utställningsutrymmet. Det introducerande innehållet genererades av AI baserat på knowledge base. För att utvärdera besökarnas museiupplevelse genomfördes ett fältexperiment (N = 30) på Nationalmuseet i Stockholm, där jag jämförde chatbotten med appen som tillhandahölls av museet. Resultaten visar att användningen av chatbotten för att utforska utställningen var mer informativ och engagerande. Dessutom uppskattade de den interaktiva upplevelse med att använda chatboten för att lära sig om konstsamlingen och uppskattade presentation av text- och ljudinnehåll.

Keywords: chatbot, chatGPT, museum, tour guide

Nyckelord: chattbot, chatGPT, museum, rundtursguide

1 INTRODUCTION

Exploring an art museum with an interactive experience can enhance visitors' engagement with the exhibition [13]. Nowadays, interactive museum experiences have become a transformative force, reshaping the way in which visitors interact with art, history, and culture [8]. While the traditional approach is using audio tour guides, which are still prevalent in many museums, it comes with drawbacks. Additional charges for renting this equipment beyond the museum ticket are not accessible for some visitors. Moreover, the limited interaction provided by these devices fails

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to accommodate the diverse personal contexts of visitors. Utilizing chatbots as tour guides offers a solution to these challenges, enabling visitors to engage with artworks through their mobile phones. This approach not only enhances the informativeness of the museum experience but also makes it more accessible to visitors [16]. Some museums already use chatbots as tour guides to enhance interactive experience and enjoyment. Since the advent of large language modules(LLM), such as chatGPT, these chatbots can answer queries based on users' questions and prompts, and they can generate content to introduce artworks in museums. However, previous research on creating a chatbot as a museum tour guide lacks the following aspects: (1) how to enhance museum experience to accommodate different personal contexts using a chatbot, and (2) what tour services the chatbot can provide in museums.

Previous research introduced the Contextual Model [12] to analyze interactive museum experience, including personal context, physical context, and social context. To enrich interactive museum experiences, digital interaction methods have been researched and utilized in museums, such as museum mobile applications with text or audio, augmented reality (AR), virtual reality (VR), and chatbots. These approaches convey informative and interactive content, such as text, voice, sound, and music fitting specific exhibitions and interactions [15], making the information more attractive. A chatbot is defined as a "A computer program designed to simulate conversation with human users, especially over the Internet" [1], that provides a user-friendly approach to interact in natural language. Chatbots used pattern matching, knowledge graphics (KG), and machine learning technology [1], but had limitations, such as simply responding to questions with prepared FAQs or KG relations. However, chatGPT allows for a more flexible and free conversation between the digital system and human visitors. As a result, deploying a chatbot powered by chatGPT as a guide tour service has the potential to improve the museum experience. This project's research question is *to what extent does a chatbot enhance visitors' experiences in art museums compared to museum apps?*

In this project, I created a chatbot for an art exhibition. I conducted user research using online questionnaires (N = 24) and 1-on-1 interviews (N = 6) to understand how people explore museums and their frustrations when visiting. Based on the findings of the user research, I designed a chatbot with the following modules: (1) introduce artwork in text and audio, which was generated by chatGPT; (2) detect location using image recognition; (3) answer the visitor questions based on the knowledge base, which includes knowledge about artworks in the exhibition. I developed the chatbot on Telegram, integrating chatGPT API, text-to-speech (TTS) API, Automatic Speech Recognition (ASR) API, and image recognition module. To evaluate the chatbot's usability and the museum experience, I conducted a comparison of user testing between the chatbot and the application developed by the National Museum (N = 30). Finally, participants reported that using the chatbot to explore the exhibition was both informative and interactive.

2 RELATED WORK

Digital interactions in museums have become an important aspect of tourist services. Over the years, there have been a variety of interactive approaches to enhance the museum experience. With the development of the Large Language Models (LLM), the usage of chatbots as tour guides has recently gained attention. In this section, I provide a review of studies on museum experiences, digitial interactions in museums, and the usage of chatbots in this area.

2.1 Museum Experience

Understanding the museum's visitor experience is important for designing effective enhancements that focuses on engagement, pleasure, learning outcomes, and overall enjoyment. Most studies on interactive museum experience are based on the Contextual Model, which was developed by H. Falk and evaluates interactive museum experience in three stages: before, during, and after the visit [12]: Personal context refers to visitors' motivations, interests, expectations, knowledge, and previous experience with a museum. Social context is about visiting with a group (family, friends, school trips), whether the museum is crowded or not, and interactions with museum staff. Physical context includes the architecture, immediate environment. These factors may influence how visitors move through the museum, what they observe, and what they remember.

The purpose of museum experience enhancement is multifaceted, including education and active memory sites that represents personal values, social and individual memories [19]. Furthermore, learning outcomes in museums can include improving skills, developing an interest, reflecting on values, increasing empathy, and raising awareness of a topic [14]. The types of museums also need to be considered in this topic, as different types of museums appeal to different audiences; thus, they should provide relevant visiting experiences based on genre and the audience [5]. For example, in art and archeology museums, visitors are not allowed to get close the artworks and must remain silent; while, technology museums encourage visitors to interact with the displays, attracting both children and adults [18].

2.2 Mobile Human-Computer Interactions in museums

Research shows that a well-designed interactive museum experience enhances both immersive and educational value [24]. I will present digital interaction methods in museums, and their main characteristics in the following. Digital interaction frames can be classified as stand-alone, mobile interaction, or assembly based on their spatial arrangement and visitor physical mobility [18]. Standalone is a form that presents information, which could include browsing content, specific media, problem-solving tasks, or games [21]. Mobile interaction was invented as audio guides at the beginning, and it has been adopted to play a role as a self-guided tour as an alternative to guide-led group visits [23]. Assemblies integrate components of standalone installations and mobile elements to arrange a narrative activity.

2.2.1 Mobile Interactive Methods. Mobile devices have been used as audio guides since the 1980s, and often come with digital audio players. With the advancement of AR and VR technologies, visitors' perceptions and interactions with exhibitions shift. Museums utilize AR glasses or VR headsets to transport visitors to different time periods, simulate historical events, or even allow them to step inside iconic artworks [28]. In addition to supplying mobile hardware, many museums develop mobile applications that can operate on smartphones. This approach is called "Bring Your Own Device (BYOD)", which covers smartphones, tablets, and smartwatches [4].

2.2.2 Mobile Interactive Experiences. The mobile interaction is more than a digital version of labels of description; it also includes extended content, language choices, and activities for visitors.

The content can be conveyed with various media, such as text, voice, sound, and music fitting specific exhibitions and interactions [15], which enhances visitor engagement in museums. The original mobile interactive experience was developed to offer descriptive information or guidance, which many museums have adopted. Nowadays, there are diverse interactive experiences that attract visitors to the museum, such as gamification that is designed as gameplay or shared tasks [6], and storytelling that visitors follow a narrative journey in museums [25]. Mobile applications should be able to determine the visitor's location. There are several methods for location detection. BLE Beacons can used for indoor navigation [27], GPS for outdoor navigation [11], Quide Response (QR) /number code [26] and Near-Field Communication (NFC) to locate specific spots [7]. Mobile applications offer personalized interaction that visitors can experience a "free-choice learning" tour [7] by choosing their preferred subject or collections, and following their own pace [3]. Compared to standalone and assemblies, the mobile interaction does not fit the social context well because visitors with separate mobile devices are more likely to experience social isolation from others [10], rather than engaging in discussions with companions during the visit [17].

2.3 Chatbot

A chatbot is a computer program, which responds like humans with text or voice and understands human languages by Natural Language Processing (NLP) [20]. The chatbot's interface is called Conversation User Interface (CUI).

Integrating chatbots as tour guides is a creative approach to enhancing the museum experience. It can provide personalized and interactive guidance based on visitors' preferences. This section reviews studies on the implementation and effectiveness of chatbots in museums.

2.3.1 Chatbot technology. Chatbots were primarily used to answer simple queries, such as matching keywords [2] or using a Knowledge Graph (KG) [31]. However, with the advent of advanced models like GPT-3 and GPT-4, chatGPT is able to generate responses based on queries smartly. Furthermore, combined with Automatic Speech Recognition (ASR) and Text-to-Speech (TTS) technologies, chatbots enable interaction as a voice assistant. This integration empowers the chatbot to seamlessly interact and communicate with multimedia [22].

2.3.2 Chatbots and museums. Chatbots have the potential to provide personalized guidance by adapting to the user's specific interests and preferences. Customized content delivery ensures visitors receive information relevant to their interests [29]. Some museums have already applied chatbots to provide tour guide services. For example, Anne Frank House Museum launched a Facebook Messenger chatbot that allows users to discover the personal history of Anne Frank and practical visitor information [30]. In 2022, Pompidou launched a chatbot as an information center and tour guide [9].

3 DESIGN AND INTEROPERATE THE CHATBOT

3.1 User research with questionnaires and interviews

I conducted user research with questionnaires and interviews to understand how visitors explore museums and their pain points during visits.

3.1.1 Questionnaires. The questionnaire had 15 questions, including a 5-point Likert scale(1- strongly disagree, 5 - strongly agree), multi-choice, and open-ended. There were 24 participants filled the questionnaire. The questionnaire covered the following aspects:

- `Interest in Museums`: Frequency of museum visits, favorite types of museums, preference for visiting museums alone or with others.
- `The media used for acquiring information before the visit`: The sources of information, and the reason for their selection.
- `How they gain information during the visit`: The channels and forms of information they prefer, the ways to appreciate artworks, and their attitude towards audio guide.
- `How the information impacts them after the visit`: How the information assists them remember an artwork.

From the replies to the questionnaires, I got some general insights and needs of museum visitors:

(1)Prefer to visit museums alone or in a social group (rate from 1 to 5). Fact: The average score for visiting alone is 2.3, and with others is 4.0. Insight: Most people prefer to visit museums with others. Needs: The chatbot cannot isolate visitors from talking with others.

(2)The sources of information that are usually read before visiting a museum. Fact: Official website: 71%, Social media:36%, because they are official, correct, and easy to access. Insight: They want to be prepared before a visit, like what is on display, and background, etc. Needs: The chatbot should be easy to access.

(3)I read descriptions of the artworks placed next to them (rate from 1 to 5). Fact: The average rating for reading descriptions is 3.8. When compared with visual content, they prefer not to read. They mostly read something interesting for them, like basic knowledge, artist, and background, to make the visit meaningful. But some participants think it's too tiresome to read. Insight: Reading descriptions may take over watching artworks. Needs: The chatbot can read the descriptions so that visitors can focus on the artworks they are interested in.

(4)I enjoy visiting museums with an audio guide. Fact: The preference for audio guides is evenly split between liking and disliking it. Insight: People who like audio guides find them to be valuable sources for understanding and learning, offering more information and details than labels. Conversely, those who don't like it because the cost and the time commitment required to listen. Some of them prefer a visit that feels less structured or formal. Needs: The chatbot needs to provide information beyond the labels. It should be available for free and audio should be brief.

(6) What kind of information would enhance your enjoyment of visiting museums? Fact: The story behind the artwork accounts for 55%; The history of the artwork, 18%; and the artistic genre, 10%. Insight: Providing knowledge or information about an artwork can help them in remembering it. Needs: The chatbot should provide various aspects of artwork.

3.1.2 Interviews. After the questionnaire, I conducted 1 on 1 semi-structured interviews at the Swedish National Museum, inviting participants to engage in observational interviews. The goal was to find out how to provide voice assistance to visitors, thereby they could enjoy the exhibition. Visitors with diverse personal contexts may have varying needs. Therefore, I selected 5 participants based on their responses to the questionnaire on three factors: (1) interest in museums, which refers to how much they would love to visit an exhibition and their past experiences; (2) attitude toward audio guides, reflecting their openness to external assistance; and (3) methods of learning about artworks, which relates to their preferred methods and channels for acquiring information. According to the answers and observed behaviors, I categorized visitors into four persona types based on their knowledge background, artistic appreciation, guidance needs, and their preference for reading or listening to descriptions.

- `Museum Beginners`: They are unfamiliar with art but are eager to learn to make the visit meaningful. So they are willing to learn from descriptions and require clear guidance in terms of their visiting itinerary.
- `Experience Seeker`Motivated by new museum experiences, they usually visit museums when traveling to unfamiliar locations. Their visits are casual.
- `Learners`: They are driven by curiosity, with a generic interest in the content of the exhibition. They enjoy learning new things from every source of the museum, such as labels and audio.
- `Explorers`: They love visiting museums and enjoy appreciating beautiful artworks in exhibitions. Their visit routes tend to be random like explorers to seek out what captures their interest.

The interviews revealed that these personal factors impact participants' learning and enjoyment of the artworks. The exhibition's collections span from the Middle Ages to the modern era. In the part of Middle Ages, the artworks depict religious history and stories from Greek mythology, which require visitors to have relevant knowledge. For the Museum beginners, who may lack familiarity with such subjects, they seek to understand the story or background of the artworks and what they convey. Additionally, participants' levels of art appreciation impact how they enjoy artworks. For instance, "Is this painting good? This is like a kid's painting." indicates a desire to discern the quality of a painting. Therefore, museums must be inclusive for visitors with varying knowledge backgrounds and levels of artistic appreciation. I collected the issues they met in the museum. Knowing these frustrations, I could avoid similar issues in my chatbot project. The pain points and frustrations are mostly about navigation and descriptions:

Navigation: Before they begin visit, providing a layout of the exhibition can help them build an overall picture, allowing them to set expectations. Additionally, in the in-between space, they always unsure of where to go next. Providing a map in these situations can reduce this uncertainty.

Description: For the participants who lack knowledge of the region or Greek mythology, even the descriptions cannot help them understand the artworks, especially if they contain terminology they don't understand. Some descriptions fail to include information that visitors are interested in. For example, beyond objective details like the genre, artist, and history, a participant seeks to learn something unique from subjective aspects. Similarly, beginners might be curious about how an ancient tool transforms trees, but they cannot find answers in the descriptions.

3.2 Design

3.2.1 Concept. The chatbot is a tour guide that introduces the collections, answers visitors' questions, and shows the map with visitors' location when they need navigation helps. Based on natural language processing (NLP) from chatGPT API, it responds the previous dialogue and switch to other topics regarding the user's intent. The chatbot can receive 3 types of messages: (1) image, (2) text, (3) audio. So visitors can take a photo of a painting and send it to the chatbot, then the chatbot will recognize the image and provides with the name of the painting and a summary introduction. If visitors want to know more about the painting, they can ask more questions by typing the text, sending a voice message, or select their interested aspect from provided options. The chatbot can be accessed with mobile phones, so that visitors can use it for free, and move at their own pace. When visitors are interested in a collection, they can lead a long conversation around it with the chatbot. A use case is shown in the Fig 1.

Figure 1: (A) When the visitor takes a picture of a painting, the chatbot returns its name and options to receive the introduction in text, audio, or both text & audio. It also provide the option to show the location of the painting. (B) Choosing "Read and Listen", the visitor receives the introduction about the artwork both in text and audio. (C) The chatbot also provides "More info", that the visitor can explore more about the artwork from these options. (D) When the visitor requests for locating, the chatbot asks for a photo of the closest artwork, and returns with a map with a marked location of the painting. The map can be also found from the "Show your location" option.

(1)Message types

The chatbots can deliver messages in multimedia (Fig 2). The common media are text, audio, and images. For the scenario of tour guides, most of the information is about introductions or stories of the artworks, so the messages should be conveyed by words, in audio or text. To test preferences for media types, the chatbot delivers messages in text, audio, and text combined with audio (text&audio). When helping with wayfinding, the bot will send images to show the layout of the exhibition. Additionally, the conversation user interface (CUI) incorporates interaction methods from the graphical user interface (GUI). For example, an options list is used to present different aspects of an artwork that visitors can choose from. The exhibition I researched is about gardens. To align with the theme of the exhibition on gardens, I integrated the locations of the gardens depicted in the paintings onto the map. This allows visitors to not only appreciate the artworks but also know the real-world locations of these gardens.

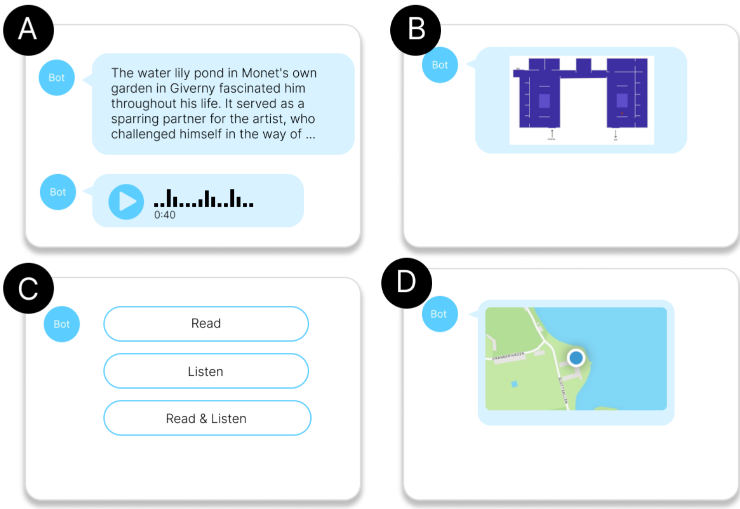


Figure 2: The message types of chatbot. (a) text and audio; (b) image; (c) option; (d) map

(2)Chat flow

Overall, there are two modules included in the chatbot: Introducing the artwork and navigation. At the beginning of the the tour, the chatbot sends a short greeting message. Then the visitor can explore the exhibition with it (Fig 3).

Introduce artwork: Introducing the artwork is the key function of this chatbot. After receiving the query from the visitor, it provides a short summary of the artwork. As a tour guide, the chatbot should be accurate and provide information based on valid content. Then the chatbot will present more aspects of knowledge about this collection, the visitor can either choose their preferred topic or engage in free conversation with the bot. The bot will respond to their questions based on its knowledge base.

Wayfinding Module: From user research at the National Museum, I found that visitors easily got lost in the in-between space. They need to know their location in this exhibition to arrange their next stop. While beacon technology is a common solution for indoor wayfinding, the National Museum prohibits external installations. To address this limitation, I devised a solution utilizing image recognition technology. The chatbot will identify the paintings closest to the visitor and send a map of the exhibition, marking the location of those paintings. This enables visitors to approximate their position and navigate accordingly.

(3)User Experience of the chatbot

The chatbot follows the basic UX principles to ensure good usability.

Provide the guide or hint: In an open conversation, it's essential to provide information about basic usage and the expected topics. I put this message in the first place. When visitors start the bot, the bot will send a greeting message: "Hi, I am a museum robot! Take a photo of a painting in the large exhibition rooms, I can introduce it to you. You can also talk about the painting with me through text or voice."

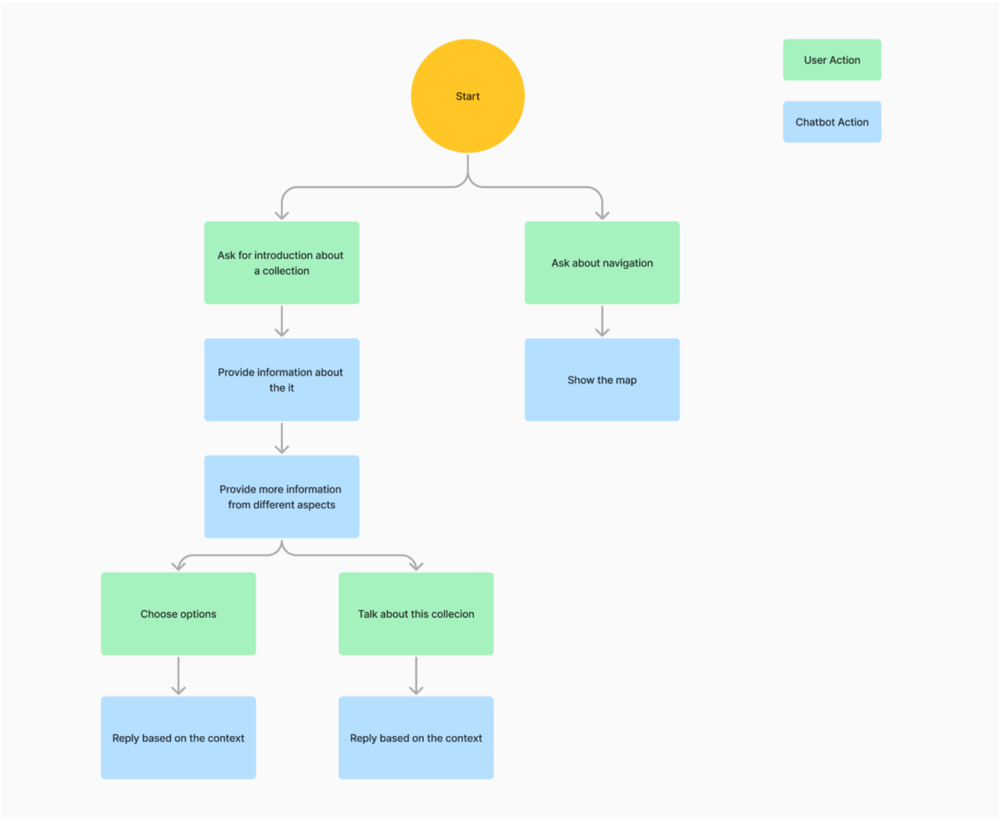


Figure 3: The basic chat flow of the chatbot

Clarify the status: The chatbot cannot send a response immediately. The time in generating content and transforming information may take a few seconds. During the waiting time, the chatbot should show what is happening on the title bar, such as "typing…", "uploading…", "connecting…". This helps manage user expectations and reduces uncertainty during the interaction.

Make messages readable: The length and tone of the content can impact the readability. Long messages should be avoided for both text and audio to make the message more user-friendly.

Declare errors: While using the chatbot, potential errors may occur. In the event of an error, the chatbot should inform users about what went wrong and provide guidance on how to resolve it. In this project, possible errors may include failure to recognize paintings in the database, disconnection from the server, inability to send images, and misunderstanding users' input. For each situation, the chatbot will send a message containing an explanation and guidance.

3.3 Implement

The chatbot ingrates four API services: (1) OpenAI's GPT API(GPT-3.5 Turbo) to generate chatGPT responses, (2) Microsoft Text to Speech (TTS) API to convert text into speech, (3) OpenAI whisper API as Automatic Speech Recognition (ASR) to convert speech into text, and (4) OpenGL to recognize paintings. I integrated the services into the Telegram chat because Telegram is a chat application for free, with message features and comprehensive Bot API documentations and developer tools. The messages are sent to the host machine. It receives text, audio, or an image through Telegram (Fig 4).

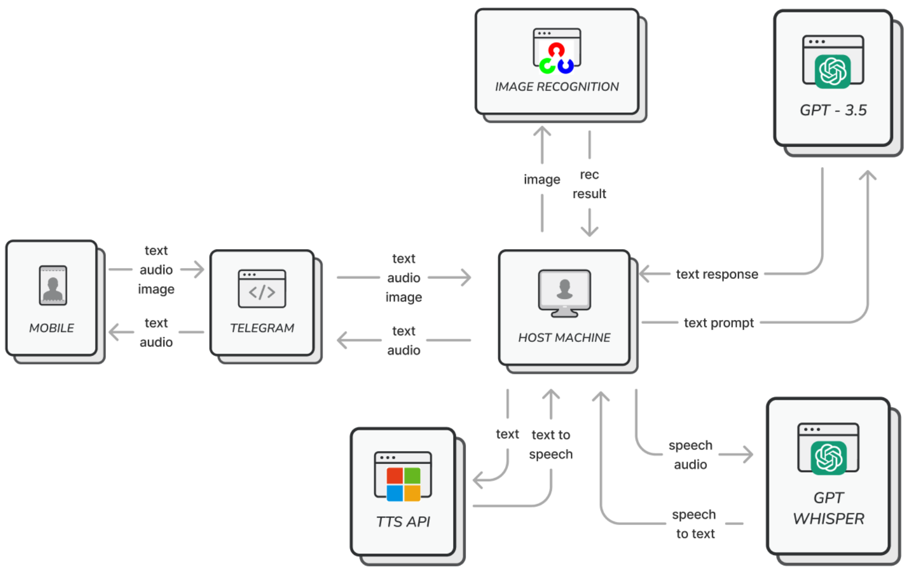


Figure 4: The software architecture of the chatbot

3.3.1 Introduction generation. The large language module (LLM) version for this chatbot is GPT-3.5 Turbo, and it has these main features: introduce artwork like a tour guide, respond to the user, and predict intent.

To set up the chatbot, I prompted it to have a conversation with a friend in a museum, and return results in JSON format as follows: " You will be provided with a conversation with a visitor in a museum. Return the result with JSON format. Your task is to complete the conversation with the context in JSON format. Recognize its intent between "navigation" and "artwork". The "artwork" means the visitor want to know more about an artwork instead of wanting to know how to get a place inside the museum. The "navigation" intent only related to the visitor like to go somewhere inside the museum."

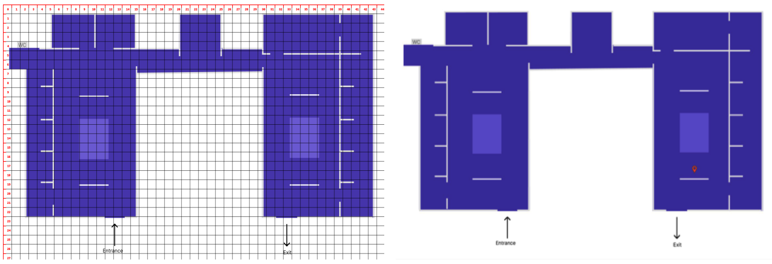
To introduce the artwork, I use the GPT module to generate a short introduction of the artwork. The prompt: "You are visiting a museum with your friend. Based on the text in the given text, summarize it no more than 120 words in a vivid and natural tone."

After a short summary, it abstracts some aspects of the given content that visitors may be interested in. “Based on the given text, select 3 aspects that you think visitors are most eager to know about the painting. Only provide the names of these aspects, and the names should be no more than 5 words, return as string, split with ’,’”

Then generate an introduction for the chosen option with the prompt: “ Introduction the aspect of this option with no more than 70 words.”

The generated introduction is based on the knowledge base, that each collection has a text file including a detailed introduction of the artwork, the artist, and related materials about the content of it. To ensure the content’s accuracy, I collected the knowledge only from valid sources, such as Wikimedia and museum official websites.

3.3.2 Wayfinding. When visitors need to know their position in the exhibition, they can get the map in two ways: by asking the chatbot or choosing the option to know their location after they take a photo of a painting. The map image was grided, and I recorded the position of each painting correlated to the grid. A map marker will be placed on the grid to indicate its position (Fig 5(a), 5(b)).



(a) The grided map (b) placing a marker to show the painting's position

Figure 5: The layout map

4 EVALUATION

To evaluate the museum experience with the chatbot tour guide, I conducted an evaluation comparing the museum experience using the chatbot and the application provided by the National Museum. In this experiment, I tried to answer the research question: To what extent does a chatbot enhance visitors' experiences in art museums compared to museum apps?

4.1 Participants

I recruited 30 participants (14 female, 15 male, and 1 non-binary) aged between 17 and 64 (M = 30.0, SD = 13.7). Half of them tested with the chatbot, and the other half tested with the application. Seventeen of them have visited museums over 5 times a year, four of them visit 3 or 4 times, and nine of them visit museums less than 2 times a year. Twenty participants thought they were good at appreciating artworks and five participants wouldn't like to have guidance when visiting museums.

4.2 Study design

This study was designed to be a comparison evaluation and have one independent variable: the type of guide, which included the chatbot and the app developed by the National Museum. The chatbot introduced the artworks with text, audio or text & audio messages, that visitors can receive the introduction by taking photos of the artwork. Based on the photo of artwork, the chatbot can also find where the visitor's location. Additionally, visitors can ask for more information about an artwork to the chatbot. The app provided introduction of a part of artworks representing in a list. Visitors can look for there interested artwork from the list, and listen to auditory description or read a short version text. The app also showed a map indicates where the artwork was located (Fig 6). After the visits, they filled a questionnaire about their user experience. Through the comparison, I could also know the advantages and disadvantages of the chatbot.

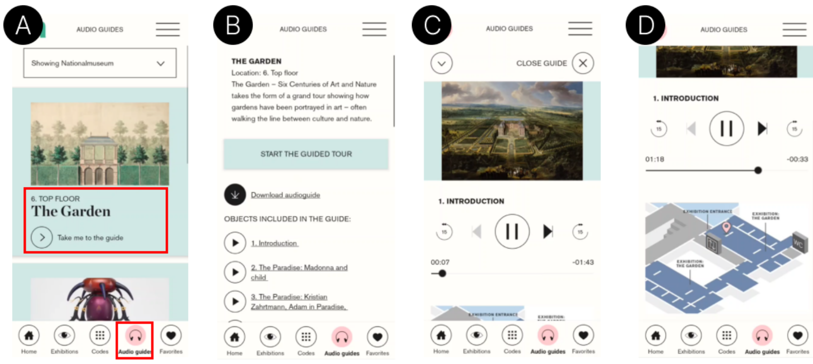


Figure 6: Interaction example of using the museum app: (A) Select an exhibition, (B) Visitors can choose their interested artworks from the list, (C) It provides with audio to introduce the artwork, (D) Locate themselves with the exhibition by scrolling.

4.3 Apparatus

The participants used a Mi A3 Android phone and a pair of earphones in the test. The phone had installed Telegram and Nationalmuseum Visitor Guide app beforehand. I recorded the screenshot video during the whole visiting process, in order to know how participants interacted with it. For the chatbot, I took the chatlog of the interactions.

4.4 Measurement

To investigate the museum experience of the chatbot and the museum app, I measured the following variables:

- `Duration of visiting`: the total time spent on exploring the exhibition.
- `Interaction with audio`: the number of times visitors listened to audio descriptions and the number of times the listen to the audio fully, more than a half and less than half of the audio based on the screen recordings and the chatlog.
- `Frequency of checking own location`: the number of times visitors asked for their location using both the chatbot and the app based on the based on the screen recordings and the chatlog.
- `Chatbot interaction`: the number of photos taken by visitors, the number of times they use the types of introduction message (text, audio, or text & audio), the number of times they asked further questions with the chatbot based on the screen shot video and the chatlog.
- `Content presentation`: at the end of each tour, participants were asked about the content in the app and the chatbot: (1) the length of the text and (2) audio, (3) tone of the voice and (4) the seed of the voice using a 5-point Likert scale (1- strongly disagree, 5- strongly agree).
- `Chatbot experience`:at the end of each tour, participants were asked about their experience using the chatbot: (1) the naturalness of conversations, preference for (2) audio, (3) text, and (4) text & audio, and (5) the options for more information about artworks using a 5-point Likert scale (1- strongly disagree, 5- strongly agree).
- `Tour experience`: at the end of each tour, participants were asked about their experience with the app and the chatbot: (1) the ease of finding information about artworks, (2) learning about the artworks, (3) understanding the exhibition's idea, (4) finding their location in the museum, (5) distraction by the app or the chatbot, (6) interactivity and (7) fun of the experience using a 5-point Likert scale (1- strongly disagree, 5- strongly agree).

4.5 Procedure

I recruited participants from the visitors at the door to the Garden exhibition. After introducing the user test and obtaining informed consent from the participants, I provided a brief overview of the procedures and the usage of Telegram. They were told that if they had any problems with the system or device, they could find me at the exit of the exhibition room. Then they started to explore the exhibition with the test phone and earphones. The visitors could decide the visit time and routes as they will. During the visits, the phone recorded the screen to know how they used the system. After the visit, they filled out a questionnaire about the visit experience and returned the devices to me. The tour duration per participants with the app or chatbot range from 10 to 60 minutes.

5 RESULT

I discovered that participants found the usability between the chatbot and the app to be similar. However, participants showed more engagement using the chatbot than the app. Most participants liked to have the extended content provided by options under the introduction, which helped them learn more about the collection. Additionally, preferences for receiving content through text and audio were about evenly split. Through the interview analysis, I identified the strengths and issues of the chatbot and the app respectively. I outline these findings in detail in the following.

5.1 Quantitative results

5.1.1 APP vs. Chatbot. Participants spent on average 25 minutes with the app and 23 minutes with the chatbot. They looked into about 6.8 artworks introduction to learn about the collection on the app, and 9.1 times on the chatbot. The audio completion rate, which refers to the percentage of audio that participants listened the whole, for the chatbot participants was 77%, and for the app was about 50%. The percentages of listening to more than 50% of the audio but not finishing it, were both around 15%. The number of the chatbot participants who only listened to less than half the audio was much lower than the number app participants.

5.1.2 Chatbot interaction. The participants who used the chatbot took from three to sixteen pictures ($M = 7, SD = 4$) of artworks. To get more information about artworks, they selected to read the message ten times ($M = 2.2, SD = 2.6$), to listen up to seven times ($M = 2.7, SD = 1.9$), and both to read and listen up to sixteen times ($M = 1.9, SD = 4.2$). The visitors chatted with the chatbot up to eight times per tour ($M = 1.4, SD = 2.3$).

5.1.3 Tour experience. I found that the participants found finding information about artworks easier using the chatbot ($Md = 4, IQR = 0$) than the app ($Md = 3, IQR = 1.5$). The participants could learn about the artworks using the chatbot ($Md = 5, IQR = 1$) and the app ($Md = 5, IQR = 1.5$), and understand the idea of the exhibition using the chatbot ($Md = 4, IQR = 2$) and the app ($Md = 4, IQR = 2$). They located themselves using the chatbot ($Md = 3, IQR = 0$) and the app ($Md = 3, IQR = 2.5$). Both the chatbot ($Md = 2, IQR = 2$) and the app ($Md = 2, IQR = 2$) distracted the participants at a low level. Lastly, the visitors found their experience interactive with the chatbot ($Md = 4, IQR = 0.5$) and the app ($Md = 4, IQR = 1.5$), and they had fun using both the chatbot ($Md = 4, IQR = 1.5$) and the app ($Md = 4, IQR = 0.5$). None of these differences between the chatbot and the app were statistically significant, as shown by the Mann-Whitney U test ($p > 0.05$) (Fig 7).

5.1.4 Content presentation. As for the content presentation, the length of the text about artworks was right for both the chatbot ($Md = 3, IQR = 1$) and the app ($Md = 3, IQR = 0$). The same applies to the audio length for the chatbot ($Md = 3, IQR = 0$) and the app ($Md = 3, IQR = 1$). The tone of the voice was pleasant with both the chatbot ($Md = 4, IQR = 2$) and the app ($Md = 4, IQR = 2$). Lastly, the audio speed was appropriate with the chatbot ($Md = 3, IQR = 0.5$)

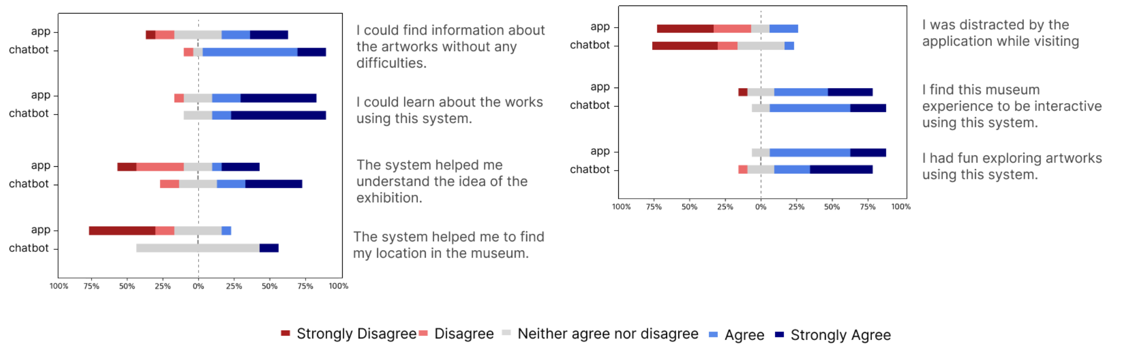


Figure 7: Likert scale results of content presentation: participants were asked to assess their tour experience by answering questions: (1)the ease of finding information about artworks (2)learning about the artworks, (3)understanding the idea of the exhibition, (4) locating themselves using the systems, (5)distraction by the app or the chatbot, (6)interactivity and (7)fun of using the systems using a 5-point Likert scale (1- strongly disagree, 5- strongly agree).

and the app (Md = 3, IQR = 0). None of these differences were statistically significant, as shown by the Mann-Whitney U test ($p > 0.05$) (Fig 8).

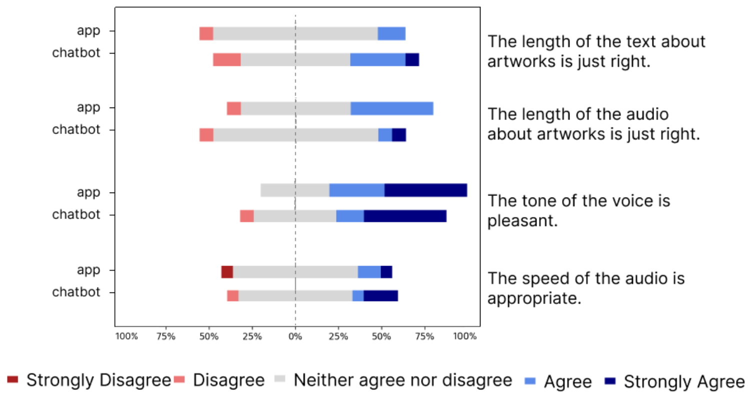


Figure 8: Likert scale results of tour experience: participants were asked to assess the content presentation by answering questions: (1)the length of the text and (2)audio, (3)the tone of the voice, and (4)the speed of the voice using a 5-point Likert scale (1- strongly disagree, 5- strongly agree).

5.1.5 Chatbot experience. As for the experience with the chatbot, the participants found that the chatbot could engage in natural conversations (Md = 3, IQR = 1.5), comparably preferred receiving information using audio (Md = 4, IQR = 1), text (Md = 4, IQR = 2), and text & audio (Md = 3, IQR = 1), and indicated that the option “More info” could help them broaden their view on the exhibition (Md = 5, IQR = 1) (Fig 9).

5.2 Qualitative feedback

Overall, the qualitative results show that museum experience with the chatbot were more positive and fun than the app provided by the museum.

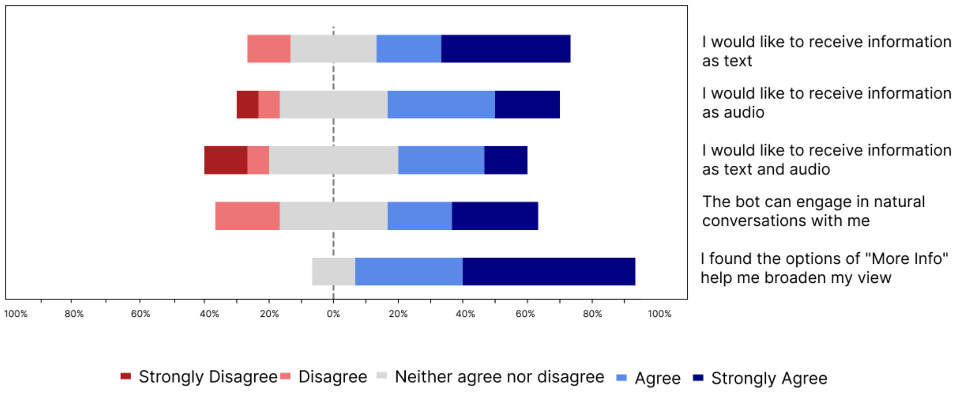


Figure 9: Likert scale results of the chatbot experience: participants were asked to assess the content presentation by answering questions: preference for (1) text, (2) audio, and (3) text&audio, (4) the naturalness of conversations, and (5) the option with more information using a 5-point Likert scale (1- strongly disagree, 5- strongly agree).

5.2.1 Finding the artwork audio. When participants wanted to get information about an artwork, the chatbot could provide it by recognizing the painting. They thought it was simple and convenient, and they could get information quickly. As P4 mentioned: *"It was very simple to use, and a fluid experience which helped gain knowledge of the paintings."* Conversely, the app participants reported that it was hard to find the artwork audios they were interested in. As they noted: *"It's not easy to find the artworks from the list that I want to know."* [P15], and *"the audio is pretty helpful, but it is hard to find specific audios."* [P13].

5.2.2 Informative Content. On one hand, some chatbot participants (N = 7) were satisfied with the content of the chatbot. It was informative that helped them get a deeper understanding of the artwork, and the suggested extra options assisted in getting more information about the artwork. Meanwhile, the length of the information was just right. As the participants' comments: *"It was very good, the bot helped me get a deeper understanding of the artwork itself and the painter in question."*[P20] and *"I liked using the system to get more in-depth knowledge about some of the paintings where the basic information from the museum was a bit lacking."* [P25]. On the other hand, there are drawbacks as well. As a participant reported: *"The text was so academic that might not be accessible to everyone.* [P17] and *"Personally, I don't like audio guides since I prefer reading about it. I felt the texts were a good length and easy to read. Some texts felt a bit like it was very obviously AI-generated, though, which was a bit distracting for me. Overall it gave good information, though!"* [P20]. Moreover, participants mentioned that they could spend more time at paintings and pay more attention to details while using the chatbot: *"It was a great experience for me to get the additional info and learn more about the paintings that interested me. It made me spend more time observing the painting as well with details or info I might have missed otherwise."* [P21] and *"I was generally impressed by the bot. My personal preference are to not have my phone out at an art museum, but I could overcome that for this."* [P18]. Compared with the chatbot, the app participants wanted to have more information (N = 3). They reported that the app only provides a small portion of artwork information. The visitors wanted to have more pieces. For the existing information, it was not enough for those who wanted to learn more about the artwork. A participant said, "I want more information on the history part of the period. There could also be commentary on the artist's personal history."

Table 1: The chatlog of the chatbot participants

Topic	Chatlog
The artist	Who is Gaspar Dughet?
The meaning of the collection	What is Jerusalem Delivered?
The elements in the paintings	What role did excotic birds play in the garden paintings? Can you describe landscape with huntsmen? What's the emotion of the lady? Is it from southern Europe?
Drawing techniques	What's the skill of movement in the sky? Is there any poet like this?
Ask for more info	Give me more info about Hugo Birger Terrace with Peacock? You already told me this information i want more info on this painting?
Comment	ChatGPT offered a reductionist interpretation of the tale of Ariadne The painting also refers to Bacchus. ChatGPT should clarify Roman v. Greek

5.2.3 Audio. The participants (N = 3) liked the audio because it had a pleasant voice and spoke at a good tempo. But the app participants (N = 3) mentioned that the tone was a bit sleepy: *"I like the audio speaks in a natural way, but it made me sleepy sometimes."* and they suggested that the voice could be more vivid and motivated.

5.2.4 Chat with the bot. The chat logs are grouped in the Table 1. Most of them were questions about the collections. They asked about the artist, the meaning of the collection, the elements and techniques of the artworks, and some of them asked for more info about it in general. The chat logs are grouped in Table 1.

5.2.5 Issues. There were some issues the chatbot participants met during the testing. Firstly, the errors in image recognition were the most serious, that it might recognize a wrong painting, couldn't recognize a painting from special angles, or the painting was not included in the database. The participants felt annoyed when they got a wrong recognition result. They stopped using the chatbot when the errors occured 3 times. Secondly, they (N = 2) couldn't set the chatbot in their native language, *"native language could be better to add more information."* Thirdly, it took time to generate the content, which was about 5 seconds.

6 DISCUSSION

I discovered that the usability of the chatbot was almost equivalent to the app. However, the participants found that the convenience led by image recognition to get information about artworks was more seamless, and enjoyed the interaction with the chatbot based on the qualitative feedback. Lastly, the participants were more engaged in the exhibition with the chatbot because it was convenient to get AI-generated content about the artworks, and they could ask for more info from options or chat with the bot.

6.1 Usability

I tested the usability by comparing the systems from learnability, convenience, and distraction aspects. I discovered that both the chatbot and the app are easy to learn, and don't distract the visitors by limited interactions. Detecting the paintings by recognizing images made it convenient to receive information about the paintings. Compared with inputting codes, this method saves a few interaction steps. And it's with higher accuracy compared to the NFC approach, especially when the collections are displayed closely. For the other feature, wayfinding, although it got the same average rating as the application, it was rated with a high score when removing the ones who didn't use the feature. It shows that pointing out their location in the exhibition space helps visitors in navigation. Lastly, there were not a lot of interactions with the system that distracted the visitors. It fits the context of art museums where watching artworks is the main activity, and it may have different requirements in science and technology museums.

6.2 Content

The chatbot participants found that the content given by the AI was informative and they could gain more knowledge from their respective perspectives of interest. The “More info” options that followed the introductions provided more aspects to extend the knowledge. It was also helpful to ask questions about the artwork to the chatbot, getting more information beyond the given introduction and options. This method is an effective way to meet visitors’ personal contexts, encompassing different levels of knowledge backgrounds and art appreciation skills. However, the generative content heavily relies on the data in the knowledge base. Some of the chatbot’s replies on an artwork included repetitive info because there was not enough introduction data for that artwork. It usually happens with lesser-known artworks or artists.

6.3 Interactive & Enjoyment

The chatbot tour guide was interactive for the visitors, and they felt enjoyment using it while visiting. I think it comes from these aspects: the tone of the message is friendly, and they can converse with the bot. Fristly, his light tone may come from the prompt: “You are visiting a museum with your friend. . . . in a vivid and natural tone.” which the AI avoids using complex phrases. Additionally, the TTS audio is set at a slightly faster speed and utilizes with a young male voice, preventing visitors from feeling bored or sleepy. Secondly, engaging with the bot through chat facilitated active connections with the artworks. Similar to interacting with a human tour guide in a museum, visitors can ask questions or share their thoughts thereby fostering a sense of connection. In this way, the chatbot effectively serves as a friendly tour guide, facilitating communication and engagement with the art.

6.4 Chatbot on demand

I found that of various ages had different attitudes towards the app and the chatbot. The average age of chatbot participants is 28, and the app is 37. When I invited participants to test the chatbot, senior visitors always turned me down and they preferred to use the app or the audio guide equipment. Conversely, the young visitors were willing to try the new interactive methods to explore the exhibition. Additionally, the chatbot was provided in English, and some participants reported that they couldn’t understand all of the information because it was not in their native language. Moreover, the image recognition accuracy, 79%, affected the satisfaction with the chatbot. The visitors showed impatiently or even stopped using it when it recognized wrongly more than two times. Finally, the testing device was not the participants’, so they were not familiar with it, leading to mistap, keyboard errors and taking time to learn the usage of the phone. This decreased the user experience and may have affected their judgment of the usability.

7 LIMITATIONS AND FUTURE WORK

The user experience mainly depends on the interactions and the content. In this chatbot project, I think the limitations mostly come from the content. Although the introduction content generated by the GPT model gained high satisfaction, there are limitations in accuracy and stability. Accuracy has not been evaluated by museum professionals. Even though it was summarized from valid content, it might be possible that the language model makes up some knowledge beyond that. The stability is affected by the model because the generated content may differ slightly even when using the same prompt. As a result, it’s necessary to review the generated content regularly. More than that, the knowledge base for this chatbot only covered one third of the exhibition collections. It took a lot of time to collect valid knowledge about the artworks. Preparing the knowledge base will involve an amount of workload if we want to cover the whole museum collection.

From the view of museum visiting experience, the chatbot considers the personal context by providing different content and physical context by wayfinding feature, but it ignores the social context. While participants visited the exhibition in pairs, both the app and chatbot separated them. They only interacted or chatted with the systems instead of talking with their companions. The chatbot, a connector between visitors and collections, also needs to connect between visitors.

I found that there is some future work that can improve the chatbot:

(1) Making the chatbot accessible on the web would enable users to access it through any smartphone without the need for downloading.

(2) Offering the chatbot in multiple languages would allow visitors to access information in their native language, enhancing their experience.

(3) Enhancing the chatbot's knowledge base with additional information about artworks would improve its ability to generate high-quality content.

(4) Since the chatbot is designed for general exhibitions, further evaluations may be necessary in other museum settings to ensure its effectiveness across different contexts.

8 CONCLUSION

In this project, I proposed the design and implementation of a smartphone-based chatbot based on chatGPT as a tour guide in museums. And I evaluated the chatbot by comparing it with the museum's developed app. The results indicate that the participants were more engaged in the exhibition when using the chatbot. However, I did not observe differences between the chatbot and the app in learning about the exhibition, locating visitors in the museum, or having fun exploring the artworks. Futhermore, I discovered that the chatbot could meet visitors' personal contexts by providing content options and chat services, and help them know about the physical space through wayfinding maps. Lastly, the chatbot participants reported that the museum with the chatbot was interactive and fun.

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