

2025

Final Report

HUMAN COMPUTER INTERACTION

Team: PULLSH

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1. Intro

Project Name: My Museum Adventure.

The value proposition is: “*Your museum! Your rules! Explore the museum with interactive maps and enjoyable explanations*”

1.1 Members and team name

The team is composed of four people:

- Flavia Calabrese, 23 years old, enrolled in the Software Engineering Curriculum of Computer Engineering
- Francesco Di Santo, 23 years old, enrolled in the Graphic & Multimedia Curriculum of Computer Engineering
- Salvatore Giugliano, 26 years old, enrolled in the Graphic & Multimedia Curriculum of Computer Engineering
- Giovanna Rosace, 26 years old, enrolled in the Graphic & Multimedia Curriculum of Computer Engineering

Team name: PULLSH

1.3 Solution Overview

The problem we identified is that kids visiting museums often have difficulty understanding the descriptions, and many times they become bored with the content they are looking at.

The solution we developed is an app that allows kids to choose their preferences and creates a tailored tour for them. The app provides descriptions in both text and audio formats. Additionally, we added a **treasure hunt** feature to further engage them.

Chapter 1: Need-finding

2. Domain of interest

Our team was assigned the topic "Playful exploration of the world". After a brainstorming session, we decided to focus on the domain of "Children's Visits to Museums," specifically targeting children aged 6 to 12. We decided to focus on this area because museum tours for kids are not very developed, and the interactions inside museums are often not engaging for children. Additionally, these types of places may not seem very interesting from a child's perspective.

3. Methodology

Our team identified the children as Immediate Users, the museum guide as the Domain Expert, and the school teacher as the Lead User. All interviews were conducted in Italian.

2.1 Participants

We interviewed four female children, aged 6 to 11 years, the individual responsible for the guides and the organisation of educational activities at the Museo Nazionale del Cinema (aged 51), and a primary school teacher (aged 59).

We visited the Museo Nazionale del Cinema to observe how children behave during their visit. At the end of the tour, we waited at the museum exit, and, with prior written consent from their parents, we interviewed the children to analyse their immediate reactions following the tour.

We selected a primary school teacher as the Lead User due to her extensive experience working with children during guided tours and her ability to understand and meet their needs. The consent form can be found at this [link](#).¹

2.2 Questions and Observations

The questions asked to the children were:

1. How many times have you been to a museum in the last year? 1, 2, 3 or more
2. If you've been to multiple museums, which one did you like the most and which one did you like the least?
3. Tell me about something you like and something you don't like about going to the museum?
4. Have you ever participated in a workshop in a museum?
 1. Which aspect did you like the most and which least?
5. Before coming to the museum, what did you expect to see?
6. On a scale of 1 to 5, how interesting was the visit to the museum? Where 1 is equivalent to "not very interesting" and 5 to "super interesting"
7. Tell me about 3 things you saw at the museum?
8. Tell me one thing you liked more and one less inside the museum
 1. How did you find it?
 2. Why are you telling me about this?
 3. Did you want to see more things like this or not?
9. Tell me something you learned at the museum?

¹ Link: <https://github.com/polito-hci-2024/PULLSH/blob/main/A1/Authorization%20documents.pdf>

10. Tell me something you did during the visit that you particularly enjoyed doing?
 1. Which one less?
11. What emotions did you feel during your visit to the museum?
12. Among all the things you've seen, what would you like to learn
13. How long did the visit last?
14. Was this a guided view you did?
 1. What was the aspect that you liked the most?
 2. Which one less?
15. On a scale of 1 to 5, how much did you feel off during the visit? Where 1 is "not at all lost" and 5 is "so much lost"
16. How did you move inside the museum?
17. On a scale of 1 to 5, how tired did you get during the visit? Where 1 is "I'm not tired" and 5 is "so much"
 1. [3,4,5] What made you tired the most?

The questions asked to the tour guide were:

1. How is the program of a museum visit determined?
2. How are students prepared before the visit?
3. Can you list 3 pros and 3 cons of a museum visit?
4. How do you manage museum trips with the presence of children requiring special support?
5. What aspects do you consider fundamental when choosing a museum for a school trip?
6. What educational objectives do you aim to achieve with the museum visit?
7. How would you describe the emotional state of the children at the beginning of the visit?
8. How would you describe their emotional state at the end of the visit?
9. On a scale of 1 to 5, where 1 is not effective at all and 5 is extremely effective, how would you rate the effectiveness of the museum visit in relation to the topics covered in class, and why?
10. How do you collaborate with museum staff to plan the visit?
11. On a scale of 1 to 5, where 1 is not effective at all and 5 is extremely effective, how would you rate the presence of workshops and/or activities to be carried out inside a museum, and why?
12. How do you ensure the safety of children during the visit?
13. How do you evaluate the children's interaction with technological tools provided by the museum to support the visit?
14. Which topics or themes do your students find most interesting during museum visits?

The questions asked to the teacher were:

1. How long have you been doing this job?
2. How long have you been working in this museum?
3. Can you list 3 pros and 3 cons of guiding children?
4. What is the strangest question a child has asked you, if there has been one?
5. What are the differences between children visiting with school and those visiting with their families?
6. If you use any particular strategies to keep children's attention, can you share which one works best?
7. If you use techniques to explain things more easily to children, can you tell us which is the most effective?
8. What initiatives does the museum offer to schools?
9. Can you explain how children are managed during workshops?
10. How are the workshops proposed to schools created?

11. How would you describe the emotional state of children at the beginning of the visit?
12. How would you describe their emotional state at the end of the visit?
13. How is the safety of the museum ensured when there is a group of children?
14. How do you manage visits that include children with special needs and/or disabilities?

In addition to the primary questions, we asked follow-up questions based on the participants' responses during the interviews. Inside the museum, our focus was on observing the children's behaviour, particularly how they navigated the space, what exhibits they found most engaging, and how they interacted with their parents.

For the interviews, we divided into two teams: one team conducted interviews with the tour guide, while the other interviewed the children. In each group, one team member led the interview, while the other was responsible for recording and taking notes.

3.3 Material Used

We used smartphones to record the interviews and to take photographs of the exhibits and areas that captured the children's interest. Additionally, we used paper for notetaking during our observations.

4. Result



Figure 4-1: Statue of Alien



Figure 4-2: statues of monsters



Figure 4-3: children observe museum



Figure 4-5:phenachistoscope



Figure 4-6: children observe a museum piece

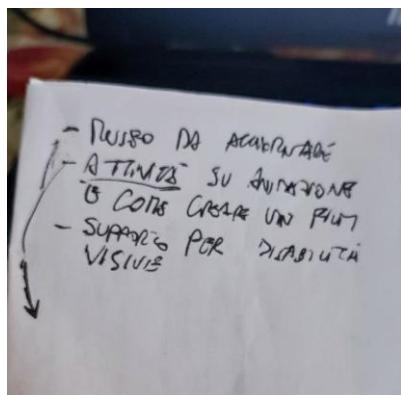


Figure 4-4: notes from the interview with the tour guide



Figure 4-7: child with mom looks at photos of the most famous faces in cinema

5. User Needs

We conducted a brainstorming session based on the interviews with all users, as shown in Figure 5-1.

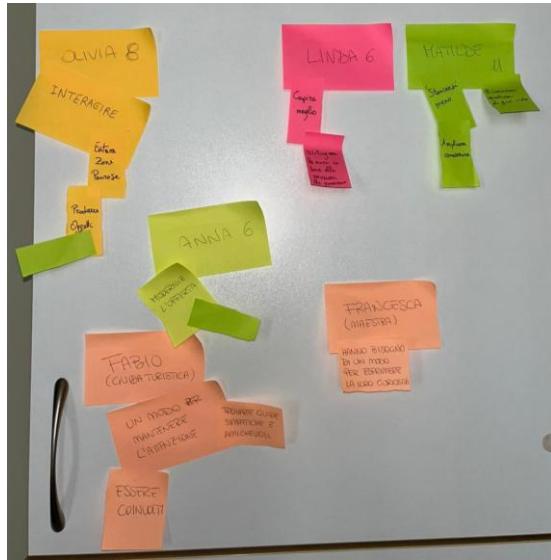


Figure 5-1: brainstorming on users' needs

From the interviews, we identified the following needs:

- Olivia, 8 years old: the need to interact more with objects, avoid scary areas, and engage in creative activities.
- Anna, 6 years old: the need to modernize the exhibition.
- Linda, 6 years old: the need for a better understanding of the exhibits and to clearly identify the theme of the various sections.
- Matilde, 11 years old: the desire to find familiar subjects in the museum, deepen her knowledge, and feel less fatigued during the visit.
- Fabio, 51 years old: he observed that children need to stay focused, be more engaged, and interact with a friendly tour guide.
- Francesca, 59 years old: she pointed out that children need to express their curiosity, learn new things, and observe in practice what they have studied.

From these insights, we identified the following deep user needs:

- **The user needs to facilitate learning and deepen knowledge during the museum visit** - This need arose from:

Linda's experience, as she could not read the text, needed her parents to explain it to her.

Matilde also touched on this in her response to question 7, where she said: "*They caught my attention because they were things already seen*".

Francesca, in response to question 9 for teacher, mentioned, "*The main advantage is that the children can see up close what they have studied, this makes the experience very engaging and concrete for them*".

- **Express their curiosity about the things they saw in the museum** - This need arose from:

Francesca highlighted this in response to question 7 for teachers, where she said: “*At the beginning of the tour the children are very agitated, but this agitation comes from their curiosity and enthusiasm for what they are going to see*”;

Fabio, in response to question 12, added: “*They are very curious and want to ask a thousand questions*”.

- **Identify the theme of the various area of the museum** - This need arose from:

Olivia’s response to question 3, “*It scared me*” and the father explained that the statue was scary for the kids.

By the answer to question 7 for kids Linda said “*It wasn’t scared*” referring to the phantoms in the Corto “Fantasmagoria” and the mother said she was interested in.

6. Solutions

We conducted a brainstorming session to address four core user needs. A five-minute timer was set for each need, during which each team member proposed potential solutions, as illustrated in Figure 5.1.

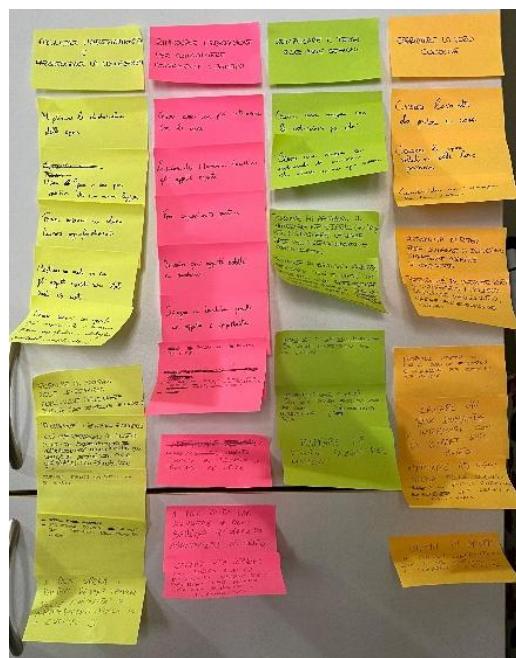


Figure 6-1: brainstorming for solutions

After the brainstorming session, we reviewed all the ideas and used the "post-it voting" technique to select the most promising solutions. The selected ideas were as follows:

- Create a map that indicates the emotions each section of the museum might inspire.
- Designate a space where children can ask questions after the tour.
- Develop a personalised tour based on the child's interests and preferences.
- Create a section where children can interact with exhibits and understand how they were made and used.
- Provide audio/video descriptions of the exhibits tailored for children.
- Organise a treasure hunt in which children search for specific works based on clues.
- Establish a section where children can display the works they created during workshops.

Following this, we discussed which solutions would best address the majority of user needs. The final solution selected was:

A personalised tour of a museum tailored for the child user

This solution addresses several key user needs, including facilitating learning and deeper knowledge, identifying the themes of different sections, and encouraging children to express their curiosity. The emotional map allows children to select which sections of the museum to visit according to their preferences, helping avoid negative experiences like the one Olivia had when she felt scared. Additionally, the interactive tour and child-friendly explanations help children better understand and engage with the exhibits they see.

Chapet 2: Storyboard & Low-fi Prototype

7. Tasks

We have chosen these tasks because they represent different levels of interaction and insight that a child can experience during a museum visit, making the experience more engaging and suitable for different cognitive needs.

1. **Simple task:** Initiate a tour based on personal preference

This allows children to explore the museum more freely and engagingly, choosing thematic routes based on their interests. The app can suggest personalized itineraries, making the visit more stimulating and less dispersive.

2. **Moderate task:** Deepen knowledge about a work of art.

Here the child can interact with digital content to discover trivia, stories and hidden details about a specific work. Through quizzes, the app transforms simple observation into an active and immersive experience.

3. **Complex task:** Report the correct classification of a section of the tour.

It allows you to check whether the app provides correct and consistent data on the classification of the museum sections. Additionally, it helps determine if children can complete the task without technical difficulties or confusion, improving the app's usability.

8. Storyboard

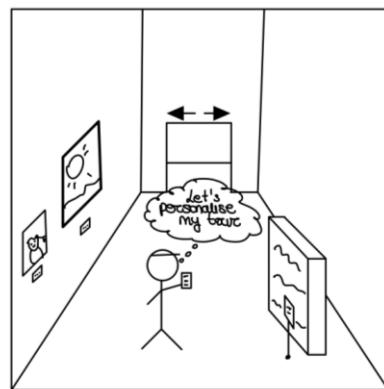
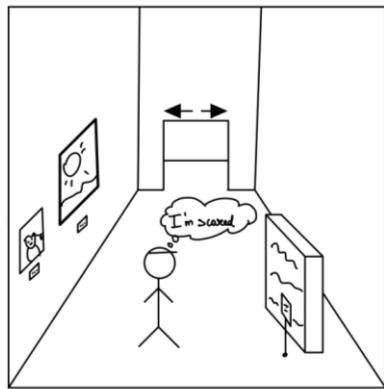
We chose to represent the simple and moderate tasks because they answer the need that we identified. The storyboard represents the most common scenery the tool must solve

Location: museum

Actors: child 10 years old

Problems/needs: he wants to find things he likes

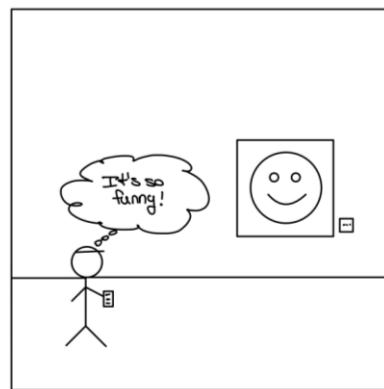
It's shown in the Figure 8-1: Storyboard



"let's personalise my tax!"



"I love funny things"



"I'm so funny"

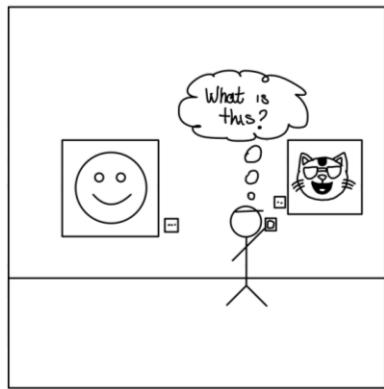


Figure 8-1: Storyboard

9. Modality Exploration

After a brainstorming session, we identified that a smartphone or a VR application would answer perfectly to the solution. We discarded the tablet because it would be too uncomfortable to carry it around.

The smartphone application would be easy to use by kids, and it has all the characteristics necessary to complete the tasks.

The VR could help to solve the tasks, and in addition it would add a more engaging experience.

10. Smartphone Low-fi prototype

The prototype, shown in Figure 10-1: Smartphone Low-Fi Prototype, solve the simple task by making the user decide to start a personalised tour by clicking the button in the bottom-centre of the screen, this would open a page with a collection view of all the categories and with the possibility to choose

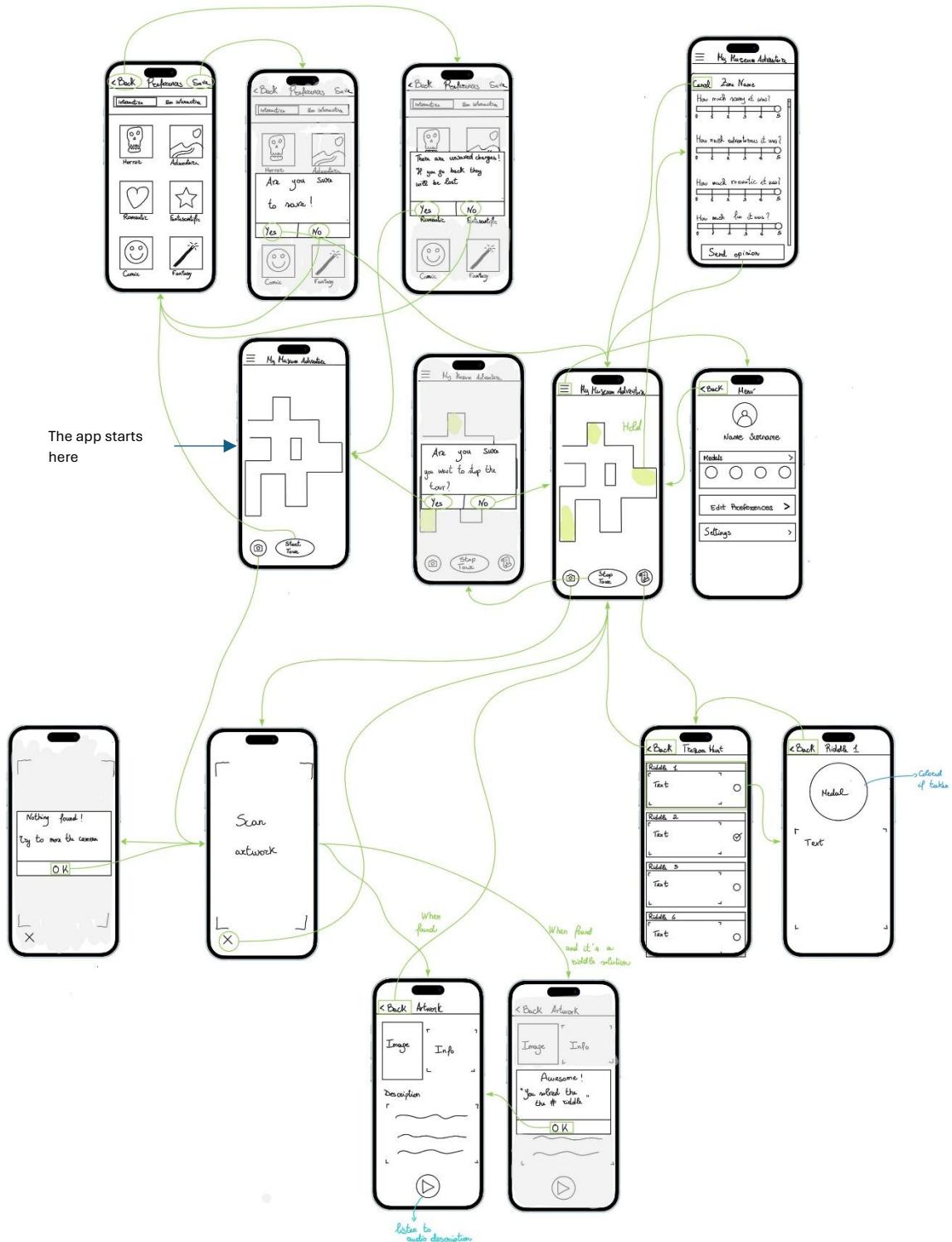


Figure 10-1: Smartphone Low-Fi Prototype

an interactive tour. Once the user has chosen his preferences, the app goes back to the main page, with the map that shows the sections to visits in a different colour and a button in the left-bottom that

goes to the Treasure Hunt page. Here the user could see all the Riddle. To solve it the user must scan the artwork he thinks is the answer.

To answer the medium task, we decide to add a scanner to search the artwork you are watching, the scanner starts by clicking the camera button on the main page. Once the app identifies the artwork it goes to a page in which there is a description of it and there is a button to listen to the explanation.

At last, for the complex task, the user can hold the section he wants to report. This would open a modal view in which the user can express how much the section is suitable to the different categories the app supports.

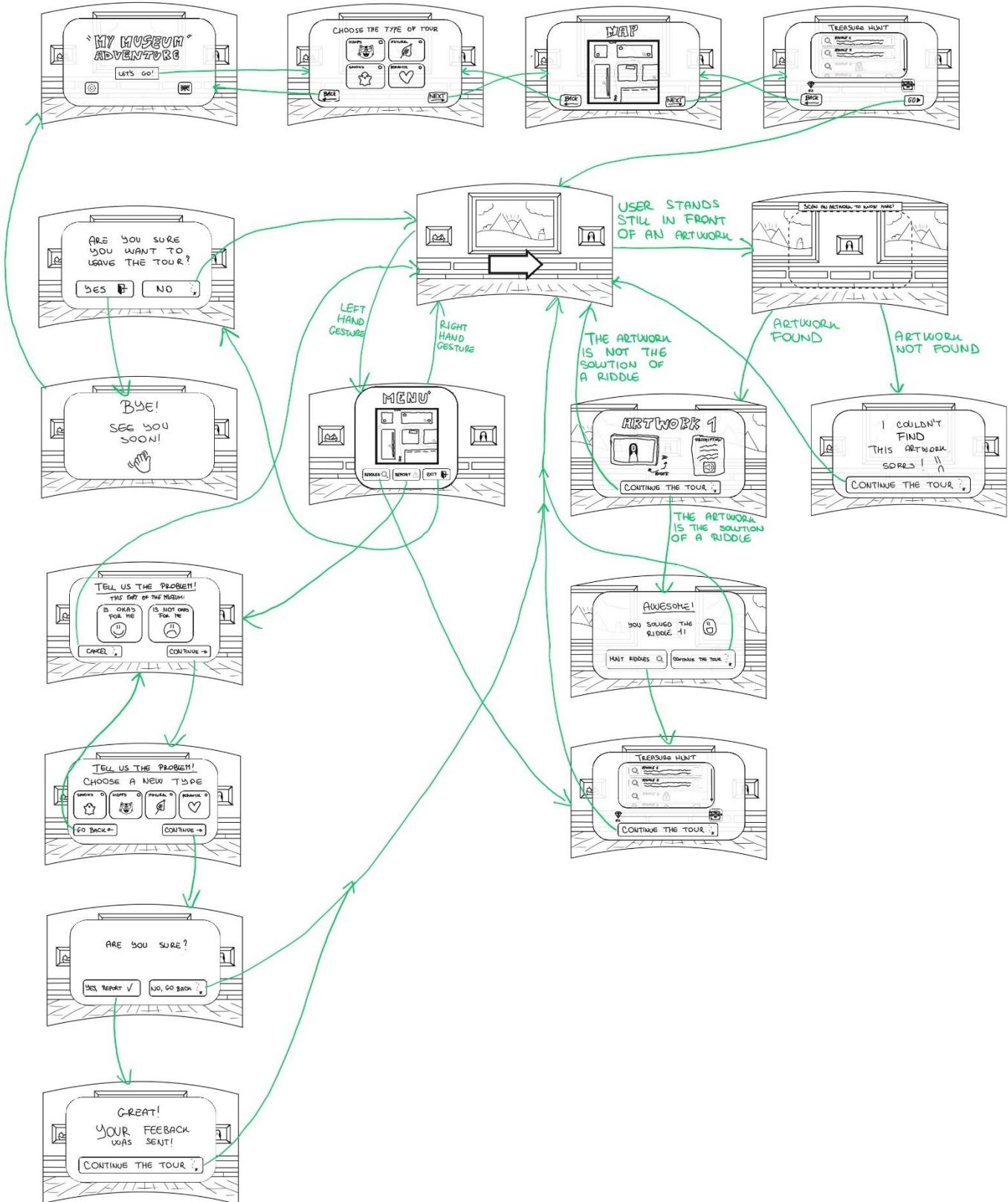
The prototype perfectly fits the storyboard scenario.

11. VR paper prototype

The prototype (Figure 11-1: VR Low-Fi Prototype) realized for VR can be incorporated into the storyboard scenario.

First, a landing screen appears, displaying the title, a settings button, a language selection button, and a "Let's Go!" button. When the user clicks the latter, they are prompted to define a tour based on their preferences, thus resolving the simple task. After selecting the type of tour, a map is generated along with riddles that the child will solve during the treasure hunt. If the child isn't satisfied with the

Figure 11-1: VR Low-Fi Prototype



suggested route, they can go back and select a different tour type. Once the “GO” button is pressed, the tour begins. The route is guided by directional elements like arrows.

To complete the moderate task, the user needs to stand still in front of an artwork for a predefined amount of time (e.g. 3 seconds). If the artwork is not recognized, the message "I couldn't find this artwork. Sorry!" will pop-up on VR screen. Otherwise, a screen with a 3D reproduction of the artwork and its description will be shown, with the ability to rotate the former in the 3D space with hand gesture and listen to the explanation by clicking the megaphone button. If the artwork is not the solution to a treasure hunt riddle, clicking "Continue the Tour" will lead the child back to the tour view; if it is, the app will notify them that a riddle has been solved. The child can then choose to return to the tour view or check their treasure hunt progress.

At any time during the hunt, the child can open a menu with a left-hand gesture and close it with the other hand. This menu displays a top-down view of the tour map and three buttons: one to exit the tour, one to check the treasure hunt progress, and one that allows the user to execute the complex task. In fact, by clicking it, the child can report that a section of the museum, which is also part of the tour defined previously, is misclassified. They can specify whether it is suitable for them or not, and propose a new category for the section. The app will then ask the child to confirm their report, and, if confirmed, a message will inform them that their feedback has been sent. In any case, the child is then redirected to the tour view.

Chapter 4: Medium to High-fi Prototype

For the **Heuristic Evaluation**, we kept the group divided as we did for the **Low-fi prototype**. We printed a paper version of each prototype, and during the evaluation, students came to assess our prototypes during lab hours.

12. Smartphone Violations

12.1 Approved

#	Violation	Where	What	Why	Severity	Evaluator
1	H1	In the screen with the map	The map does not visually indicate if an area has already been voted on, maintaining the same color as unexplored zones	Users cannot differentiate between completed and pending areas	4,3	1, 2
2	H1	In the screen listing the riddles	It is not immediately clear which riddles have been completed, especially when there are many items	Users may struggle to identify their progress due to the lack of clear segmentation	3,2	1, 2
3	H2	In the artwork information page	The bottom-centered icon used to listen to the description of the artwork is misleading	The icon may not be familiar to the user, who might not understand the meaning of the button since it doesn't match the purpose of the button itself	2,3	4, 1, 2
4	H2	In the main page after the selection of the preferences for the tour	The upper-left icon used to go to the profile information page can lead to confusion	The icon chosen doesn't match properly the associated action. It looks more like a side menu	2,1	4,3
5	H4	In the selection of the preferences of the sections for the personalized tour	The position of the up-right start button is not intuitive	It refers to a violation of external consistency. The button should be as close as possible to the list of preferences since it is directly related to them	3,1,2	4,3,2
6	H4	In the screen listing the riddles for the treasure hunt	The list appears to be composed of selectable cards, but the checkmark indicates that the riddle is completed	Misleading design could confuse users about the functionality	2	1,2
7	H4	Icon for treasure hunt	The current icon, a parchment, does not effectively represent a treasure hunt with riddles to solve	It creates inconsistency between the intended functionality and the visual representation, making it less intuitive for users	1	2
8	H4	Error message after scanning an incorrect solution	The error message uses an "OK" button instead of a clearer "Try Again" label	The terminology is inconsistent and does not guide the user toward the next logical action	1,3	2,1
9	H4	In "Artwork" page	The audio "Play" button	There is no way to pause or stop the audio after it's played	3	3

10	H4/H2	In the screen where scanned artwork is verified	The palette icon does not align with the action of verifying correctness	It does not intuitively suggest the verification function	2,3,1	1,3,2
11	H5	In the page where a user can report a wrong section	A user can send feedback by mistake	No error prevention mechanisms, such as a disabled button or a confirmation message, are implemented	4	4
12	H5	In "Preferences" before when "Back" button is clicked instead of "Save"	The message in the popup is not clear and might cause data loss	When user clicks "Back" from "Preferences" a popup displays with the message "There are unsaved changes. If you go back, they will be lost". User has option "Yes" and "No". This is unclear and might lead to unwanted loss of progress	3	3
13	H7	In the screen with riddle descriptions	No shortcut for scanning the corresponding artwork is provided	Users must navigate back to initiate a scan, reducing efficiency and breaking task flow	3,2	1,2
14	H7	In "Themes" page, in theme selection screen before clicking "Start" button	Selecting all the themes together	The user can select all the themes for the tour, but there is not a "Select all" option, therefore the user must click all the themes one by one	2	3
15	H8	In "Zone name" page	Zone evaluation grades	If the user is doing a horror tour and decides to give a grade to a specific zone of the map, it doesn't make sense to give a grade about "How romantic it was" because the tour is not intended to be romantic from the beginning. So, the grades should be personalized for the tour type	3	3
16	H10	Across the app	The app lacks a dedicated help section to guide users on solving riddles or using the map	Users might struggle to understand certain functionalities without assistance	3	1, 2
17	H10	After clicking the treasure hunt button on the main page	A treasure hunt is available, but no explanations on how to proceed	Since the treasure hunt is not directly related to the main tasks, a step-by-step guide is necessary	3	4
18	H10	In the main page after clicking the button that explains how to report a section	The message explaining how to report a section is unclear	The message lacks clarity, making it difficult for the user to understand how to proceed	4	4

12.2 Not Approved

#	Violation	Where	What	Why	Severity	Evaluator	Reason why X
19	H1	Riddle list page	The icon on the right side of the riddle list only indicates completion status but does not provide clear feedback on which riddles are still incomplete	Users may struggle to quickly distinguish between complete and incomplete riddles, especially in a long list. This lack of clarity reduces the system's ability to effectively communicate its current state	2	2	The icon is checked, so if it is present, the riddle is considered completed; otherwise, it is not.
20	H1	In the selection of	The app doesn't provide custom feedback if more	When the user selects just one preference, the app gives feedback saying that the tour	4	4	The alert that shows up when "Start" is clicked

		the preferences	than one or all preferences of the sections are selected	will be based on that choice. But if the user selects two or more preferences at the same time, there is no feedback. This leaves the user unsure about what type of tour they are getting. Without this feedback, the user doesn't know if their choices have been properly recorded or how they'll affect the tour. Giving clear feedback after selecting multiple preferences would help the user understand what kind of tour they will experience and reduce confusion			says what are the chosen preferences.
21	H1	“Places” in the map of the tour	Press and hold gesture	The application does not provide information about the existence. Unless there is an info or any popup, the user most probably will miss this functionality	3	3	There is a button that explains the function.
22	H2	Task 1, selecting themes	The themes and terms used in the app are not explained in child-friendly language	The app should use concepts and language that children aged 6 to 12 can easily understand to ensure they can effectively use the app	3	5	We think the language used in the app is already suitable for kids.
23	H2	Task 2, scanning artwork	There is no indication of progress while the scan is in progress	Users are left uncertain about whether the app is working or stalled	2	5	The corners of the camera would move during the scan.
24	H3	During the game or on the map screen	There is no option to change thematic preferences after they have been initially selected	Users are forced to exit the game and return to the main menu to change their preferences, which limits their control over the experience	2	2	This problem domain is outside the three task, so we didn't model it.
25	H3	In the treasure hunt pages after clicking one of the available riddles	The treasure hunt leads to a large set of subsequent pages, and the only way to return to the main page is a back button that goes back one step at a time	There is no button to return directly to the main page, so the user must navigate through exhausting and extended dialogues	3	4	This type of navigation is common in smartphone; in addition, to go back to the home, you only need to press the back button twice.
26	H3	After selecting the preferences for the personalized tour	Despite the pop-up that aims to avoid error-prone interactions, the user cannot modify preferences instantly. The user has to go first to the profile section, click on the associated area, and only then make the changes	The user cannot undo the selected preferences without facing an extended dialogue	3	4	Before the tour starts, it is always possible to change the preferences; the user needs to click "No" in the alert to do so. Changing them after the tour is started is not part of the tasks.
27	H3	Task 3, providing	Once the modal view is open, there is	Users should have the freedom to easily exit or	2	5	There is a "Cancel" button

		feedback on sections	no clear option to cancel or go back to the previous screen	cancel out of a task without feeling trapped in the modal view			on the top-left corner of the modal view. Considering it's a modal view, the user can also swipe the page to the bottom to close it.
28	H4/H6	In the page after scanning the artwork code successfully	The back button goes back to the main page	It refers to a violation of internal consistency, as the back button usually navigates one step back and not directly to the main page	2,3	4,5	After scanning successfully an artwork, according to us, it would be better to go back to the map.
29	H4	In the page where a user can report a wrong section	The back button is labelled "Cancel."	It refers to a violation of internal consistency. The app consistently uses the "Back" button for undo operations, but here it is labelled differently	2	4	Here the "Cancel" label is better because we are stopping an operation and not simply going back to a previous page.
30	H4	In the screen with the map	The scroll icon does not intuitively communicate its purpose	It creates a mismatch between the icon and its function, potentially confusing the user	2	1	There is no scroll-bar in the main page.
31	H4	In the scanning artwork code page	An X icon is used to undo the current operation	It refers to a violation of internal consistency. The app predominantly uses a back button to undo operations	2	4	In this case, the button's function is to cancel the operation rather than navigate back, so we used an "X" instead of a "Back" label.
32	H5	Task 1, choosing preferences	No confirmation step when preferences are changed	It increases the risk of accidental changes without user confirmation	2	5	Clicking on a preference will highlight it. Tapping it again to deselect will remove the highlight.
33	H7	In the screen for reporting an area	Holding the exclamation mark button to report is unintuitive	A single tap followed by a confirmation dialog would simplify the interaction and reduce confusion	3,2	1,2	The exclamation mark button doesn't have an "hold-on" function.
34	H7	Task 1, treasure-hunt page	The app does not offer shortcuts for more experienced users, such as saving common preferences or using quick navigation	Allowing more flexibility and efficiency in navigation can enhance the user experience, especially for returning users who are familiar with the app	2	5	In the app, preferences cannot be saved because they must be re-selected at the start of each tour.
35	H8	Task 2, artwork description	The description page is cluttered with unnecessary details	It distracts from the main content and overwhelms young users	2	5	We consider this to be the necessary information.

36	H8	In "Themes" page, after clicking "Back" button	The confirmation popup	The tour hasn't started yet or no progress can be lost at this point of the application, so there is no need to ask for confirmation to go back	2	3	The lost data pertains to the selected preferences, ensuring that if the user mistakenly clicks on it, they won't lose the preferences already chosen.
37	H8	In "Themes" page	"Interactive" / "Non interactive" buttons	The buttons contain a long text and might not fit correctly and/or might make the screen heavy. A different filtering approach can be chosen for a cleaner design.	1	3	From our point of view, the text lenght is fine.
38	H8	In the page where a user can report a wrong section	The presence of the up-left sidebar icon is unnecessary as it is unrelated to the page's purpose	The icon adds irrelevant information, reducing the visibility of relevant content.	1	4	This is a modal view, so the background remains visible but is dimmed.
39	H9	Task 3, providing feedback on sections	No clear guidance on what to do if the modal view fails to load	Users may not understand how to troubleshoot or proceed	3	5	The modal view is not a web page, so it does not have a load time.
40	H10	In the main page after the selection of preferences for the tour	Insufficient explanations on the main page despite the number of icons present	After selecting preferences, users may feel overwhelmed by too many buttons and unclear tasks	3	4	There are only four buttons, making them easy to understand.

13. VR Violation

#	Violation	Where	What	Why	Severity	Evaluator
1	H1	Interaction with the artwork during the tour	Users are required to pinch for 3 seconds to make a pop-up appear, but there is no feedback or indication on the interface to inform them of this action.	The lack of feedback leaves users unaware of how to interact with the artwork. Users are not informed if their action is being registered or processed, leading to uncertainty and frustration.	4	2
2	H1	Starting the tour (4 page)	The page shows an arrow to guide users, but it lacks a clear description or confirmation that the game has started. While the arrow provides some feedback, it does not fully inform users about the current system state or what they are supposed to do.	The lack of explicit confirmation or explanation leaves users uncertain about whether the game has started and what the arrow represents. This could cause confusion, as users may not immediately recognize the arrow as an indicator of the next step. Clear feedback about the system state is essential for reducing frustration and ensuring smooth interaction.	3	2
3	H1	Signs displayed during the tour	The system provided no clear feedback to explain why certain areas were restricted for children or what action users should take when encountering the signs.	Users were not informed about the current state of the system or provided with an explanation for the restrictions. This lack of feedback left users uncertain about how to proceed and could even spark curiosity in children, encouraging	2	2

				them to explore restricted areas instead of avoiding them.		
4	H2	In the interaction design for scanning artwork	The system's scanning interaction does not resemble how scanning works in real-world experiences (no visual confirmation or indicator when scanning starts or ends).	The system doesn't align with real-world conventions, making it harder for users to understand when or how the scanning process is complete.	2	2
5	H3	"Tell us a problem" section	The only problem supported are wrongly categorized artworks, not allowing for other options or a custom description by the user.	If a user finds any other kind of problem, it will be impossible for them to report it.	4	1
6	H4	At the end of the tour, on the page displaying "Hunt Riddles" and "Continue" options	Pressing the "Continue" button takes the user back to the previous tour instead of moving forward to the next level, as expected.	The action of the "Continue" button is inconsistent with its labeling and the user's expectation. Buttons labeled "Continue" are typically associated with progressing forward, not returning to a previous state. This inconsistency creates confusion and undermines user trust in the system.	3	2
7	H4	Signs displayed during the tour	Two different types of signs were used to indicate restrictions, but their meanings and differences were unclear.	Inconsistent signs confuse users, increase cognitive load, and disrupt understanding. Clear and standardized signs are essential to ensure users quickly grasp their meaning without frustration.	3	2
8	H4	Choose your type of tour	Unclear how selection will impact tour on museum. What to expect from general labels as "Happy"	Makes future state unclear, turning it more difficult for user to accomplish their task.	2	1
9	H4	"Treasure Hunt" page	Unclear how to go down (swipe) to see further riddles. An arrow is drawn on the side, but how to use it is not clear nor intuitive.	Doesn't follow a standard on how to swipe down	2	1
10	H4	"Are you sure you want to report this section?" page	The "Go back" button is on the right while in all other pages, this same option is always presented on the left side of the screen.	It's a break of a consistent pattern of option placing.	2	1
11	H4	Between pages, on "Go back" and "Continue" pages	Arrow placement is inconsistent. Sometimes on top of text, sometimes below it.	Inconsistency of placing goes against the consistency principles.	1	1
12	H5	Interaction with the artwork during the tour	Users are required to pinch for 3 seconds to make a pop-up appear, but there are no instructions, visual cues, or progress indicators to inform users how to perform the action or how long they need to pinch. This forces users to guess and experiment with interactions	The lack of clear instructions or feedback makes the interaction confusing. Users are left to figure out the required gesture and duration through trial and error, increasing the likelihood of frustration and mistakes.	4	2

13	H5	“Scan artwork to know more” page	System allows users to scan artworks that are unavailable or unrecognized	The application is aware of available artworks with details available, but it allows users to try and scan unavailable ones.	2	1
14	H5	“Are you sure you want to report this section?” page	Options to go back on previous choice and to cancel the report are written in a too similar way, demanding more attention from the user to distinguish them.	With both options similar, the user is more likely to choose the wrong one.	2	1
15	H5	“Tell us the problem” page	Messages “Is okay for me” and “Is not okay for me” are too similar, demanding extra attention from the user to correctly choosing between them.	Similar messages can cause confusion and wrong selection of option from the user.	2	1
16	H5/H6	“Tell us about your problem” page	“Is okay for me” is given as an option for users reporting a problem. This is redundant and leads users to errors allowing them to press it.	Allowing to report a “not problem” in a page dedicated to reporting problems opens a new way for users to commit errors.	3,2	1,2
17	H5/HN	“Tour” page	Application allow users to enter regions classified as “Warning” without showing a warning message for user to confirm action	Allows users to make an error where it could be easily prevented	2,3	1,2
18	H6	Main “Tour” page	Unclear how to enter “Scan Artwork” page, without any clues or signs on how to do so.	Users must always recall what action is required to enter that screen.	3	1
19	H6	Choosing a category in “Tell us the problem” page	There is no indication on screen about previous choice of “Is okay for me” or “Is not okay for me”.	Users need to remember input of last page when deciding on the following screen.	3	1
20	H6	Maps (pre tour)	The map was confusing because it was unclear whether users needed to memorize it for later use or refer to it directly.	This forces users to rely on memory, increasing cognitive load and causing confusion. The interface did not clearly indicate how users should interact with or use the map, making the task unnecessarily difficult.	3	2
21	H6/H5	Transition from main tour to “Menu” screen	Unclear how to enter the page, without any indications or signs on how to do so.	The absence of information on how to access this page forces users to recall the action needed to do so	3,3	1,2
22	H7	“Scan Artwork to know more”	This page is relatively redundant; users could skip this page and directly see scanned work details from main tour page	Adding an extra page and requiring extra effort from a user to perform a task is adding inefficiency to application.	1	1
23	H8	Homepage	The prototype contains two buttons (setting and language) that do not perform any action and are unrelated to the task.	These buttons are irrelevant and add unnecessary clutter to the interface, violating the principle of focusing on essential elements. They distract users and reduce the clarity of the interface.	2	2
24	H9	After the system fails to find the scanned artwork	The error message (“I couldn’t find this artwork”) does not provide any suggestions for diagnosing or fixing the issue,	Users are not guided to recognize why the error occurred or how they can recover from it. Providing actionable suggestions (“Try holding the device closer” or “Ensure good lighting”) would make the	3	2

			such as retrying the scan or repositioning the device	error more manageable and less frustrating.		
25	HN	On screens such as "Choose Type of Tour" and "Tell Us the Theme."	Instructions are vague and not tailored for children. Phrases like "Tell Us the Theme" assume an advanced level of comprehension, which may not align with a child's vocabulary or understanding.	Ambiguous instructions can confuse children, requiring more explicit and simplified guidance ("Pick Your Favorite Topic"). Without clear, child-friendly instructions, the application may fail to engage or guide its primary audience effectively.	2	2
26	H10	Interaction with the artwork after the pop-up appears during the tour	The pop-up instructs the user to scan the picture but provides no guidance on how to perform the scanning action.	Users are left without the necessary instructions or context to complete the action. Clear, contextual help or visual instructions should be provided to ensure users can understand and perform the scanning task effectively.	3	2
27	H10	During the process of unlocking riddles.	The system lacked instructions or documentation explaining how to progress through the steps to unlock riddles, such as whether to revisit tours or explore new ones.	This leaves users without guidance, forcing them to guess whether to revisit tours or explore new ones. Providing a clear "How to Unlock Riddles" section or inline tips would eliminate guesswork and frustration.	3	2
28	H10/H4	Gestures in overall application	Several gestures are required for the user to manipulate the application and navigate the screens, but there is a lack of support for user to learn how to use those gestures.	Lack of any form of tutorial/documentation makes learning curve for users to discover the application steeper and disturb overall perception of it.	3,3	1,2

14. Prototype selected

The decision to choose the **smartphone** prototype over the VR headset for our project was made after considering several factors related to accessibility, ease of use, versatility, usability for children, and technical reasons.

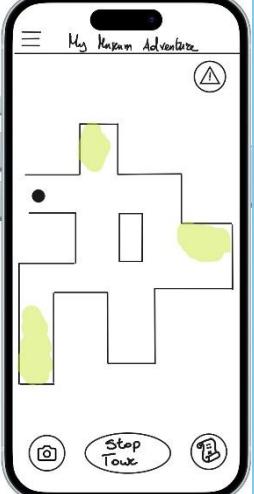
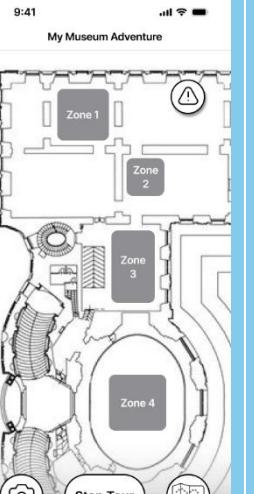
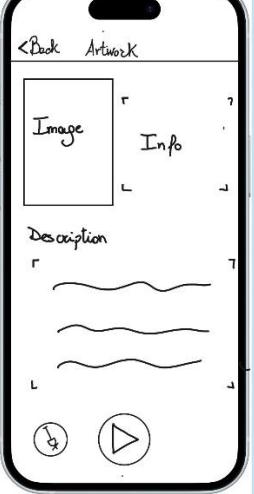
- Accessibility and Availability:** Smartphones are widely distributed and easily accessible, with global availability and generally lower costs compared to VR headsets. This enables broader distribution of the app and greater inclusivity.
- Ease of Use:** The smartphone interface is intuitive for children, who are already familiar with touchscreen devices from an early age. Navigation is simple and straightforward, minimizing the risk of frustration.
- Portability:** Smartphones are lightweight and easily portable, allowing flexible use of the app without the need for bulky equipment.
- Technology:** Smartphones allow the integration of features such as the camera, which are not easily incorporated into VR headsets due to privacy concerns.

No feature needs to be moved from one prototype to another, the implemented smartphone prototype is complete.

15. Medium Fidelity Prototype

Screens selected: *Map - Artwork information*

We have chosen these screens because they are the most important for the user to complete the tasks, and the ones with most violations.

	Old	New	Fixed violations
Main Page			<p>① - severity 4,3 - Sol. 1 ④ - severity 2,1 - Sol. 4 ⑦ - severity 1 - Sol. 7 ①⑧ - severity 4 - Sol. 17</p>
Artwork Page			<p>③ - severity 2,3 - Sol. 3 ⑨ - severity 3 - Sol. 9 ①⑩ - severity 3,2,1 - Sol. 10</p>

In addition, on [Figma](#), we added some more corrections to other screens.²

16. Plan for the High-Fidelity Prototype

► 1) Violation 1:

Areas already reported will be removed from the map.

► 2) Violation 2:

² Link Figma: <https://www.figma.com/design/Y8H5kZevJ3MoIJ95X50SdK/Medium-fidelity-prototype-PULLSH?node-id=0-1>

We will add a filter to allow selection between completed and uncompleted riddles.

► **3) Violation 3:**

We changed the icon  to 

► **4) Violation 4:**

We removed the "User Profile" icon because it's not related to the app's tasks.

► **5) Violation 5:**

We will move the "Start" button to the bottom-centre of the view, anchoring it in the foreground of the collection view.

► **6) Violation 6:**

We will remove the checkmark from the riddles list and differentiate completed riddle cards from uncompleted ones by using distinct colours.

► **7) Violation 7:**

We changed the icon  to 

► **8) Violation 8:**

We will replace the "OK" button with "Try Again".

► **9) Violation 9:**

We added stop and pause buttons that will appear once the audio starts.

► **10) Violation 10:**

We changed the icon  with 

► **11) Violation 11:**

We will add a confirmation message before sending the report.

► **12) Violation 12:**

We will allow the end user to evaluate the tour based only on the topics they selected at the beginning.

► **13) Violation 13:**

We will add the camera button for scanning on the riddle description page.

► **14) Violation 14:**

We will add a "Select All" button under the "Interactive/Non-Interactive" switch.

► **15) Violation 15:**

We will display only the grades related to the tour type.

► **16) Violation 16 and 17:**

We will add a tutorial at the start of the treasure hunt:

- One in the main page indicating the treasure hunt functions.
- Another in the riddle list explaining how to solve them

► 17) Violation 18:

We changed the text of the message

Chapter 5: High-fidelity Prototype

17. Tools, Frameworks and Libraries

We developed a native Android smartphone app using Android Studio and Kotlin, integrating APIs for artwork scanning to enhance our mobile app development skills. We utilized Jetpack Compose and Material3 for rapid UI development with native components. The app supports both English and Italian.

For local data storage, we used Room to store:

- Selected themes
- Solved riddles
- Museum zones

Artwork scanning was implemented using CameraX, with Imgur API for online image hosting and SerpApi for image classification. Navigation through the app was managed using androidx.navigation.NavHostController with a TopBar component. For audio playback, we implemented an ExoPlayer using the media3 library from androidx. We chose these frameworks because they are easy to use, widely adopted, and provide good performance, user experience, and compatibility. The GitHub repo can be found at this [link³](#).

18. Prototype

18.1 Changes from the Medium Prototype

Home Page:

- The bottom-right button on the bottom bar, which navigates to the riddles page, is disabled when the tour is not started. This is because the riddles are related to the tour; the user can only play the treasure hunt if the tour has started.

Theme Page:

- The "Start Tour" button is disabled if no theme is selected. This prevents the initiation of an empty tour.

Scan Page:

- A button was added to prompt the scan. This was a programming-related decision.

³ Link GitHub: <https://github.com/polito-hci-2024/my-museum-adventure>

Riddles List Page:

- If there are no riddles, a label will be displayed that says "No riddles found". This addresses the issue when a tour is started, and no riddle is completed. Thus, when the user goes to the "Complete" section, it is not entirely empty.

Artwork Page:

- A Circular Progress Bar was added to show the progress of the audio playback. This allows the user to track the audio duration.

Riddle Page:

- When the riddle is solved, the bottom left button will lead to the Artwork that solved the riddle. So, the user can retrieve the information about it.

18.2 Main Prototype screens

- Home Page:



This screen is the main part of the application, displaying the museum map with the selected zones based on the user's preferences. This marks the final step of **Task 1**.

- Clicking the button in the top right corner or holding a zone starts **Task 3**.
- Clicking the camera button in the bottom right corner starts **Task 2**.

The violations reported in section 2512.1 Approved have been resolved as shown in the **Medium-Fidelity Prototype**.

Figure 18-1: App HomePage

- Theme Page:



Figure 18-2: App ThemePage

- Riddles List Page:



Figure 18-3: App Riddles List Page

This screen is part of **Task 1**, where the user selects his/her preferences from the available themes.

The violations, reported in 12.1 Approved, has been resolved as follows:

- A "Select All" button has been added.

This screen represents the playful part of the app. It displays all the riddles and highlights the completed ones in green.

The violations, reported in 12.1 Approved, have been resolved as follows:

- A **filter** has been added at the bottom of the **Top Bar** as a segmented button.
- The **riddle card** is now coloured when completed, instead of displaying a checkmark.

- Riddle Page:



On this page, we display the riddle along with its title, description, and the medal if the riddle is completed.

The button at the bottom left leads to the artwork if the riddle is completed; otherwise, it redirects to the Scan Page, resolving Violation 13.



Figure 18-4: App Single Riddle Page

- Scan Page:



On this page, the user can scan an artwork as part of **Task 2**.

The violations, reported in 12.1 Approved, have been resolved as follows:

- In the alert displayed when the user scans an invalid artwork, the dismiss button now says "Try Again" instead of "OK".

Figure 18-5: App Scan Page

- Artwork Page:



On this page, the scanned artwork is displayed. This is the final part of **Task 2**.

The page includes:

- **Information** about the artwork.
- **A button (bottom left)** to check if the artwork solves a riddle.
- **A button (bottom center)** to play the audio description.

The violations on this page have been resolved as shown in the **Medium-Fidelity Prototype**.

Figure 18-6:App Artwork Page

- Zone Modal Page:



This page is used to report a zone for misclassification. It marks the end of **Task 3**.

The violations, reported in 12.1 Approved, have been resolved as follows:

- After clicking "**Send Report**", the app displays an **alert** to confirm the action.
- If the user confirms, the **corresponding zone is removed** from the map.
- The user can only **evaluate the theme** of the zone they wish to report

Figure 18-7: App Zone Page

18.3 Target device adaptation

To adapt the application for the target device (Android smartphones), we made the following changes:

- All **alerts** now include both a **title** and a **description**.
- The button to **dismiss the modal view** on the zone page has been removed.
- The **museum map** has been replaced with an **SVG file**.
- The entire design has been adapted to a **Material3** app, using standard components.

18.4 Limitation and Data

The app has the following hard-coded elements:

- The **zones on the map** are correctly positioned only on the phone used for testing.

The pre-stored data in the app includes:

- The app supports only **7 artworks**, each with a related **audio description**.
- There are only **6 riddles**, one for each theme.

The app limitations are:

- The app does not **track the user's position** on the map.
- The map does not support **zoom** for the map.

19. Usability test

19.1 Preparation and run

The participants are five children:

- Emma, 13 years old
- Pietro, 13 years old
- Leo, 10 years old
- Margherita, 12 years old

The team members have been assigned the following roles:

- Flavia: Facilitator
- Salvatore: Observer – responsible for screen recording and questionnaires.
- Giovanna: Observer – responsible for audio recording and note-taking.
- Francesco: Observer – responsible for photography.

The evaluation was conducted at a home setting, and in Italian. The facilitator, following the script, guided the user through the execution of the tasks. The test protocol in PDF format, including the completed consent forms and questionnaires, can be found at this [link⁴](#).

Before the task execution, the users were asked to complete a pre-test questionnaire (shown in the protocol PDF), designed to gather information about them.

The tasks are as follows:

1. Start a personalized tour:

⁴ Link test protocol: <https://github.com/polito-hci-2024/PULLSH/blob/main/A5/Usability%20Test.pdf>

- a. Task: You are visiting a museum and want to explore areas related to your interests. Use MyMuseumAdventure to create a tour based on your preferences.
- b. Success Criteria: The user successfully selects themes and starts the personalized tour.
- c. Methodology: Think-aloud (useful because this task requires some easy steps to be solved, and it would be useful to as have the knowledge about what the user thinks)
- d. Metrics: Successful Task Completion
- e. Score: Boolean type

2. Access the "Riddles" section:

- a. Task: Now that you have started the tour, discover the riddles for the treasure hunt.
- b. Success Criteria: The user access to the “Riddle List” page and see the list of the available riddle
- c. Methodology: Think-aloud (this task requires the user to understand the icons and their meaning, so it was useful have their insight)
- d. Metrics: Successful Task Completion
- e. Score: Boolean type

3. Scan an artwork:

- a. Task: You are in front of a work of art and want to know more about it.
- b. Success Criteria: The user correctly views the artwork's description.
- c. Methodology: Think-aloud (this task requires the user to understand the icons and their meaning, so it was useful have their insight)
- d. Metrics: Successful Task Completion
- e. Score: Boolean type

4. Check if the artwork is the solution to a riddle:

- a. Task: You have scanned a work of art, now check if you have solved a riddle.
- b. Success Criteria: The pop-up indicating the riddle's solution opens.
- c. Methodology: Observation
- d. Metrics: Successful Task Completion
- e. Score: Boolean type

5. Listen to the audio description of an artwork

- a. Task: You have scanned the artwork, listen to the audio description.
- b. Success Criteria: The user successfully starts the audio and listens to the description.
- c. Methodology: Observation
- d. Metrics: Successful Task Completion
- e. Score: Boolean type

6. Check the completion of a riddle:

- a. Task: Discover the medal you obtained for solving the riddle
- b. Success Criteria: The user correctly identifies the riddle's completion status
- c. Methodology: Observation
- d. Metrics: Non-Critical Errors
- e. Score: # of errors

7. Read unsolved riddle

- a. Task: Try to solve a riddle
- b. Success Criteria: The user receives the pop-up of riddle's solution
- c. Methodology: Think-aloud
- d. Metrics: Successful Task Completion
- e. Score: Boolean type

8. Report an incorrect classification of a museum section

- a. Task: During your visit, you realize that a museum zone does not reflect your choice, report it in the app
- b. Success Criteria: The user submits a report indicating an incorrect classification
Methodology: Think-aloud (this task is critical because it requires the user to tap on a button and then hold the zone to report it. So, we asked them to explain what they were doing both to know the procedure is perceived and to provide guidance in case they had problem)
- c. Metrics: Critical/Non-Critical Errors
- d. Score: # errors/Tot errors

9. Reopen an artwork of an already solved riddle

- a. Task: You want to re-read the description of a work with which you solved a riddle
- b. Success Criteria: User opens artwork's page
- c. Methodology: Observation
- d. Metrics: Critical/Non-Critical Errors
- e. Score: # errors/Tot errors

At the end of the task, we asked each participant to complete the SUS test and some extra questions (shown in the protocol PDF). After all the tests we asked the percipient feedback, they would like to give.

19. 2 Results

During the test we took some pictures of the participants:



Figure 19-2: App Test 2



Figure 19-1: App Test 1



Figure 19-3: App Test 3



Figure 19-4: App Test 4

The result for each participant is shown in the table below:

	Emma	Pietro	Leo	Margherita
Age	13	13	10	12
T1	Si	Si	Si	Si
T2	Si	Si	Si	Si
T3	Si	Si	Si	Si
T4	Si	Si	Si	Si
T5	Si	Si	Si	Si
T6	1	1	1	0
T7	Si	Si	Si	Si
T8	1 on 3 (C8.1)	0 on 3	1 on 3 (C8.1)	0 on 3
T9	1 on 2	1 on 2	1 on 2 (C9.1)	1 on 2
SUS score	77.5	77.5	85	87.5

As shown, the **SUS score** is above 68 for all participants.

From the observation of the **think-aloud tasks** (T1, T2, and T3), all participants easily executed these procedures. Unexpectedly, Task T8, which we initially thought would be the most difficult, turned out to be manageable for all users. They easily opened the page to report the zone, but they struggled to understand that they needed to change the score on the slider to correctly complete the procedure.

For Task T6, only one tester completed it without **non-critical errors**, but everyone successfully completed the task.

For the last task, only one participant attempted to re-scan the artwork, instead of going to the riddle and clicking the button there. But everyone made the C9.2 Non-Critical (in the test protocol PDF).

During the feedback phase, participants provided these useful tips:

- Instead of writing "Zone 1," it would be better to use the **theme name** and a number (e.g., "Fantasy 1") because the colour alone is not sufficient to identify the theme of the zone.
- When the report is sent without changing the score, no feedback is provided.
- iPhone users have difficulty recognizing the **slider component**.
- The **map image** should be updated.

19.3 Main Issue Fixes

We decided to implement the following fixes:

- The name of the **zone** will now include the **theme title**, making it easier to identify the zone correctly.
- An **alert** will be added when the user sends a report without changing the score.
- In the **Zone Report** page, the score slider will be set to **3** instead of **5**. This should make the slider component easier to identify. When checking the riddle solution from the **riddle page**, the app will no longer go directly to the

- **Artwork page.** After the scan, it will return to the riddle page with a **pop-up** informing the user if the riddle is completed. This change addresses a navigation issue, as users previously had to click back multiple times to return to the main page. This update reduces the cognitive load on the user that we observed during the test.

20. Conclusions

The main learnings from this semester were:

- **Designing and developing a mobile app**
- **Identifying real user needs** through interviews and feedback
- **Applying design principles and heuristics** to correctly design an application

During **Assignment 1**, we worked together as a team to conduct interviews and complete the need-finding phase.

For **Assignments 2 and 3**, the group was split as follows:

- **Flavia and Salvatore** → Smartphone prototype (both for developing the low-fi prototype and conducting the evaluation)
- **Francesco and Giovanna** → VR prototype (both for developing the low-fi prototype and conducting the evaluation)

During **Assignment 4**, the team worked together to analyse the results of the heuristic evaluation and then create the medium-fidelity prototype.

For **Assignment 5**, the team split the work as follows:

- **Flavia** → App navigation system, theme page, artwork data
- **Francesco** → Riddle list page, single riddle page, riddle data
- **Giovanna** → Camera page, Camera API, Imgur API, SerpAPI
- **Salvatore** → App database, main page, zone page, artwork page, translation

Our team worked well together, maintaining a steady and constructive flow throughout the project. We supported each other and handled challenges effectively. There were only a few discussions, but they were productive and helped us improve our work. Overall, we're happy with what we accomplished and how we collaborated as a team.

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22. Appendix



Figure 22-2: VR Low-Fi Helmet



Figure 22-1: App Icon