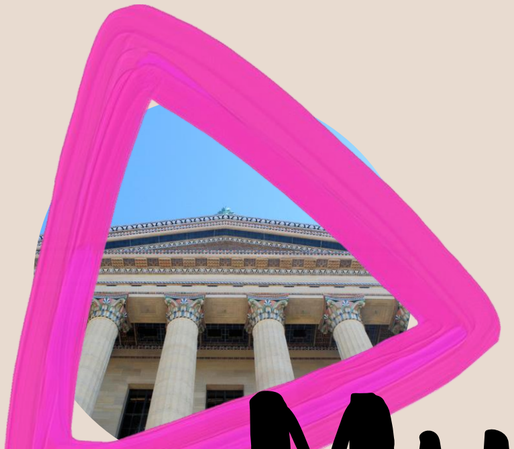


HISTORY AT YOUR FINGERTIPS, TAILORED FOR SENIORS

MuseumMate APP & smartwatch

Design by Qingfeng Huang

Abstract

Museums serve as important activity spaces for senior visitors. However, senior visitors' decreasing vision and reading abilities often make it difficult to recognize the small-size artefact description labels. Despite their interest in the history and background of these items, elderly visitors, who typically have declining cognitive and memory abilities, need more time for deeper interpretation. Senior visitors also find it challenging to navigate museums due to physical limitations and unfamiliarity with the museum environment.

The MuseumMate application and MuseumMate smartwatch can benefit seniors in museums. The application features augmented reality (AR) technology, providing elderly visitors with clear 3D views and descriptions of artefacts. Additionally, the MuseumMate smartwatch allows them to adjust the perspective of these 3D artefacts. Such real-time interactive methods enhance the engagement between elderly visitors and museum artefacts. In addition, the MuseumMate application can use a voice-guided feature to read out the artefact descriptions for elderly visitors to gain a better understanding of heritage culture (Hu et al, 2023). With MuseumMate's app map feature, elderly visitors can use sound play and large navigation route signs on their MuseumMate smartwatch to navigate specific exhibition areas. The MuseumMate app informs elderly visitors about crowd presence in specific exhibit areas and generates the appropriate route for them, planning a reasonable tour route to facilitate elderly visitors enjoying the museum fully (Tesoriero et al, 2014).

In addition, the MuseumMate application contains the drawing feature, integrated with smartwatch electromyography technology. Electromyography (EMG) technology in smartwatches detects elderly viewers‘ arm muscle memory and motor activity and controls the MuseumMate app drawing feature through gestures (Patibanda et al, 2018). By using this drawing feature, this smartwatch and application can enhance elderly visitors’ sensory-motor systems to improve their understanding and memory of artefacts. Moreover, The MuseumMate smartwatch includes emergency alarm features, ensuring elderly visitors can immediately notify museum staff if needed. By combine AR and EMG technology in MuseumMate can benefit elderly visitors with a more convenient and engagement museum experience.

Target Group & Research

User Groups:

The museum is an important venue for cultural exchange and provides a rich cultural experience, allowing seniors to appreciate different cultures' artifacts and artwork. According to Retcho (2017), the majority of museum visitors are between the ages of 50 and 80. Research by Dickey et al. (2009) indicates that seniors aged 65 and above often experience declines in cognitive ability, memory, vision, and physical functionality. Therefore, the MuseumMate application and MuseumMate smartwatch is designed for seniors between the ages of 60 and 80+, as digital technology benefits elderly physical health. It can enhance their memory, affect, cognitive abilities, and physiological functions (Ladly et al, 2017).

(Source from: Gstudioimagen1. (2022))

Research Context:

Elderly visitors face several challenges when visiting museums, such as reduced vision and reading ability, they can experience difficulty reading display labels or interpretive text, difficulty in closely observing artifacts behind glass, and unfamiliarity with the museum environment, especially on their first visit. These difficulties encountered during the visit can negatively impact the quality of their experience, preventing elderly visitors from enjoying the museum fully (Poria, et. al, 2009).

(Source from: Macrovector. (2021))

Tap This To My Research

Research

My Design Goals and How Technology Support My Ideas

In the context of previous research, it is evident that due to aging, seniors experience a decline in various organ functions. This results in an inability to fully enjoy the museum experience when visiting. However, the goals of MuseumMate app and smartwatch, can enhance the museum viewing experience for the elderly. Combine with the AR and EMG technologies can improve their memory, cognition, and learning abilities, as well as enhance their physical condition through interactive processes.

1. Combined AR technology in application to enhance the elderly perception

- The AR technology used in my MuseumMate app overlays the UI annotation on top of real-world objects in the form of a virtual tooltip. In this application, elderly visitors can interact with traditional static artefacts and enhance their engagement through 3D dimensional artefacts and text descriptions that facilitate their active learning and enhanced elderly visitors' perception resulting from knowledge gained about the 3D artefacts effect (Harrington et.al ,2021).

2. Combined EMG technology in smartwatch ensures that elderly visitors can enjoy a safe museum experience

- Physical well-being is crucial for elderly visitors during museum tours, as museums often require prolonged periods of walking, leading to significant physical exertion. However, wearing a smartwatch equipped with EMG technology can more accurately monitor the heart rate data of elderly individuals (Friman et,al. 2022). Additionally, it can promptly notify museum staff in emergencies, ensuring a safer visit for seniors in the museum.

3. Easy simple and secures way of using Museumate App

- When developing the Museumate App, considering that the elderly might forget passwords and account details, facial recognition was implemented to facilitate easier app usage for senior users. To ensure the security of elderly users, an account login feature was also added. Based on user preferences, Ubam et al (2021) conclude that seniors tend to favours simple facial recognition for logging in. Additionally, the interface features large buttons, simple backgrounds, bold color blocks, and prominent colors, making the software more user-friendly for the elderly.

4. Easy navigation of combine smartwatch device help elderly reduce the frenquency of getting lost

- In the navigation features for elderly users, the use of MuseumMate smartwatch as an external device with voice function support can significantly improve usability for seniors. According to research by Goodman et al. (2005), navigation assistance devices have been proven to effectively support elderly individuals by reducing navigation time and decreasing the frequency of getting lost.

5. Drawing feature can enhance the elderly physical well-being and memory

As people age, their risk of developing Alzheimer's disease increases as well as their ability to remember things. During the museum visit, mere textual descriptions of artefacts are often not enough to deepen elderly visitors' memory of the artefacts. Combining the MuseumMate app and smartwatch EMG technology for drawing can help seniors drawing artefacts through their imagination and gesture. The drawing feature in the MuseumMate app allows the elderly to engage their emotions and creativity in their brain centers. This psychological health therapy uses the creative process of art-making to improve seniors' physical, mental, and emotional well-being and memory. It also deepens their impression and understanding of the artefacts (Chow et, al, 2017).

6. The SOS button can help elderly visitors to receive timely assistance.

The MuseumMate Smartwatch features an SOS call button, this can help elderly or disabled visitors to call for museum staff if they feel unwell and send the exactly location to staff. This smartwatch SOS feature on the smartwatch serves as an assistive tool and acts as a facilitator to improve and encourage meaningful of senior's visitors and other attendees in museum activities (Lersilp et,al, 2020).

Discuss similar case studies

In this study, I will be comparing the pros and cons of popular guide systems and online apps on the market. By comparing these two solutions, it will be possible to better understand how they differ in helping to enhance the museum visit experience for my design.

Louvre Museum Buddy App

Advantage:

- **INTERACTIVE MAPS:** Easy to use the maps. Helps visitors zip through the numerous rooms at the museum without getting lost.
- **INFORMATIVE:** informative and interesting commentaries

Disadvantage:

- Lack of accessibility: The lack of a language switching option which limits its accessibility to a diverse visitors' base.
- Hinder a fully immersive and interactive visitors experience: As offers only two-dimensional image, lacking a three-dimensional visual appearance for visitor.

British Museum Buddy App

Advantage

- Easy to using : the interface is easy and navigation menu will directly be showing what is about.
- Voice guide features: allows for hands-free operation and provides an accessible, user-friendly way for individuals to receive information

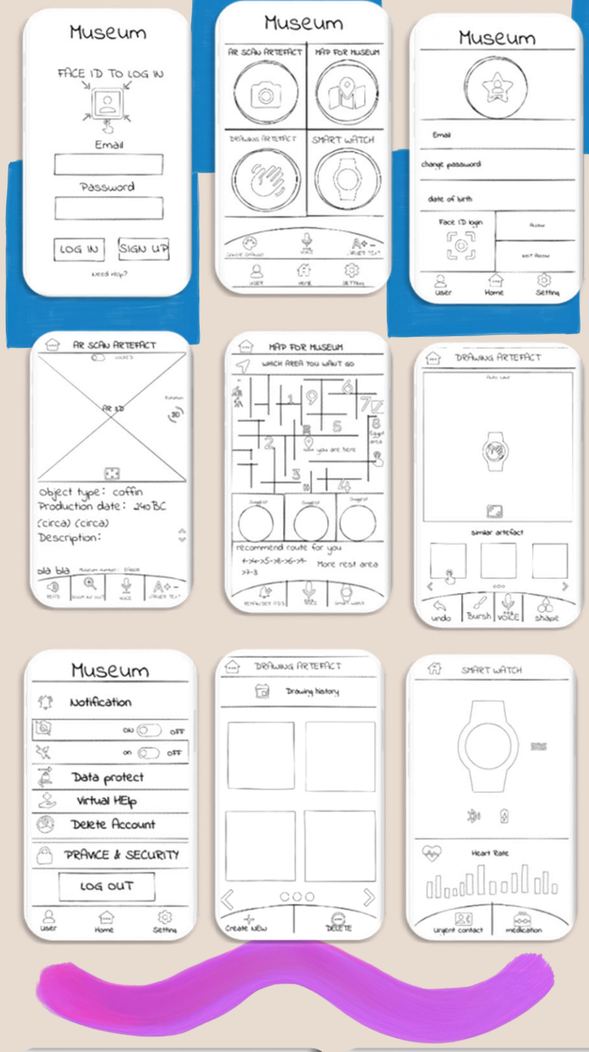
Disadvantages

- Lack of accessibility for user interface: small size of the icons in the application, for elderly people or with visual disability could not be easy to see.

Tap This To My Research

MuseumMate APP Design Process

First Sketch



Discarded Ideas and Changes

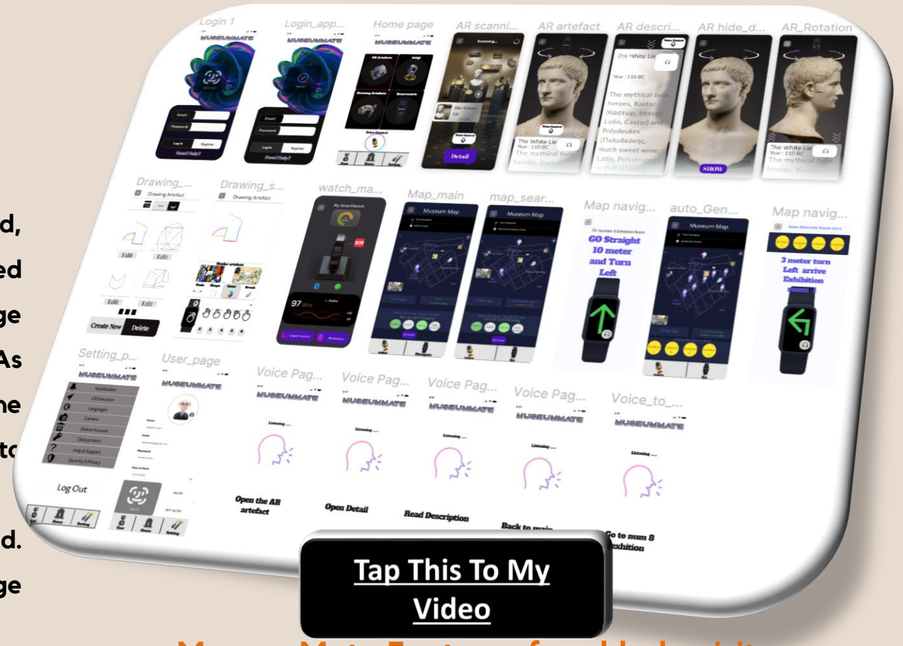
1. In the first Sketch, features like a font size enlargement button were included, considering that elderly users might need larger text. However, later it I was realized that seniors might find it difficult to operate small function buttons. Therefore, it change with simple 3D icons, were to help elderly users easily identify the function keys. As Phiriyapokanon (2011) point out that the small details in the interface design are the principal factors that easily distract the attention of older individuals. In comparison to detailed decorations, the use of relevant graphics and pictures is more important.
2. In the initial draft, the option to select different languages was inadvertently omitted. After considering the wider user base during testing, I added a language change feature in the settings menu.
3. The artefacts were rendered in 3D particle effects using TouchDesign tool, but the following considerations were change to AR technology.

- **Reduced Accessibility:** difficult for some elderly visitors to view or interact with impaired motor skills or cognitive functions.
- **Physical Discomfort**: Prolonged exposure to intense 3D visuals could lead to dizziness for elderly visitors.

Tap This To My Design Process

Tap This To My UI Research

MuseumMate App Design



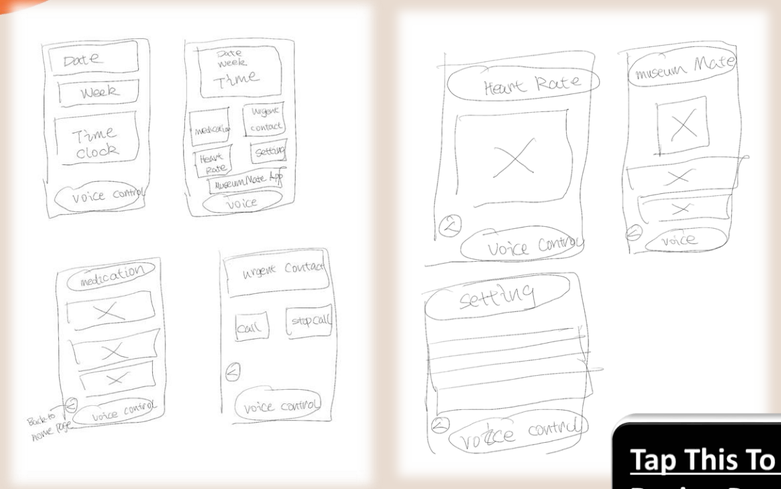
Tap This To My Video

MuseumMate Features for elderly visitors

- AR for viewing 3D texts and combined with smartwatch for visual control.
- Voice playback of artifact texts, with options to expand and large texts
- Ability to draw using the smartwatch, along with recommendations of similar artifacts based on line and color of the elderly drawing.
- Navigation to desired exhibition areas with personalized route generation, and integration with the smartwatch for enhanced safety while navigating stairs
- Ability to check the smartwatch's battery level, and set up emergency contacts and medication reminders
- Voice control capabilities for the software's functions, making it more convenient for elderly visitors to operate.
- Facial recognition login allows elderly visitors to access the system without needing to remember a password
- Personalized adjustment of privacy and security settings, such as camera activation and location tracking, to ensure the data safety of elderly user

MuseumMate Smartwatch Design Process

Sketch



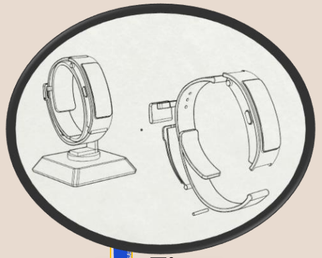
Final Smartwatch Interface

Tap This To My Design Process

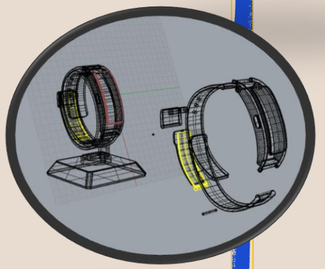
This was my initial draft, where I sketched the basic design of the watch interface in a notebook. In the final design, I incorporated simple colors and icons.

The MuseumMate smartwatch has several features.

1. **Medication Reminder:** As museum visits can be long time, this feature helps the elderly take their medication on time without having to remember it themselves.
2. **Emergency Contacts:** Ensuring that in case of an emergency during their visit, elderly visitors can directly contact family members, especially useful in sudden health episodes when museum staff may not be familiar with the individual's needs. 'Family and caregivers are the most effective contacts in such situations.
3. **Heart Rate Monitoring:** To ensure that the elderly visitor's heartbeat is healthy. This is particularly important in interactive exhibit areas for visitors with heart conditions, allowing for real-time monitoring and, if necessary, contacting emergency contacts.
4. **Link with the MuseumMate App:** Which allows disconnecting from EMG technology monitoring when not using navigation and drawing features. This ensures that when not in use, excessive data isn't collected on the smartwatch, keeping data collection within a controllable range.
5. **Settings:** All features can be turned on or off, ensuring the privacy and safety of elderly users.

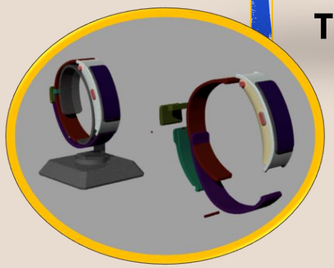


First stage Drawin



Second stage Wireframe

Third stage



Add Render color

Tap This To My Research

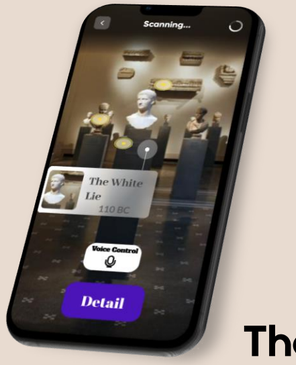
Tap This To My Video

Final Outcome

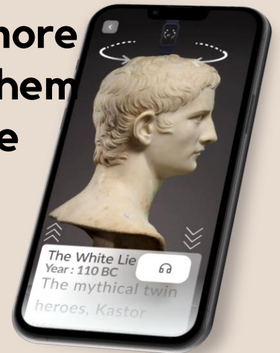
Features

1. The watch is designed with an emergency call button. When elderly visitors are in an emergency, pressing this button twice in succession will contact museum staff.
2. The long screen design is to ensure elderly users can see navigation signs and icon more clearly when using the navigation feature.

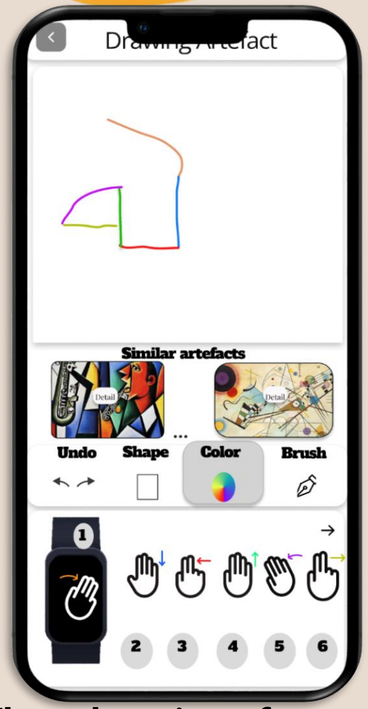
AR Feature

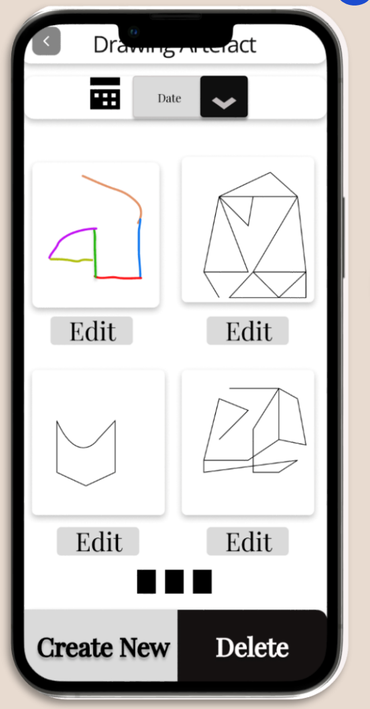


The AR feature allows scanning of real artifacts in the museum. Based on the scene in front of the camera, it displays 3D images of the artifacts for elderly visitors. This can expand on the text and also use listens icon to read artefacts description for elderly visitors and it can use voice control to control any functions. Additionally, in conjunction with the smartwatch, they can rotate the 3D images of the artifacts for more convenient viewing, providing them with a better museum experience



Drawing Feature





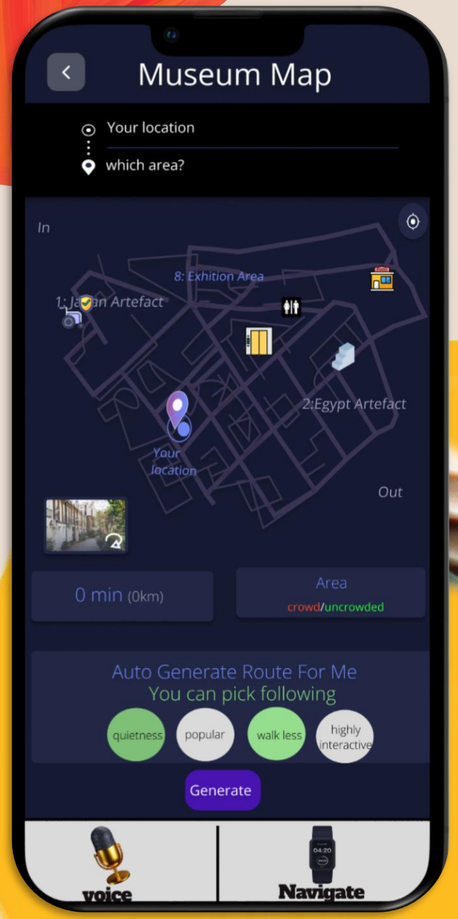
Source From: OpenAI's DALL-E, 2023

Source From: OpenAI's DALL-E, 2023

The drawing feature, linked to the MuseumMate smartwatch, allows elderly visitors to create their own artworks without having to drawing the phone screen. On this drawing feature, they can produce new art pieces or delete previous ones. Based on the artworks drawn by the elderly visitors, similar artifacts are recommended, deepening their impression of the artifacts. The interface displays a simulation of hand gestures to better help elderly visitors in understanding the drawing process. They can also change the color of the brush and add patterns, enabling the elderly visitors to interact more effectively in the museum and enrich their experience.

Map Feature

The MuseumMate navigation system combined with the smartwatch will accurately recognize and locate the elderly visitor's position in the museum venue, calculate the nearest route to reach the target point, and through the movement of the visitor's position inform the elderly visitor whether they need to turn left or right, or go up or down the stairs and nearest accessibility facility etc. This application can help them get to the exhibition area they want to visit efficiently. The display on the smartwatch's screen navigation signal and voice features can assist elderly people in navigating stairs without the need to hold a phone, especially helpful for those with mobility issues to prevent falls.

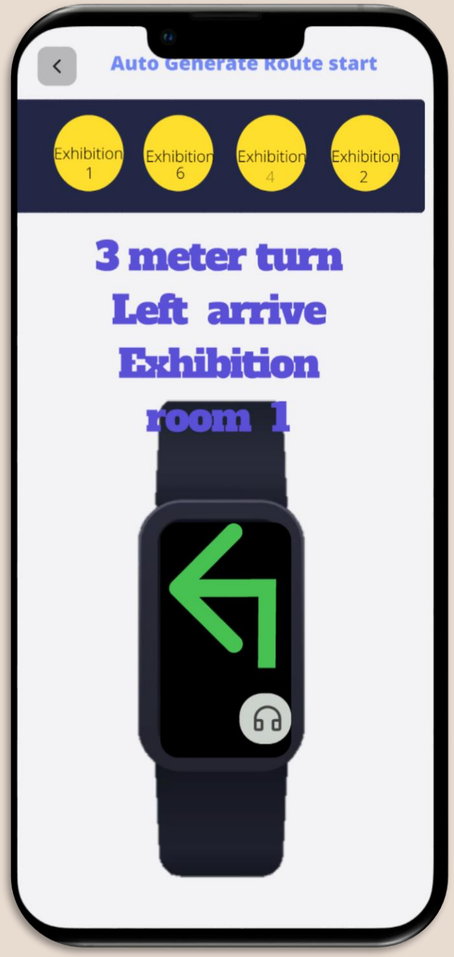


(Source From: OpenAI's DALL-E, 2023)

In MuseumMate App design, I also considered first-time elderly visitors who are unfamiliar with the museum's layout. They can use app to generated a personalized path for them. Moreover, this design consider that senior visitors might prefer less noisy areas, several options are available for selection.

In MuseumMate Auto Generate Route has serval features:

1. Quietness: To avoid peak viewing areas.
2. Highly Interactive: For seniors who enjoy interactive exhibits.
3. Popular: Guiding them to well-known exhibits; and considering their mobility challenges, 'Near Convenient Facilities.
4. Less Walk: Options are included to provide a better viewing experience for elderly visitors.



Example of Interaction by voice feature

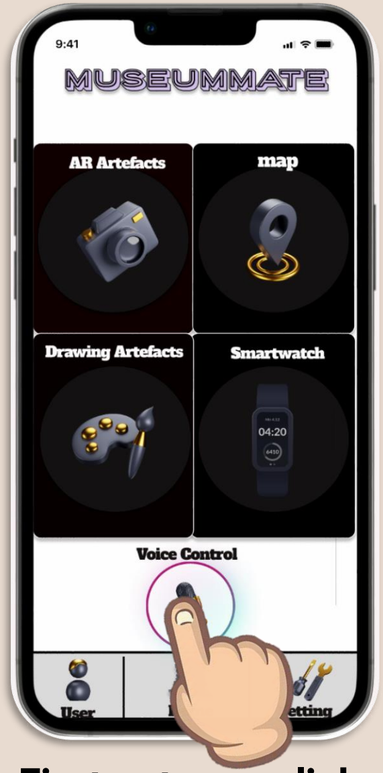
How to input you voice commands

Simply tap the 'Voice control function'

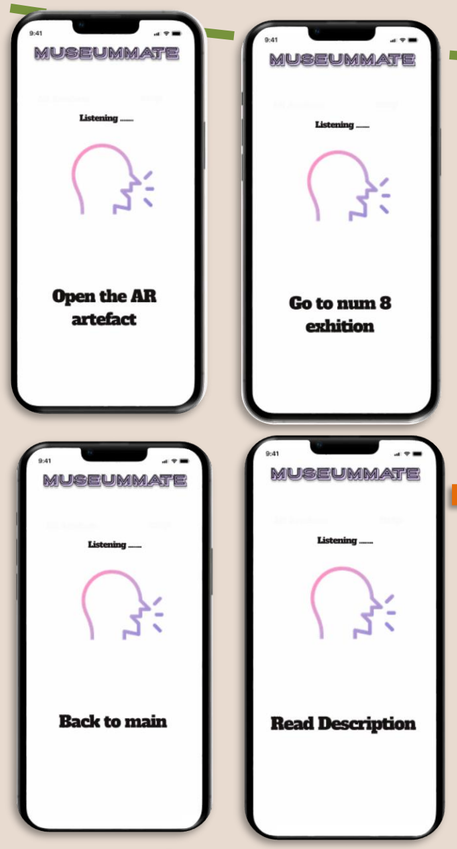
You can say:

- Open AR artifacts
- Back to Main page
- Read Description
- Go to Number 8 Exhibition Area

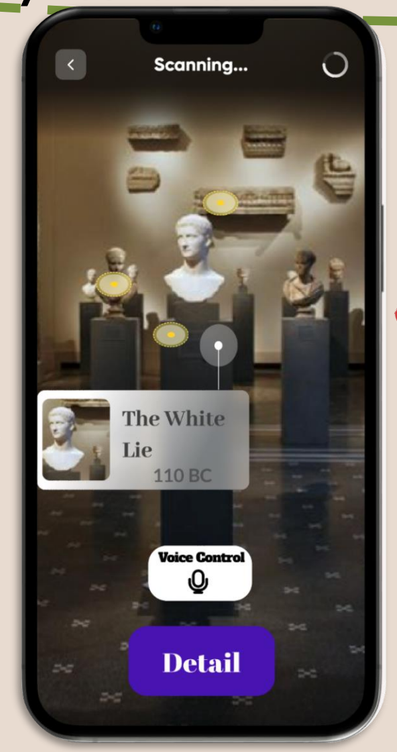
MuseumMate voice control is easy to use and convenient for elderly users. Based on their instructions, the system executes tasks. Considering the high volume of visitors in museums, simple and short commands can easily capture the keyword in elderly user's voice.



1. First step: click the 'Voice Control' button, simply with a single tap.



2. Second step: you can input the voice,such as open the AR artefacts



3. Final outcome: It will be directly taken you to the AR artifacts feature page

Reflection on my project

Evaluation using cognitive walkthroughs methods

Users List/place/situation

- The primary design intention was for elderly visitors in museums. However, the MuseumMate app can also to help disabled individuals and other group of people in need of support at museum places.

Sample Tasks

1. Navigating the museum using the app's MuseumMate map and smartwatch to show the navigation sign.
2. Showing the information for the exhibition area if is crowd/ Uncrewed information.
3. Viewing 3D artefacts and read artefacts description using AR technology, by rotating the 3D artefacts using smartwatch.
4. Using the voice-guided feature for artefact descriptions and navigate route.
5. Engaging with the drawing feature through smartwatch EMG technology and Museum app.
6. Voice control for functional button.
7. Activating the SOS alarm , medication remainder and emergency contact feature in case of need.

Product Interface:

- Interface Overview: AR view, voice guidance, navigation maps, drawing feature, and smartwatch device connection page, user page and setting page.

Alarm Test

The emergency/SOS alarm feature of the MuseumMate smartwatch is designed to prevent any physical discomfort or emergencies that elderly visitors might experience during their museum visit. It enables timely notification to museum staff in such situations. Located on the right side of the watch, the button is red to help seniors easily identify it. Upon pressing the emergency button, the location of the visitor within the exhibition area is sent to the museum's internal system, this button is easy for elderly visitor to used when is necessary， which result of facilitating the quick location of the elderly individual in distress

AR Artefacts feature Test

In the Cognitive Walkthrough test, the MuseumMate's AR artifact feature allowed elderly visitors to instantly scan their environment by clicking on an icon during their museum visit. This scanning process displays the artifacts in front of them. The 3D view angle of the artifacts can be changed by a clockwise rotation gesture, enhancing the interactivity between elderly visitors and the museum artifacts

Map feature Test

In the Cognitive Walkthrough test, the MuseumMate app navigation feature was found to effectively help and guide elderly visitors to their desired exhibition areas during their museum tours. It also helps first-time elderly visitors to the museum by generating a more suitable visiting route. Utilizing the MuseumMate smartwatch and its voice playback functionality for guidance allows for better assistance, especially when going up and down stairs, as it eliminates the need to hold a phone. Furthermore, the large navigation arrows and clear, simplistic voice guide can provide clearer direction

Drawing Feature test

In the Cognitive Walkthrough test, the drawing feature of the MuseumMate allowed elderly visitors to create their own artwork during their museum visit. Through the smartwatch's muscle detection system, gestures are translated into brushstrokes. This feature also includes recommendations of similar artifacts based on the elderly person's drawing lines. During its use, this functionality not only deepens the elderly visitors' memory of the artifacts but also provides an opportunity for them to exercise their arms

Possible Improvement

1. **Customizable AR Experience:** Allow elderly users to adjust the complexity of the AR experience (such as the level of detail in 3D models) to decide to their personal comfort levels and prevent sensory overload.

2. **Feedback on Emergency Alerts:** Provide immediate audio or haptic feedback to confirm that an emergency alert has been successfully sent to the museum staff

3. **Battery Life Optimization:** Since museum visits can be lengthy, ensuring the device has sufficient battery life or providing a power-saving mode will be beneficial for elderly visitors

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