Art Beyond Observation:

Designing Interactive Museum Experiences for an Active Learning of Art Concepts

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Master's Final Project specially prepared for the attainment of
the degree of Master in Interaction Design
Definitive Document

Lisboa, FA ULisboa, December 2025

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UNIVERSIDADE DE LISBOA

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Finishing a Master's degree is hard. Finishing one 9,500 km away from home is much harder.

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Thank you.

Abstract



The traditional art museum experience is often a passive, silent observation of a real object, failing to provide access to the reality of its social and historical context. This closed approach limits visitor comprehension and emotional engagement.

This project addresses this problem through a Research through Design (RtD) methodology. The objective was to design an interactive experience that transforms passive viewing into an active, embodied exploration of an artwork's context. The audio augmented reality system uses ultrasonic sensors to translate a visitor's body movement, mainly their longitudinal position and proximity to the artwork, into a visitor-aware spatialized audio narrative. This transforms the visitors from passive observers into an active participant.

The research was structured in three phases: an exploratory phase, with the literature review and field research, followed by a generative phase, that is the development of the system prototype for the painting O Grupo do Leão, and finally an evaluative phase, the iterative user testing with ten participants.

The evaluation revealed that an initial prototype with "invisible" interaction failed, with an 80% failure rate in discovering the proximity-based mechanic. After an iteration that introduced physical affordances in the form of floor markers, the refined prototype achieved a 100% discovery rate.

The system transformed the artwork from a static object into a dynamic event. User interviews confirmed the emotional benefits, with participants calling it a "living painting", revealing they felt "transported to the scenario and present at the moment the painting was made", and, most profoundly, that the audio "helps a lot to see them as individuals who existed, and not as characters in a painting". This proves the system's ability to cut through the real object to reveal its human reality.

This research concludes that an embodied, auditory-narrative system, when supported by clear usability affordances, is a highly effective model for enhancing visitor comprehension and emotional connection. It successfully creates an experience that is open for active interpretation of the piece, enhances visitor comprehension, and fosters historical empathy and a profound, personal emotional connection to the artwork. This proves that art museums can use interaction to actively engage visitors with their artwork’s hidden realities.

Keywords: Embodied Interaction; Audio Augmented Reality; Museum Interaction; Spatialized Audio; Visitor Engagement.

Resumo



A experiência de visita tradicional em um museu de arte é frequentemente marcada por uma observação passiva e silenciosa do objeto real, o que muitas vezes falha em proporcionar um acesso profundo à realidade do seu contexto social e histórico. Historicamente, as instituições museológicas têm focado na preservação da aura da obra de arte, isto é, a sua existência única no tempo e no espaço, mas esta abordagem tende a criar um distanciamento entre o público e a peça. O modelo de exposição baseado em informações estáticas e silêncio contemplativo funciona como um "texto fechado", onde a interpretação é limitada e depende fortemente do capital cultural prévio do visitante. Sem as ferramentas adequadas para decifrar a complexidade de uma obra, o visitante acaba reduzido a um papel de receptor passivo, o que limita significativamente a sua compreensão intelectual e, especialmente, o seu envolvimento emocional com o que está a ser observado.

Para enfrentar esta problemática, esta investigação propõe uma mudança de paradigma através do Design de Interação, utilizando a metodologia de Investigação através do Design (RtD). O objetivo central foi conceber e desenvolver uma experiência interativa que transforme a visualização passiva numa exploração ativa, corporizada e multissensorial do contexto de uma obra de arte. A premissa fundamental é que o significado de uma pintura não deve ser algo estaticamente imposto pela instituição, mas sim algo descoberto e construído pelo visitante através da sua própria atividade e movimento físico. Ao transformar o corpo do visitante na interface principal, o projeto procura quebrar a barreira do "olhar distante" e permitir uma imersão na realidade humana e social que reside por trás da superfície da obra.

O sistema desenvolvido consiste numa instalação de realidade aumentada sonora que utiliza tecnologia de sensores ultrassónicos para monitorizar o comportamento espacial do visitante. Tecnicamente, a solução utiliza microcontroladores Arduino e sensores HC-SR04 para detetar a posição longitudinal e a proximidade do utilizador em relação à pintura. Esta configuração permite traduzir o movimento físico em camadas narrativas de áudio espacializado e sensível à presença. Ao contrário dos guias de áudio tradicionais que isolam o indivíduo através de auscultadores e narrações lineares, este sistema foi desenhado para ser uma experiência aberta e social, onde o som é projetado no espaço, permitindo que o visitante explore a obra como se estivesse a navegar num ambiente vivo, onde as vozes e os sons mudam conforme o seu posicionamento e interesse.

A investigação estruturou-se em três fases distintas e interdependentes. A fase exploratória consistiu numa revisão aprofundada da literatura sobre perceção artística, interação corporizada e mediação tecnológica em museus, complementada por uma investigação de campo que analisou diferentes modelos de exposição em Portugal e na Bélgica. Esta fase permitiu identificar a necessidade de interfaces que não distraíssem da obra original, mas que funcionassem como uma lente que revela camadas ocultas. Seguiu-se a fase generativa, focada no desenvolvimento do protótipo para a pintura "O Grupo do Leão" (1885), de Columbano Bordalo Pinheiro. Esta obra foi selecionada pela sua complexidade narrativa, apresentando um grupo de artistas e intelectuais cuja história e diálogos oferecem um terreno fértil para uma exploração sonora detalhada. O desenvolvimento envolveu não apenas o design de hardware e software, mas também uma extensa investigação histórica para recriar os diálogos com base nos debates que realmente ocorreram na época.

A fase final, ou fase avaliativa, consistiu na realização de testes iterativos com utilizadores, envolvendo dez participantes num ambiente que simulava a galeria de um museu. Esta fase foi crucial para aperfeiçoar a usabilidade do sistema e compreender o seu impacto emocional. A avaliação revelou uma descoberta fundamental: na primeira iteração, o protótipo utilizava uma interação "invisível", sem pistas

visuais sobre como o som era acionado. Isto resultou numa taxa de falha de 80% na descoberta da mecânica de proximidade, pois os utilizadores não compreendiam que o seu movimento de aproximação era o que alterava a narrativa sonora. Este resultado sublinhou que, em contextos de museu, a tecnologia "invisível" precisa de ser acompanhada por *affordances* físicas claras.

Na segunda iteração, foram introduzidos marcadores de cor no chão e sinalética informativa que relacionava as cores aos personagens da pintura. Esta alteração elevou a taxa de descoberta da mecânica de interação para 100%. Os utilizadores passaram a navegar no espaço de forma consciente, utilizando o seu corpo para "editar" a banda sonora da pintura. A análise dos dados recolhidos através de questionários SAM (Self-Assessment Manikin) e da Geneva Emotion Wheel demonstrou que a interação física aumentou o interesse e a curiosidade dos visitantes pela obra e seus personagens.

O impacto qualitativo do projeto foi validado pelas entrevistas pós-teste, onde o sistema foi descrito como capaz de transformar uma obra de arte de um objeto estático num evento dinâmico. Os participantes relataram benefícios emocionais, utilizando expressões como "pintura viva" para descrever a experiência. Muitos revelaram que se sentiram "transportados para o cenário" e presentes no momento em que a cena se passava, indicando um alto nível de imersão e presença. O aspeto mais significativo foi a capacidade do áudio em promover a empatia narrativa: os utilizadores afirmaram que a experiência os ajudou a ver os personagens não como figuras planas numa tela, mas como indivíduos reais que existiram, com vozes, opiniões e conflitos próprios.

Esta investigação conclui que um sistema de narrativa auditiva corporizada, quando devidamente apoiado por affordances de usabilidade claras, constitui um modelo altamente eficaz para melhorar a compreensão e a conexão emocional dos visitantes. O projeto criou com sucesso uma experiência aberta à interpretação ativa, promovendo empatia narrativa e uma ligação emocional profunda com a obra de arte. Em última análise, este trabalho prova que os museus podem e devem utilizar o design de interação para envolver o público de forma dinâmica, tornando o conhecimento histórico e artístico uma experiência viva e pessoal.

Palavras-chave: Interação Corporizada; Realidade Aumentada Sonora; Interação em Museus; Áudio Espacializado; Envolvimento de Visitantes.

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1. Introduction

Museums are institutions dedicated to preserving and studying unique and rare artifacts. The research conducted on these collections generates new knowledge, which is then shared with the public through the organized exhibitions. However, these displays often provide information in a traditional, passive format, where visitors are expected to solely read and, from these texts, learn the curated information. Although many projects have tried to add interactive elements to museums, they usually are oriented for a more technological approach, falling in attempts to enhance the commercialization of the exhibitions by the addition of flashy and appealing technological devices. This comes at the expense of a belief that interaction could bring new ways of expression inside the exhibitions (Tsitoura, 2010).

It is also important to make clear the difference of interactions available in the different kinds of museums. Interactive exhibitions were, at first, popularized by science museums which embraced the idea that learning natural sciences could be fun. In these exhibitions, guests were encouraged to engage directly with activities in fields such as physics and chemistry. Kids were invited to play with builder robots, families could see the different machines used to explore the space, and everyone could take part in doing and seeing the results of different scientific experiments. These experiences were designed to be engaging and motivating, often with the goal of inspiring children to pursue science-related careers.

In contrast, art museums do not offer the same hands-on capabilities. Unlike science museums, which can allow children to control the robots that build modern products, art museums cannot provide direct engagement with the historical context, the tools, and stories that created a famous painting, as these are a unique work and not a serialized production. However, this should not be an excuse to exclude the possibility of making the artistic pieces interactive. Even if we can't reproduce the making of a Mona Lisa, visitors can still be fascinated by aspects of the exhibited work, and many would enjoy their visit more if these museums offered activities designed with active exploration of the pieces in mind. Instead, many art museums still expect the general public to develop an interest in the artworks through passive

observation alone. This contrasts with many science museums, where visitors can explore freely and learn through immediate feedback. For instance, when someone plays with a robot that moves a box, the outcome is visible and easily understood. In contrast, a sculpture expressing the artist's emotions may not offer such an immediate outcome, requiring a deeper level of interpretation that some visitors often need help to grasp.

This way, the purpose of this research is to design new ways for art museums to become more interactive. This should come in a way that is also friendly for users that are not familiarized with either advanced technology or art history, and in a manner that is socially relevant, not only entertaining or commercial. While I'm not a critic of the concept of having fun, this will not be the goal of the project, even though it could be a great path. The goal, however, is to achieve something that fosters the visitor's way of feeling and thinking about the highlighted art piece. This project aims to demonstrate that art can be more interesting for everyone, that learning about the pieces' context, narratives, and emotions don't need to revolve around reading long texts on walls. This project speculates on how we might cut through the purely visual aspect of a painting, offering a more embodied and emotional pathway to a deeper understanding.

1.1 Problematization

Every art piece that is currently in the possession of an art museum was created in a specific context, and it's often vastly different from the museum environment in which it is now displayed. Through the curatorial process, these pieces are not only removed from their original settings but also distanced from the contexts and meanings that produced them (Morales, 2012). To compensate for the lack of context, museums often construct new narratives for these works, updating their meanings to something that resonates with contemporary audiences (Mendiola, 2002). However, these constructed meanings often replicate the will and wishes of intellectual and societal elite groups (Morales, 2012).

This issue is intensified by the dynamics of power and knowledge described by Foucault in The Archaeology of Knowledge (1972). Foucault argues that knowledge is shaped by those in power, who use it to maintain societal control in a concept known as "power-knowledge". In the context of art museums, this means that the narratives displayed often serve to reinforce existing societal values and hierarchies, rather than offering space for diverse or marginalized perspectives. Consequently, these museums risk functioning as vehicles for maintaining the status quo rather than as open forums for critical engagement and dialogue.

This exclusion is structural. As Bourdieu (1979/2007) argues in Distinction, the appreciation of art is not innate but relies on "cultural capital", a specific code acquired through education and family background that allows the viewer to decipher the work. Without this code, the uninitiated visitor perceives the artwork only as a chaotic arrangement of colors or forms, leading to a sense of confusion or inferiority. The traditional museum often assumes the visitor already possesses this code, failing to provide the necessary keys for interpretation. This lets these visitors, the ones lacking the cultural capital, to perceive the artwork only through a functional or emotional lens rather than the "pure gaze" the museum expects.

This creates a dilemma about the role of visitors in art museums. On one hand, museums want to be an educational space, and in order to achieve that goal, they ought to allow visitors to develop their own in-

terpretations. On the other hand, the fixed narratives attached to exhibitions often block this possibility. Without opportunities to explore or criticise these narratives, visitors are left to be passive observers, excluded from the meaning-making process and the broader dialogue about the context and characters of the works on display.

Art museums are recognized for showcasing the results of artistic labor, but they usually do not give the same importance to the creative processes behind these works. Visitors are left to admire the finished product without being presented the decisions, historical and social context, and the stories of the characters that brought it to life. Umberto Eco (1995) proposes that the spectator plays a crucial role in providing meaning to an artwork. When museums present "closed texts", as in narratives that leave no room for other interpretations, they limit the possibility for visitors to engage critically with the art. This results in a one-sided experience where guests behave as “eyes without bodies” (Morales, 2012), mere observers who absorb information without actively influencing it.

In contrast, an "open text", as described by Eco, invites visitors to participate in meaning-making. By promoting spaces where individuals can form their own connections and interpretations, museums can transform passive spectators into active participants. Falk and Dierking (1992/2002) propose similar ideas, as the one they call Contextual Model of Learning, arguing that visitors are active constructors of meaning who filter the museum experience through their own personal context, that is, their prior knowledge, interests, and motivations. If the exhibition fails to connect with this personal reality, no genuine engagement will exist. However, to achieve this shift we will need to design a new way of thinking about how an art piece and its meaning are presented. We might distinguish between the ”real”, the physical artwork observed on the wall, and its ”reality”, the mix of context, history, narrative, and sensations it represents. Traditional displays, even those critiqued by Tsitoura (2010) as superficially interactive, often keep the visitor focused only on the real aspect, presenting a closed text that isn’t proactively enhancing the visitor’s access to a deeper level of the reality.

What can we, Interaction Designers, then do to keep art museums open for the immersion and comprehension of all kinds of visitors, independent of their familiarity with arts? What kind of interactive experiences could be used by these art institutions?

Museums are already trying to answer this question, at least partially. As interactive devices got more popular, they also started to show up at exhibitions in all kinds of formats. However, many exhibits labeled "interactive" merely incorporate technology as a tool for disseminating the information that was previously available in a physical format rather than as a medium for active participation (idem). This focuses on making exhibitions more marketable, using technology to appeal to visitors instead of investing in interaction as a tool to transform the relations inside the exhibitions. This approach reflects broader trends in the leisure market, in which cultural institutions are now inserted and need to compete for visitors' time and attention (Polese, 2018). While this strategy may increase attendance numbers, it rarely upgrades the visitor's understanding or connection to the art.

According to Tsitoura (2010), many exhibits are labeled “interactive” simply because they include technological elements, yet the true interactive value remains limited. She argues that “hands-on” or “participatory” exhibitions, which often lack advanced technology, actually offer greater opportunities for meaningful engagement. These experiences invite visitors to explore the artistic process collectively, breaking down the barriers between the creator and the audience. In these events, it is not rare to see the artist

themself guide visitors through a process or a debate, allowing for guests to discover much more about art than solely its final results. This suggests that interaction does not need to be technology-driven. Instead, it should focus on encouraging active participation and exploration of the exhibited pieces.

While exploring how interaction design could transform art museums, there was a problem that stood out: a museum has multiple restrictions on what can be altered inside it.

Walter Benjamin, in his essay “The Work of Art in the Age of Mechanical Reproduction” (1935), argues that the unique existence of an artwork in time and space, as he calls its “aura”, is essential to its relevance. In the museum context, this "unique existence" is endorsed by the preservation of both the physical work and the controlled narratives that shape its significance. This is what differentiates the original, unique piece, from any of its copies.

Drawing from Benjamin’s theory, if these narratives are disrupted or democratized, if multiple, potentially conflicting interpretations are given space, the aura of the artwork might risk being compromised. Allowing visitors to interact and generate new meanings to art pieces could be an interesting idea. However, allowing for multiple narratives challenges the aura of the artwork and challenges the hierarchical systems that frame artworks as singular objects of reverence. As Hooper-Greenhill (2000) suggests, this shifts their meaning from one rooted in authority to something more accessible and participatory. While this might appear like an opportunity, it also subverts the foundational role of museums as sole settlers of cultural authority. Hooper-Greenhill argues this shift is essential for the post-modern museum to remain relevant in a diverse society, even as it challenges traditional curatorial control.

This analysis reveals two distinct design opportunities. The first would be to challenge the systemic singularity of museum narratives itself, a foundational issue rooted in the institution's authoritative history. While critical, a solution to fundamentally restructure the Western museum is beyond the scope of this research. The second, more actionable opportunity lies in addressing the transmission of context. Traditional art displays often fail to make the social and historical reality of an artwork accessible, reducing the visitor's role to passive observation. Unlike science museums, which have successfully embraced active learning and interactivity, art museums remain focused on preserving the aura of their collections.

Therefore, this project proposes a tactical intervention: the addition of an interactive layer designed to complement, not replace, the original artwork. By integrating interaction design, we can speculate on experiences that, while preserving the artwork's essence, make its context and meaning more accessible to the public, intentionally moving beyond its physical, real shape. Who are these characters in this painting? What was happening at the time this sculpture was made? What social conflicts defined the look of this work? By introducing a new, interactive layer to the piece, the goal is to highlight the artwork's context, meanings, and evoke emotions. This will make these intangible aspects more accessible and emotionally resonant through active, interactive exploration, bringing together the aura of the object and the engagement of the visitor.

1.2 Research question

How can interaction design create experiences that enable active discovery of an artwork's social and historical context, enhancing visitors' emotional engagement, without devaluing the curatorial integrity and preservation of the original pieces?

1.3 Goals

To answer for the research question, these are the project goals:

1.3.1 Main Goal

Design an interactive experience that transforms the traditional, passive viewing of an art piece into an active exploration of its context and subjects whilst preserving the physical integrity of the artwork and respecting its historical context.

1.3.2 Secondary Goals

1. Empower interaction by using the visitor's physical movement as the primary interface, investigating how this link affects their sense of engagement and the artwork's artistic and documentary significance.

2. Enhance emotional connection by designing an "augmented reality" system that un-silences the painting in a way that complements the visual experience without distraction or cognitive overload.

3. Ensure good usability by identifying, testing, and implementing the necessary physical and visual affordances to make an "invisible" sensor-based system discoverable and easy to navigate.

4. Enhance visitor's comprehension of the displayed artworks by creating an open text system for active narrative discovery. This aims to explore the balance between visitor agency and curatorial integrity, allowing visitors to pull information and construct their own meaning within a historically grounded experience.

1.4 Argument

This project argues that the passive nature of traditional art museums creates an environment that limits visitor engagement. It proposes that this can be overcome by introducing an interactive element that relies on embodied interaction, specifically the visitor's physical movement in the gallery space, as the primary interface. By designing a system that translates physical proximity into narrative discovery, the artwork is brought to life, transforming the visitor from a passive spectator into an active participant. This active exploration involves the visitor physically navigating the space to trigger specific audio layers, effectively editing their own experience. Most important, this intervention is designed to complement, not replace, the traditional viewing experience. It respects the physical integrity of the artwork by using non-invasive technology while expanding its narrative scope. This shift is argued to be the factor that will

lead to a deeper comprehension and a more profound emotional connection, a hypothesis that will be validated through qualitative user feedback and quantitative engagement metrics.

1.5 Research Design

This project employs a Research through Design (RtD) methodology, where the act of designing, building, and testing a functional prototype serves as the primary method of inquiry. The prototype takes the form of a sensor-based auditory augmented reality installation built on the Arduino platform. It utilizes ultrasonic distance sensors to track visitor movement and a spatialized audio system to deliver a location-aware narrative. The system was validated through user testing in a simulated museum environment, which replicated the spatial conditions and scale of the O Grupo do Leão exhibition room to ensure higher fidelity.

This research is centered on the intersection of three main topics: Interaction Design, Art Interpretation, and Museology. Theoretical concepts from Museology, specifically the critique of passive observation, guided the project's goal to challenge the museum's lack of opening. Art Interpretation provided the historical groundwork for the narrative content, while Interaction Design principles were applied to translate these theoretical concepts into an embodied physical interface.

The evaluative phase employed a mixed-methods approach to measure the impact of the interactive experience. Qualitative engagement was assessed through semi-structured interviews and direct observation, while emotional connection and user agency were quantified using the Geneva Emotion Wheel and the Self-Assessment Manikin (SAM) scale.

Considerations of accessibility and inclusion were also taken during design steps. By prioritizing an audio-first narrative, the system aims to offer an engaging experience that does not rely solely on visual acuity, proposing a more inclusive model for visitors with diverse needs, although physical mobility constraints remain a factor for future iteration.

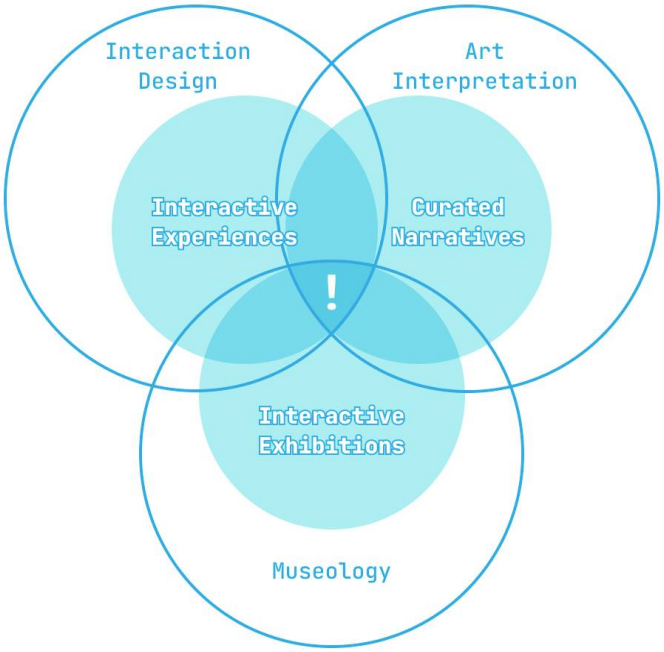


Figure 1: Diagram of research areas.

1.6 Document Structure

This document is structured to guide the reader through theoretical inquiry to practical implementation and empirical validation. Its organization aligns with the three phases of the research: Exploratory, Generative, and Evaluative, as illustrated in the project flowchart (Figure 2).

The document begins with the Introduction (Chapter 1), which establishes the research context by outlining the Problematization (1.1) of passive museum experiences. This leads to the central Research Question (1.2) and the specific Goals (1.3) that this project aims to address. The Argument (1.4) then articulates the core hypothesis, setting the stage for the investigative work. This introductory chapter concludes with the Research Design (1.5), detailing the methodological approach, and this Document Structure (1.6), which serves as a roadmap for the reader.

The Exploratory Phase is detailed across **Chapter 2: Theoretical Framework** and **3: Field Research**.

Chapter 2 goes into existing literature on museum interaction, decolonial perspectives, embodied engagement, and the concept of open versus closed texts. This theoretical foundation informs the problem space and positions the research within current academic debates. It establishes the theoretical concepts of embodied interaction and affordances that will later guide the design of the prototype.

Chapter 3 presents the empirical field research. Using a direct observation methodology to categorize existing interaction models, this chapter identifies current practices ranging from passive "closed text" experiences to more active, human-led or discovery-based interactions, confirming the opportunity for this intervention.

The Generative Phase is covered in **Chapter 4: Designing the System** and **5: Project Development**.

Chapter 4 outlines the strategic design choices, starting with the selection of O Grupo do Leão as the case study due to its dense social narrative and historical significance. It defines the system's concept, and details the rationale behind using auditory augmented reality and embodied interaction.

Chapter 5 then chronicles the iterative development of the functional prototype. It explains how the theoretical insights into museum experiences and interactions guided the specific hardware and software choices, alongside the crafting of the historical narrative and voice recordings.

Finally, the Evaluative Phase is presented in **Chapter 6: User Tests** and **Chapter 7: Conclusions**.

Chapter 6 details the user testing protocol, which utilized a mixed-methods approach combining semi-structured interviews, behavioral observation, and quantitative system logs. Presenting findings from both the initial and refined prototype iterations, it analyzes user engagement, usability, and emotional responses, providing empirical evidence to assess the system's effectiveness.

Chapter 7 synthesizes these findings to evaluate the achievement of the project's main and secondary goals. It answers the research question, discusses limitations, and offers final considerations on the broader implications for art museology.

To visualize the logical progression of this research, the following flowchart (Figure 2) organizes the project into three distinct but interconnected phases. The Exploratory Phase establishes the theoretical

problem and context. This informs the Generative Phase, where the specific design (artwork selection, narrative, hardware) is iteratively developed and prototyped. Finally, the Evaluative Phase tests this artifact against the initial research questions, creating a feedback loop that validates the entire methodology.

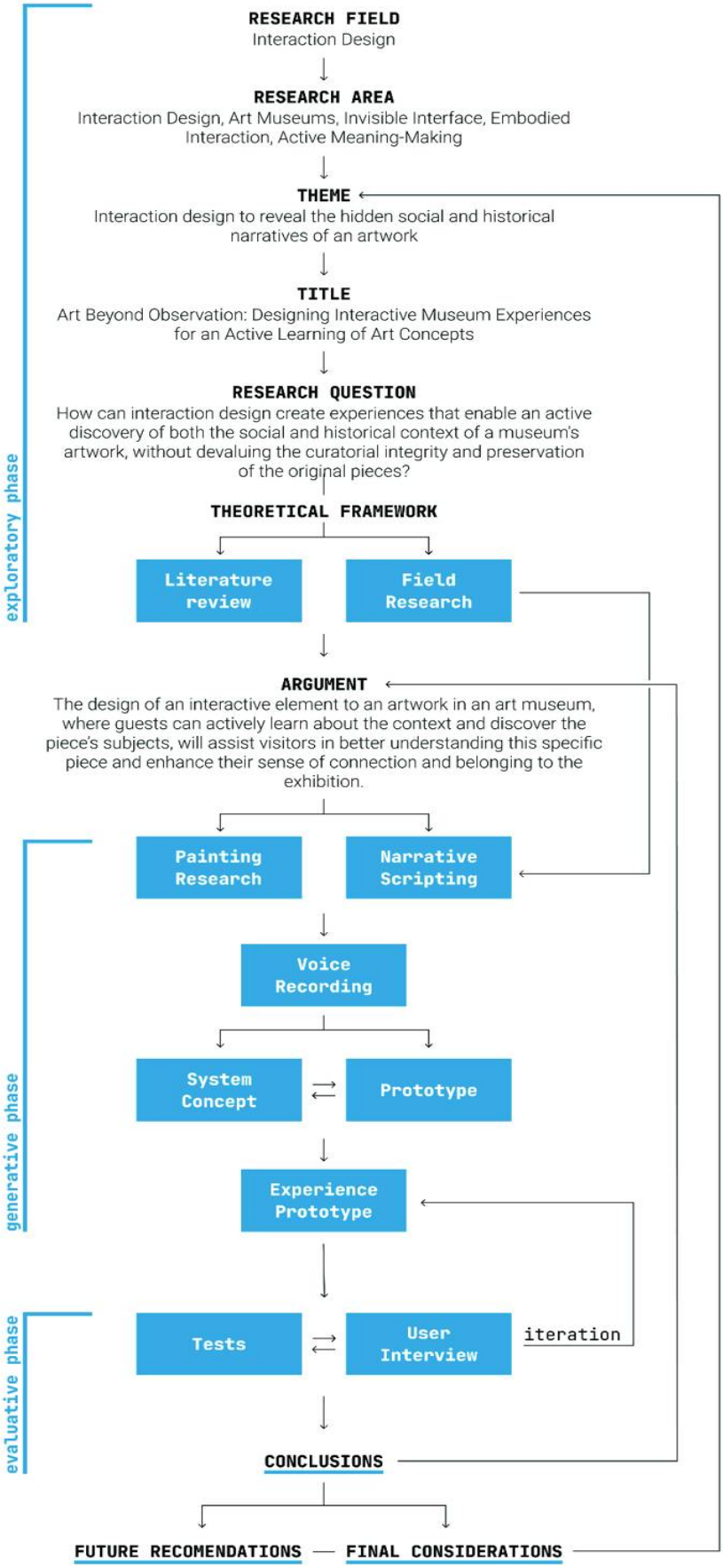


Figure 2: The three-phase research process (Exploratory, Generative, and Evaluative), illustrating the flow from theoretical inquiry to practical prototyping and final validation.

2. Theoretical framework

As established in the introduction, this research examines the passive nature of the traditional art museum experience, where visitors often encounter closed texts that limit their ability to engage in a more active discovery of the pieces. To analyze this issue and guide the design of an interactive solution, this chapter will deconstruct the core concepts drawn from museology, art interpretation, and interaction design, that will point toward a new model of visitor engagement. It's important to note that this model of interactivity is not merely functional but also political. By shifting the agency to the visitor, interactive systems have the potential to challenge static, Eurocentric narratives and promote a diversity of interpretations. Decolonial critiques and arts-based teaching methods are discussed in **Appendix A**.

2.1 Interaction in art museums

Tsitoura (2010), in her "Socio-cultural visions of Interactivity within Museums" argues:

> *"The new strategies adopted by museums towards progression and broader accessibility –at least regarding interactivity, seem to be linked more with a dominant commercialization of culture and education, than with a belief towards an effect on social change through the promotion of social interaction within a pluralistic and multicultural society, acknowledging the diversity of nature, opinion and practices, which can be combined instead of contrasting each other"* (p.89).

This explains that while many museums have embraced interactivity, their motivations are often to prioritize marketable features over developing genuine social connections or cultural inclusivity. In this research, a deeper interactive experience is defined as one that moves beyond superficial engagement, such as mere button-pushing, to facilitate meaningful cognitive and emotional connections with the artwork's context, empowering the visitor to actively construct knowledge rather than passively receive it.

Moreover, it is mentioned that interactivity plays an important role in relationship building between museums and the public. Engagement and participatory culture, marked by active involvement, depend

heavily on the strength and duration of the relationships they promote. This places a responsibility on museums to design and maintain interactive experiences that aids to form these relationships.

Witcomb (2003) directs a chapter in her book "Re-imagining the museum" to discuss interactivity. There, she mentions Bennett (1995), who says that inside a museum "locomotion – and sequential locomotion – is required as the visitor is faced with an itinerary in the form of an order of things which reveals itself only to those who, step by step, retrace its evolutionary development" (p.129). Her understanding is that this technology of "organized walking" saturates the routines of the visitor as the lesson of art's progress takes the form of an itinerary that the visitor is obliged to perform. This way, instead of the exhibition being a place it becomes a path, and instead of having conclusions, it only has an end. Some of the authors quoted in the book defend that interactivity is a great way to transform an exhibition from a path to a place, where visitors can enter a room and dive in a fun exploration of the theme instead of simply passing through the pieces.

However, Witcomb challenges this belief, arguing that "most of the literature on museum interactives frames these as didactic tools based on some form of mechanistic activity. Visitors push a button, touch a screen or manipulate an object in order to elicit information. Adding a multimedia station to an exhibit will not, therefore, necessarily challenge a one-way flow of communication which the exhibition as a whole may be premised upon. Nor does multimedia in itself necessarily represent a more democratic, open medium of communication" (p.129). This way, she concludes that interactivity doesn't instantly mean that visitors can now dive in the pieces, as many interactive stations are solely replications of the traditional, printed information, but in a digital format.

If exclusively passing through the artworks on a designed route weakens the connection between museum and visitors, as they transform the exhibition places in paths, a different research actually shows how important it is to, when in front of an art piece, to make visitors move:

> *"frequency of left-right ($r\tau$ = -.276), front-back (-.252), and total movement/60 s (-.291) all correlated again to less reported negative emotion. Left-right movement/60 s also positively correlated to more change in meaning (.294) and front-back movement/60 s correlated to feeling insight (.239). Total distance moved, not standardized to time, also showed a significant positive correlation with finding the art dynamic (.255) and feeling insight (.307). Overall, there was a significant relation between viewing time and total distance of movement (.511), but not to movement frequency in any direction, suggesting that viewers tended to constantly move around throughout the experience." (Kühnapfel et al., 2024)*

In summary, what they found was that the more visitors moved in front of the piece, the more they engaged and became interested in it. Kühnapfel et al. conclude that when people spend more time physically closer to the artwork, they also rate the art as more meaningful, interesting, and report feeling more stimulated and insightful. To verify this, they also found that those visitors who spent more time further away from the artworks reported having a less stimulating, moving, and emotionally arousing experience.

These findings support arguments for closer and more intimate engagements, and reinforce the idea that active involvement strengthens the visitor's sense of connection to the exhibited pieces in museums. Although the mere act of adding buttons to be pushed doesn't make a piece interactive, per Witcomb, the findings from Kühnapfel et al. suggest that an interactive device designed to encourage physical movement and exploration can be a powerful tool. Therefore, as it improves the closeness between visitor

and pieces, such a device can help transform the museum path into a much more interesting and moving place. We need, then, to define the best model of interaction for it to be capable to fulfill these findings.

Back to Witcomb, she later quotes Pitman-Gelles (1981) to explain that interactive exhibitions "provide a sense of discovery or direct experiences with objects. They appeal to a variety of senses and generally require the adult or child to handle materials, play roles, day dream, operate equipment and participate in play or work.". In other words, she refers to interaction as a great way to make the visitors participate in the artwork, mainly as they create the need for visitors to be a direct part of the piece's discovery process.

For a further understanding, Lewis (1993) creates a set of basic questions that anyone involved with the design of interactive pieces should ask themselves:

> *"Is it a stand-alone educational tool?*
> *Is it part of the overall interpretation of the story being told in the gallery?*
> *Is it merely for entertainment?*
> *Is it being targeted at a specific age group?*
> *Will it consist of a single workstation or multiple positions?*
> *Who is the audience?"*

These questions shape this concept around a more technical point of view. Lewis shows to be more interested in the physical characteristics of the interaction instead of the imaginative capabilities of Pitman-Gelles. However, these questions offer a great framework for better understanding this project goals and necessities.

Witcomb then concludes with a quote of McLean (1993), who states that designing an interactive exhibit "requires an ability to integrate communication goals (what you want the visitor to *learn*) with behavioural goals (what you want the visitor to *do*), and even emotional goals (what you want the visitor to *feel*)" (p.133).

In the book "A History of Participation in Museums and Archives", Kidd (2020) points out some ethical implications that interactive and participatory processes of generation of knowledge inside cultural institutions should have in mind. These concerns are mainly about the ethics of microworking, as some critics start to use the term labor to describe involvement in citizen and crowd participation projects. These projects are brought by the institutions in the goal of democratization, under a belief that if more people, each one with a diverse background, participates a bit in the generation of knowledge, the end result will reflect a broader section of the society.

This process, however, brings some concerns about the knowledge that is generated:

> *"Participation will be multiply skewed along lines of gender, age, ethnicity, education, geography, class, and ability in ways that may be difficult if not impossible to anticipate or to understand. [...] some groups may be more or less likely to donate their data, which in turn introduces potential sources of bias in the datasets produced." (idem, p. 78)*

Other concerns revolve around the economic aspect, such as the remuneration of the users due to their labor, and the intellectual property implications of having a dataset created by multiple citizens.

As the author concludes, "It is too simplistic to assert that all citizen-science projects are exploitative, or that anything other than financial remuneration is inadequate. This does not, however, absolve those

working at the sharp end of delivery on such projects of the responsibility to think through these questions." (p.84). This way, although the idea of this project is not to generate knowledge, but to transmit the already existent one in a more active, participatory way, Kidd's warnings about access, bias, and inclusivity still apply. How would an interactive piece be seen by the broad set of visitors that a museum welcomes? By the addition of this installation, would there be any difference in the willingness to participate by gender, age, race, or, most importantly, digital literacy, that would make this project more welcoming for some than to others? Therefore, the design process must remain vigilant about these ethical dimensions, aiming to create an experience that is as equitable and accessible as possible for all museum visitors.

2.2 Art museums and current scene

The theoretical and ethical critiques laid out, from the passive, closed texts of traditional curation (Eco, 1995) to the deep-seated colonial foundations of the institution itself (Vergès, 2024), lead up to the current scene in museology. Coinciding with the rise of digital technology, the role of museums is undergoing a significant transformation. As Hooper-Greenhill (2000) suggests, while the modernist museums treated their visitors as deficients who lacked information, as empty vessels waiting to be filled, the museum audiences are nowadays being reassessed. Based on European origin, this scheme of an authoritative, didactic broadcasting of a single truth to a passive audience was exported worldwide. However, the post-modern museum is in the process of coming much closer to its audience, moving beyond being a mere custodian of artifacts to become a space where communication is understood as a complex cultural process. Here, meaning is not fixed on a label but is actively negotiated through the visitor's own cultural perspective, making their interpretation as vital as the curator's intent: "Where the modernist museum transmitted factual information, the post-museum also tries to involve the emotions and the imaginations of visitors." (p.143). Consequently, interactive experiences must do more than display data, they must empower the visitor to navigate these multiple narratives.

Evans & Sterry (1999) conducted a research project focused on building an interactive device for an industrial museum, exploring the use cases of new technologies in heritage sites in a period where these technologies were still fairly new. They chose a gallery where large, historic textile machines were displayed but were inactive most of the time. Interpretation was limited to simple text panels, and visitors struggled to visualize how the machines worked or understand their context.

Their multimedia application was designed to be a discovery-based interface, so it didn't just show videos. The screen showed an illustration of a room in the textile mill, and visitors could touch different elements (machines, people, objects) to get more information. As the authors defend, interactive multimedia is a great tool due to how effectively they communicate and compliment the already established interpretative formats: "It is evident that much more could be accomplished in terms of applied new technology especially in the interpretation of exhibits." (Evans & Sterry, 1999, p.114)

It is not, however, solely the technology that allows for this enhancement in the museum exhibition, but also a concurrent change in the museum's role in society. As museums "move away from glass cases towards interactive multi-sensory experiences, museums are no longer a place to visit but a place to participate" (idem). This way, the addition of an interactive exhibit is a must for every new gallery. These pieces are also ideal because they allow for visitors to access information at their own pace.

The results of their multimedia application were clearly positive, as visitors who used the computer could recall significantly more processes from the textile mill, on an average of 4 processes vs. 3 for the control group. The number of people who couldn't name any process dropped from 14 to just 1 in the computer group, against 15 to 10 in the control group. Visitors using the computer spent, on average, 3 minutes longer in the gallery. They also spent the largest proportion of their time focused on the main exhibits, the textile machines, unlike the control group who spent more time looking at other, secondary exhibits. Over 90% of users enjoyed the device and found it easy to use. 84% felt they explored the exhibits in more detail, and 92% felt they had learnt more than they would have without it.

The study's main findings, therefore, highlight two key points. First, the value of moving beyond fixed interactive kiosks to discovery-based interfaces that grant visitors the freedom to move and acquire the information from wherever they want. Second, it proves that this form of active, contextual interaction directly enhances the visitor experience. The fact that 92% of users felt they had learned more and that visitors spent, on average, 3 minutes longer in the gallery demonstrates that an interactive tool designed to actively reveal an exhibit's context can significantly improve both visitor engagement and self-reported learning.

More recent research, such as a study by Campos et al. (2011) in a cultural exhibition, has moved beyond kiosks and touch-screens to compare different sensor-based interaction styles, such as touching, walking over, waving, and page-flipping gestures. However, their findings complicate the idea that interactivity is always the ultimate goal. The most enjoyable installation in their work, with the highest levels of social interaction reported was, paradoxically, a non-interactive, 360-degree immersive room. The authors suggest that the mere enjoyment and immersive factor alone were enough to make visitors comfortable and initiate conversations.

Nonetheless, among the interactive installations, the most successful were those that facilitated collaborative activities. An interactive floor, which displayed pictures that changed as guests walked over it, "clearly enhanced the level of engagement" and sparked social interaction. This supports the findings of Kühnapfel et al. (2024) that movement-based engagement is highly effective. The study also identified a significant accessibility gap: "Older visitors were more averse to interacting and preferred to simply watch" (Campos et al., 2011, p.8), highlighting the need for clear affordances, such as a "walk over me" label, “since adult visitors never had a clue and didn’t realize that it was supposed for them to walk over the floor. This didn’t happen to children, who understood what the floor was for, even with no label or any other clue” (idem). They recommend that traditional Human-Computer Interaction Design principles, such as the importance of affordances, should also be followed in the design of museum experiences. If not, “if the visitor doesn’t understand the installation’s purpose and usage in the initial minutes (even seconds), then the installation won’t be effective in supporting the user’s visit." (idem). This study also critiqued traditional audio guides for providing only an individual and detached experience, reinforcing the need for more social and immersive solutions.

While these studies confirm the potential of well-designed interactions, research by Polese (2018) on visitor expectations for the 21st-century museum reveals both a strong desire for this type of engagement and a significant design challenge. Polese's interviews with cultural tourists found they overwhelmingly expect future museum experiences to be dynamic, interactive, immersive, personalized, and engaging. Visitors expressed a clear interest in storytelling and, most relevantly, in seeing hidden treasures and going behind the scenes.

However, Polese's case study of the Boijmans Van Beuningen Depot, which is a publicly accessible art storage facility, found a difference between expectation and reality. Visitors reported feeling confused, distracted, and overwhelmed, stating that the experience was "just too much". One visitor even described the open-storage setting as "dehumanized".

These studies provide a clear directive: a successful interactive experience must do more than just provide data. It must be designed to be immersive and social (Campos et al., 2011), accessible to all (Campos et al., 2011; Kidd, 2020), and must carefully structure its narrative to provide the context visitors desire without causing the confusion and cognitive overload of an unstructured data dump (Polese, 2018).

2.3 Chapter synthesis

This theoretical framework has established a clear set of criteria for a meaningful and effective museum intervention. The literature demands a solution that moves beyond the commercially-driven, superficial interactivity critiqued by Tsitoura (2010). A successful design must instead operate as an intervention that challenges the traditional, monolithic narratives currently presented by revealing more of the artwork than its physical instance (Vergès, 2024; Kidd, 2020).

To achieve this, the project shall adapt academic principles of deconstruction of an art piece (Srouji, 2017) into an accessible experience that leverages physical movement to enhance emotional engagement (Kühnapfel et al., 2024). Finally, the practical studies on museum installations provide the crucial design constraints: the experience must be immersive and social (Campos et al., 2011) while delivering its contextual information through a carefully structured narrative to avoid cognitive overload (Polese, 2018).

These synthesized principles form the critical lens for this research. The following chapter will now use this lens to evaluate, through empirical field research, how existing museums are attempting to transmit information, and where the opportunities for this intervention are.

3. Field research:
How are art museums transmitting information

Following the theoretical framework, the research moved to an empirical stage to analyze how these theories apply in real-world settings. The chosen strategy was Observation, a method that "allows the researcher to unobtrusively gather information by looking and listening without direct participation or interference with the people or behaviors being observed" (Martin & Hanington, 2012, p.90). This method was selected to allow for an unbiased discovery of visitor behaviors and existing information transmission dynamics.

The observation was conducted in two sets of institutions. The first set, located in Lisbon, Portugal, included the Center for Modern Arts of the Calouste Gulbenkian Foundation (CAM), the Gulbenkian Museum, the National Museum for Ancient Arts (MNAA), and the National Museum of Contemporary Art (MNAC). These were chosen to establish the baseline of a typical exhibition of art collections. The second set, located in Belgium, focused on interactive models at the House of European History, the Parlamentarium, the Plantin-Moretus Museum, and the Museum of Industries. These were selected to identify alternatives in embodied and discovery-based learning outside of the traditional art museum. This diversity of contexts, going from art, history, and industry, allowed us to identify how different kinds of institutions use interaction, and what we could learn from them.

The observation was oriented by the theoretical framework. The focus was to observe how some of the theoretical aspects were transported into the real-world scenario. Critiques of superficial interaction, the importance of physical movement, the different kinds of interactive possibilities, and the process of discovery of the narratives inside the exhibition, all were taken into account during the observation. The focus was on the inherent pedagogy of the exhibition design itself, how the visitor and its freedom are treated in each institution from different areas, no matter who the visitor is.

3.1 Analysis of Findings

The field research identified four distinct categories of information transmission (see **Appendix B** for the complete field report and detailed case studies). First, the closed text experience remains the baseline in most art museums, confirming the prevalence of passive observation where visitors are limited to reading static labels. The information transmitted in this category is fixed and non-negotiable, consisting primarily of biographical data, dates, materials, and singular curatorial interpretations.

Second, instances of superficial interactivity (Tsitoura, 2010) were observed. Technologies such as touch-screens or barcode scanners were used merely to digitize traditional wall texts without altering the passive nature of the engagement.

More effective engagement was observed in the third category, "Personal active guidance", where human guides facilitated dynamic inquiry and dialog, prompting the visitors with questions and providing information based on their personal interest during their one to one conversations. However, this model is inherently non-scalable.

Finally, examples of active discovery were seen in science and industry museums, where visitors used physical manipulation to learn concepts. Specific examples included touch displays that could be physically moved to reveal historical facts about the city's skyline, and workshop-like processes using auto-guided printing presses mechanics. These interactions showcased how well physical manipulation leads directly to active engagement. Comparative observation suggests that this active mode is less common in art museums, as none were seen inside the visited institutions, because traditional museology prioritizes the static contemplation of the artwork, viewing physical interaction as a challenge to conservation and reverence.

3.2 Synthesis and Opportunity

This field research empirically confirms the problems identified in the theoretical framework. The art museum experience remains dominated by passive observation, and technological additions often fall into the category of "superficial interactivity" critiqued by Witcomb (2003) and Tsitoura (2010).

The most meaningful interactions observed were not technological but human-led. These personal, guided experiences successfully created a social sphere but are inherently unscalable. Conversely, embodied interactions were observed in other museums. These functioned by linking physical action to content revelation, resulting in higher engagement due to the visitors actively choosing, with their body, what to see and when to reveal it. However, they were not applied to art narratives. Expert consultation also pointed to successful non-technological models, such as a participatory label-writing project at the Alcântara Library or a tactile children's exhibit in Denmark (Santos, personal communication, 2025). These examples confirm that successful engagement often relies on personal connection and physical agency rather than complex digital screens.

Our opportunity, then, is to create a system that combines the narrative engagement of the human-led model with the scalability and embodied principles seen elsewhere. The following chapter will now detail the design of a system guided by the principles of embodied interaction, affordances for a good usability, and narrative engagement.

4. Designing the system

The preceding chapters have established a clear theoretical framework and identified a significant gap in current museum practice. The theoretical analysis revealed that a successful interactive experience must move beyond the superficial, mechanistic button-pushing critiqued by Witcomb (2003) and Tsitoura (2010). It must avoid becoming mere window-dressing or pacification (Vergès, 2024) and instead function as a tactical intervention that reveals the hidden narratives of an artwork.

Furthermore, the research identified these principles to be adapted for this system:

1. It must leverage physical, embodied movement as a core mechanic for engagement (Kühnapfel et al., 2024).
2. It must be accessible and intuitive for all visitors, including those with low digital literacy (Kidd, bidimensionality; Campos et al., 2011).
3. It must be immersive and social, avoiding the detached experience of traditional audio guides (Campos et al., 2011).
4. It must be carefully structured to avoid the cognitive overload and confusion of many open-access exhibits (Polese, 2018).

Finally, the field research demonstrated that while human-led guided tours are highly effective at providing this narrative context, they are not scalable.

This chapter moves from theory to practice. It details the design of a speculative interactive system created to synthesize these findings and solve this precise challenge. It proposes a system that replicates the benefits of a personal, guided tour in a scalable and independent format, using the embodied, movement-based principles observed in the field research. To achieve this, the design employs ultrasonic distance sensors to create an "invisible" interface, where the technology isn't highlighted. The visitor's physical movement, specifically their lateral position and proximity to the canvas, is directly integrated

into the artwork's narrative, triggering distinct audio layers. This approach ensures the interaction remains intuitive and accessible, allowing users to navigate the story through natural body language rather than complex menus or screens.

It will define the the Who (the choice of the painting O Grupo do Leão and its characters, and the expected users), the What (the system concept), the Why (the design rationale linking back to the theory), the Where (the museum setting), and the How (the proposed interaction model and sensor technology).

4.1 Who?

The idea of this project is to experiment with new ways to interact with artistic pieces, removing it from the fate of passive observation alone. To achieve this, it was needed to define one piece to base our design work on, one artistic creation to try out the ideas from this research.

4.1.1 The selected painting

After further research, to develop and test this research's concept, the painting O Grupo do Leão (1885) by Columbano Bordalo Pinheiro (1857 - 1929) was selected as the ideal case study. This monumental piece (376cm x 201cm) is a snapshot of a lively social gathering at the Leão de Ouro tavern. It is populated by 12 of prominent naturalist artists, writers, and intellectuals from the period, accompanied by 2 restaurant workers, forming a group of complex relationships, personalities, and ideas. (Lapa, n.d.)



Figure 3: The selected artwork, the "O Grupo do Leão" (1885) painting, currently exhibited in the Museu Nacional de Arte Contemporânea do Chiado.

The painting was first made to be exhibited at the very tavern where they gathered. According to contemporary accounts, the group's previous meeting spot was closing, and the artists decided to follow their favorite waiter, Manuel Fidalgo, also represented in the painting, to the new establishment he was moving to. As a sign of their backing, the members decided to decorate the new restaurant, which would be named "Leão d'Ouro", with their own works. While other members contributed landscapes and even an embroidered lion, Columbano Bordalo Pinheiro chose to paint the group, creating the only portrait of the members of the naturalist movement of Lisbon. The finished work was hung at the restaurant's entrance until 1945, when it was removed due to new renovations, after it had gained critical acclaim. The Portuguese government bought the painting a few years later, adding it to the museum collection. (Silva, 2018; Lapa, n.d.)

This painting was selected due to a few reasons. First and foremost, it was a painting that particularly captured my interest. During my museum visits, I spent a good amount of time observing this massive piece, wondering who these people were. Although it was made in a style that reassembles a collage, in which each figure is individually positioned within the group setting, it creates a vivid portrait, a scene that was captured in the moment that a lot of things and social interactions were happening. Additionally, it's a painting of a dense social narrative and historical significance. This made sense for this project, as this made me believe that this great amount of things also allowed for a good amount of interactive possibilities, such as spatially navigating the distinct conversations between the artists, uncovering the hidden biographies of the peripheral figures like the waiters, exploring the elements on showcased on the table, and immersing the visitor in the specific political and artistic debates of 19th-century Lisbon.

4.1.2 Who are those on "O Grupo do Leão"

The painting is a definition of each individual's personality of this naturalist generation, capturing 14 individuals in what Columbano intended to be a snapshot of a real, interrupted moment, as if a photographer had just walked in (Silva, 2018).

The figures depicted are:

> Standing (from left to right): The painter João Ribeiro Cristino, the intellectual Alberto de Oliveira, the waiter Manuel Fidalgo, the artist himself, Columbano Bordalo Pinheiro, the brewery owner António Monteiro (also identified as Diaz), and the landscape painter Cipriano Martins.
>
> Sitting (from left to right): The landscape painter Henrique Pinto, the painter José Malhoa, the marine painter João Vaz, the painter Silva Porto (who sits at the center as the "head of the group"), the painter António Ramalho, the painter Moura Girão, the famed caricaturist Rafael Bordalo Pinheiro (Columbano's brother), and the sculptor José Rodrigues Vieira.

4.1.3 Expected users

The design of this intervention is targeted at the general museum visitor, not the art history specialist. The field research found an unmet need where visitors are often curious but the traditional text on the walls fails to satisfy their desire for context.

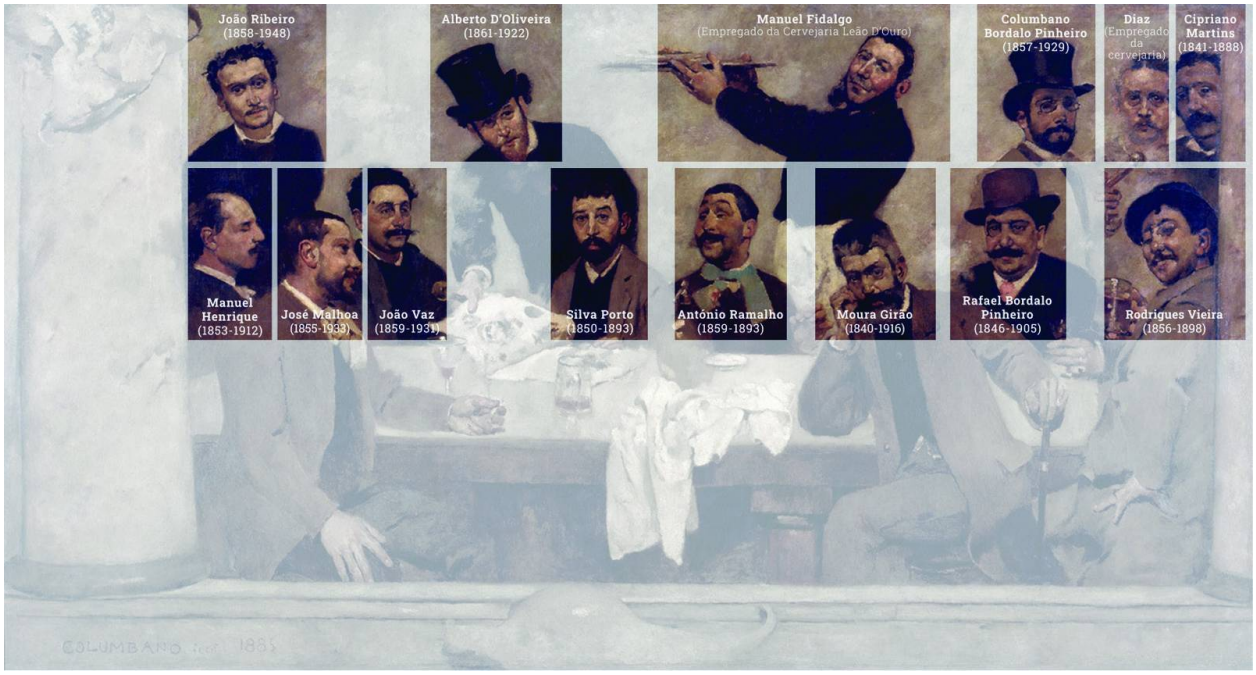


Figure 4: The painting edited to highlight each of the group's members.

Therefore, the expected users for this project are defined by their curiosity and need for access, rather than by any specific demographic. The system is designed to be inclusive, targeting three primary archetypes identified from the research.

First, there is the visitor who is curious but not familiarized with arts. They are represented by the visitor observed in the field research, someone intrigued by the people in a painting like O Grupo do Leão but who lacks the art-historical background to know who they are or why they matter. They want to find information that is accessible and relatable, connecting the visual object with deeper information without using academic vocabulary. The system addresses this by using narrative audio content focused on personal stories and social dynamics, rather than presenting disconnected historical facts.

Then there is the visitor who is technologically hesitant. Campos et al. (2011), and Kidd (2020) refer to an accessibility gap, where many visitors are averse to or intimidated by complex touch screens and Augmented Reality applications. This group doesn't want to learn how to use a new technological device for a single exhibition. This project tries to address this need by aiming for an interaction that works through an "invisible" interface. Working based solely on natural body movement, it requires no prior digital literacy, solely the user's position in front of the area of interest.

Finally, there are the social groups, such as families, friends, and couples that visit the museum together: the system is intended to be a shared social experience. Their primary need is to maintain the social bond during the visit, avoiding the isolation proportioned by the use of individual technology, such as the one seen with traditional audio guides (Campos et al., 2011; Falk & Dierking, 1992/2002). By utilizing open-air speakers in a spatialized audio experience, it allows multiple people to experience the content together and foster the dialogue and shared discovery observed.

This way, the expected user is anyone who has ever stood in front of a painting and wondered "Who are these people?" or "What is the story here?". The goal of the system, to be detailed next, is to provide a tool that is an active, imaginatory exploration of the painted scene.

4.2 What? The system concept

This project proposes a speculative design intervention aimed at transforming the passive viewing of a painting into an active, embodied, and emotional exploration. The core of the concept lies in distinguishing between the artwork as a real object and its encompassing reality. The real is the physical, tangible painting on the wall: the canvas, the paint, the light. It is what the visitor sees with their eyes, often in a brief, rational, or formalist glance. The reality is the intangible, invisible context that produced the painting: the social debates, the hidden narratives, the artists' emotions, the historical conflicts. It is what the visitor must stop, observe, feel and discover to truly connect with the work.

The proposed system is a sensor-based installation designed to cut through the real to reveal the reality. It uses an unexpected and disruptive layer, sound, to achieve this. While the painting O Grupo do Leão is exaggeratedly realistic, the choice to add audio is a speculative act. It is not a "natural" addition, as it would be in a film, but a deliberate intervention that takes the flat, silent, 2D object and lifts it off the wall, making its world feel 3D, spatial, and alive.

The goal is to expand the painting's artistic and documentary significance by creating a form of Auditory Augmented Reality. The system augments the physical object not with visuals, but with a rich audio soundscape that targets the senses and emotions, rather than just adding more the visitor's rational gaze.

Technically, the proposed system is a sensor-based installation. It is a system of invisible technology, as per the project's secondary goals, that avoids screens, text, and menus. The visitor's own physical presence and movement, and, most importantly, their own curiosity, are the only interface.

The system works by dividing the physical painting into five vertical zones, each corresponding to a group of 3 or 2 characters engaged in a conversation. This conversation will represent the thoughts, beliefs, personalities, and worklife of each member of the group. It will also point to some important events and novelties from the period when the painting was made.

Using a series of discrete ultrasonic presence sensors, the system tracks the visitor’s position on two axes. This allows it to know how far the person is standing from the painting, and the position where the visitor is standing in front of the artwork. This tracking triggers a multi-layered audio narrative delivered via audio speakers aligned with each zone. The visitor does not follow instructions, they simply explore the painting as they normally would, and their movement brings the scene to life.

There is an experience guide next to the painting, taking the spot of where the wall text currently is. It allows for a quick explanation of the experience and some extra details for those who might be interested in it. There is, in this stage, nothing to prevent multiple audio zones from being triggered simultaneously by multiple concurrent users. Since this is a tavern, a place where multiple conversations happen at the same time in a noisy environment, this decision was made to preserve the ambience of the scene: if there are multiple visitors in front of the painting at the same time, there will be multiple conversations happening, just like the real world setting. Since the audio speakers are located right in front of each zone, producing audio relatively close to the visitor, we believe this might not become a critical problem. However, this will need to be verified later, as it might become a usability constraint and endanger the user’s comprehension.

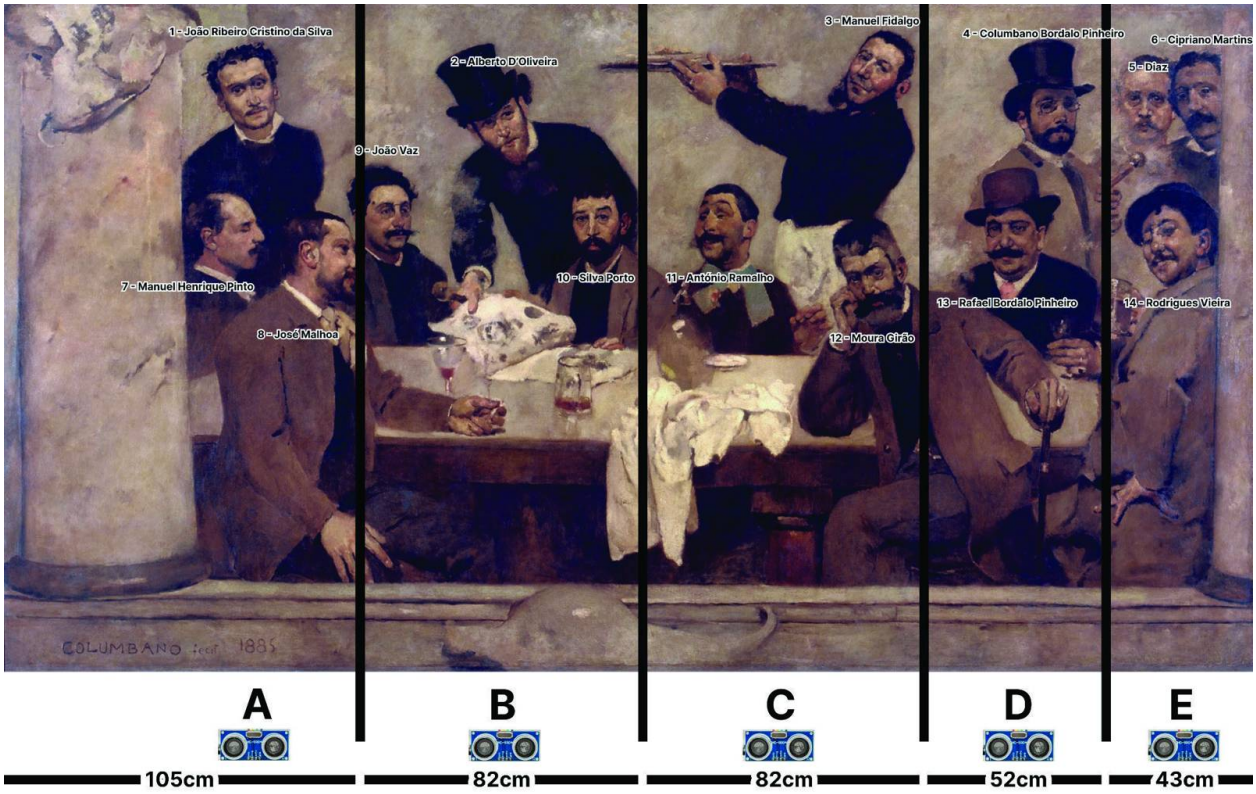


Figure 5: The painting is divided in 5 zones, each one with 3 or 2 members. Each zone will be identified by a presence sensor, to be detailed later.

As a visitor approaches a specific zone, they begin to hear the conversations from that group. The narrative is then revealed in three layers of proximity, where each layer activates a specific character's voice corresponding to their physical depth in the painting. The dialogue is structured to create a cohesive narrative with no singular progression, moving from background context to intimate, emotionally resonant debates designed to evoke a sense of belonging and camaraderie. This makes the visitor feel as if they were a guest at the tavern, moving between conversation groups, listening and being part of the character's debates. It rewards the visitor's curiosity and directly links physical movement to engagement, as found in the Kühnapfel et al. (2024) research.

By physically navigating the painting, the visitor actively reconstructs the social scene. They are not passively told the story, they are empowered to discover it. This process is designed to turn a quick glance at the real object into a longer and deeper exploration of its reality, fostering a personal connection and allowing each visitor to build their own meaning. Future iterations could also include complementary interfaces, such as haptic feedback or subtitles, to broaden accessibility. It is an experience that can even be "seen" with eyes closed, offering a moment of "darkness" based in feelings in contrast to the painting's purely visual nature.

4.3 Why? The choices made

The main goal of this project, as previously defined, is to remove the painting from the classic two-dimensional way it is presented and transform it into a living, interactive experience. To allow for a visitor to dive into a painting is to break up with the passiveness with which the artwork is currently showcased.

However, as the project's secondary goals defined, it must not interfere with the artwork's physical form. It should, instead, expand it.

This way, all the options that would make for a total immersive environment, such as Virtual Reality (VR) headsets were discarded. A VR headset would disrupt the traditional visitor flow, as it totally blocks the user's view of the original artwork, replacing it with a virtual recreation. Furthermore, VR presents a significant accessibility barrier for users who are not digital natives, a key challenge to inclusivity that would skew the user base to one more comfortable with this piece of tech, as identified by Kidd (2020).

With VR deemed too disruptive, a more subtle approach was also considered: the addition of a screen. One possibility was a television placed below the painting, similar to the installation at the Industry Museum in Gent (see in **Index A**), which could showcase details within the artwork. Another idea was a screen positioned to the side, allowing users to discover what the "photograph" had left outside the canvas.

However, while these screens would not substitute the painting, they would still add significant visual information that distracts the visitor from the original piece. This concern was validated in a consultation with Luísa Santos, a museum curator and art professor. Drawing on her experience with interactive installations, she emphasized that in an era of constant visual stimuli, the "scrolling culture", any additional visual layer must be critically evaluated so as not to overpower the artwork itself. She suggested exploring invisible interfaces, citing examples where sensors are hidden in the architecture to project light or sound without visible hardware. Furthermore, Santos highlighted the risk of conditioning the visitor's imagination. Just as a concert can be diminished by excessive visuals, a painting's interpretation can be narrowed if the interactive layer is too prescriptive. Therefore, the system must open up the experience without dictating it, maintaining respect for the original work (Santos, personal communication, 2024). In conclusion, any screen-based solution would fall into this category of a distraction, not an expansion of the original piece.

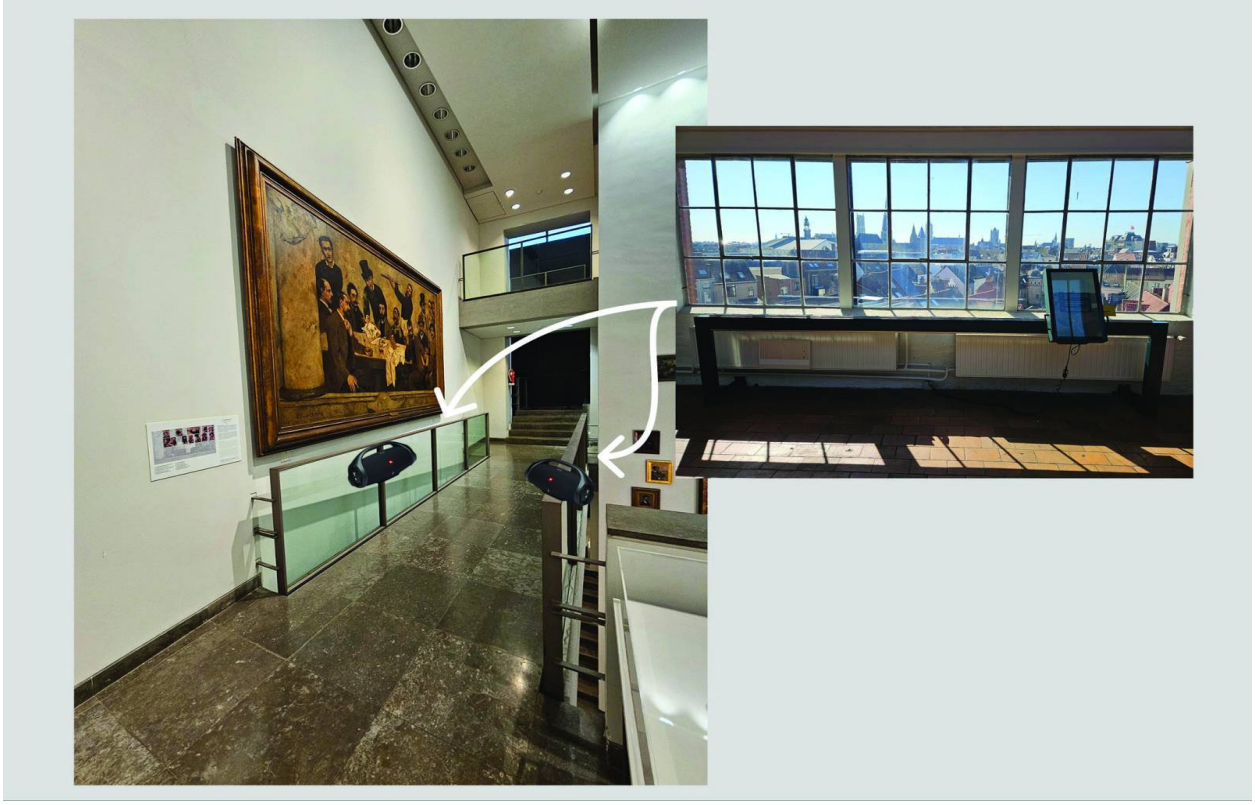


Figure 6: Rough sketch of how a television system could be installed in the painting setting.

The choice, then, was to work with an audio installation, as it allows for the addition of information without adding visual distractions. It enhances the viewing experience by activating an extra human sense, not overcharging a single one.

Additionally, when Vergès (2024) calls for a programme of absolute disorder, as detailed in Appendix A, it is not about bringing chaos, but disrupting the established, colonial order. The museum presents these 14 men as silent objects to be passively viewed. This is the current order, and this project, through audio, gives them their voices back. This act of "un-silencing" is itself a disruption of the traditional museum experience. Moreover, Vergès (2024) also calls for a post-museum focused on narratives, communities, and practices rather than objects and ownership. This concept achieves exactly this, as it uses the physical object, the real thing we see, as a gateway to the human narratives, the reality of the work, that is the debates, friendships, and ideas that the museum's wall text ignores. The goal of this project is therefore not to revolutionize the museum, but to create a tactical, speculative design intervention that shifts the focus from the cultural authority, singular voice of the museum, transmitted through a closed text (Eco, 1995), to a much broader and open experience, where visitors can actively interpret the social scenario in which they are inserted through the audio and visual scenery combination.

The choice of spatial audio speakers over headphones also solves the issues identified by Campos et al. (2011), who defines the traditional audioguides as an individual and detached experience. Besides traditional guides isolating the visitor, Falk and Dierking (1992/2002) emphasize that the museum experience is fundamentally shaped by the “Sociocultural Context”. Most visitors arrive in groups, and their learning is socially mediated through conversation and shared discovery. Therefore, a successful interactive system must account for this social dimension, allowing the physical context, the architecture and the object, to facilitate rather than inhibit group interaction. Consequently, by utilizing open speakers it creates a shared soundscape that multiple visitors and social groups can experience together, fostering the dialogue and shared discovery of the artwork.

Finally, the base choice of splitting the painting in five different zones is also to inspire visitors to physically move in front of the painting. This goes on as direct response to the findings of Kühnapfel et al. (2024) that visitors feel more engaged, develop deeper interest, and rate art as more meaningful and interesting the more they move and approach the art piece under observation. To make it even more engaging, the sound narrative is designed as overheard conversations and personal thoughts, instead of an informational guide. Through specific speech tones, such as joy or intense debates, it evokes these emotions in the visitors, who can feel as if they belong in the scene. This approach aims to promote a form of historical empathy, encouraging visitors to reflect on the human relationships and social realities behind the painted figures rather than simply absorbing factual data. The design rejects the mechanistic activity of button-pushing seen in the digital wall text examples in Appendix B. Instead, the visitor's own physical presence and movement is the only interface, leading to an experience that is more intimate and longer, that is, turning what could have been a mere part of a path into a place (Witcomb, 2003).

4.4 Where? The art museum setting

Inside MNAC the painting is located on the upper floor, on a wall dedicated only to this piece. Going upstairs after a tall wall full of portraits, the visitor is faced with this painting at the end of the hallway. This leads to a bridge-like corridor that isn't part of the primary circulation path, as the main museum route directs visitors to turn left before reaching this area. The bridge itself serves primarily as access for an elevator, meaning visitors who step onto it are not simply passing through to another gallery.

This way, the painting sits in a place that excludes the risk of accidental disruptions caused by a passers-by and enhances the experience of the longitudinal movement, as the narrow, exclusive corridor potentializes this left-to-right movement, the same one used to navigate through the audios.

As a result, the installation will take up the entire length of this corridor–shaped bridge. As it can be seen in Figure 8, the corridor will be equipped with 5 different ultrasonic presence sensors, one for each zone (A to E) of the painting. Then, inside each zone, the system also senses the distance the visitor is from the painting. Consequently, it plays the audio according to their position, matching the visitor's spatial location with the painting characters' location. For example, if someone was to be in zone A close to the painting (white circle), they would listen to José Malhoa, who is sitting exactly in the front part of zone A, also marked by a white dot in the sketch.



Figure 7: The 3,76m painting has a wall dedicated only for it. To approach the picture, visitors must pass by the entrance for the following room and go to the bridge that connects the elevator, behind the portraits wall, and the second floor. This allows for a closer and more exclusive observation area.



Figure 8: Sketch of how the system would work in the museum setting. Each zone (A-E) will be activated by one presence sensor. The sensor also gets the distance from which the person is standing in front of the painting (white, red, blue dots), so the audio played will correspond to the character of the position where the visitor is standing.

4.5 How? The pieces behind it

Finally, to implement the system as conceptualized, a stack of sensors and speakers was required. The main need was to select a sensor that could reliably detect both a visitor's longitudinal position and their proximity.

Classic Passive Infrared (PIR) sensors are very common, often seen to turn on lights when someone walks in. However, these models only detect the change in a scene but cannot track a person's static presence or measure their specific distance from the sensor. Infrared cameras, such as the one used by Kühnapfel et al. (2024), can capture the exact position where any person is standing in front of the artwork. This allows for a more precise but also much more expensive installation. Another possibility was to use floor-based sensor pads. However, this would require a disruptive floor installation and demand precise, unguided foot placement from the visitor, creating a possibly confusing user experience

The chosen solution, therefore, is a system built with ultrasonic distance sensors, specifically the widely available HC-SR04. They are excellent at measuring precise distances, allowing the system to easily differentiate between a visitor who is far away and one who moves closer. Moreover, by placing one sensor aligned with each of the five zones of the painting, the system can reliably determine where the visitor is standing along the artwork's longitudinal axis, and since they are inexpensive, using five of them wouldn't be a problem. Finally, small sized, they can be easily concealed from view, fulfilling the secondary goal of using invisible, non-disruptive technology.

This sensor array will be paired with a set of small audio speakers. One possibility was to use Spotlight Audio, a technology that beams the audio in a way that only those right under it can listen. This would reduce the noise infiltration in surrounding areas, but would also remove the social part of the installation while also greatly enlarging the cost and complexity. However, as the museum curator Santos warned, sound contamination is a critical issue in museum spaces. To mitigate this risk without losing the social aspect of open audio, the speakers will be positioned at a low volume and calibrated to be audible only within the specific proximity zones, creating a localized soundscape that respects the surrounding gallery environment.

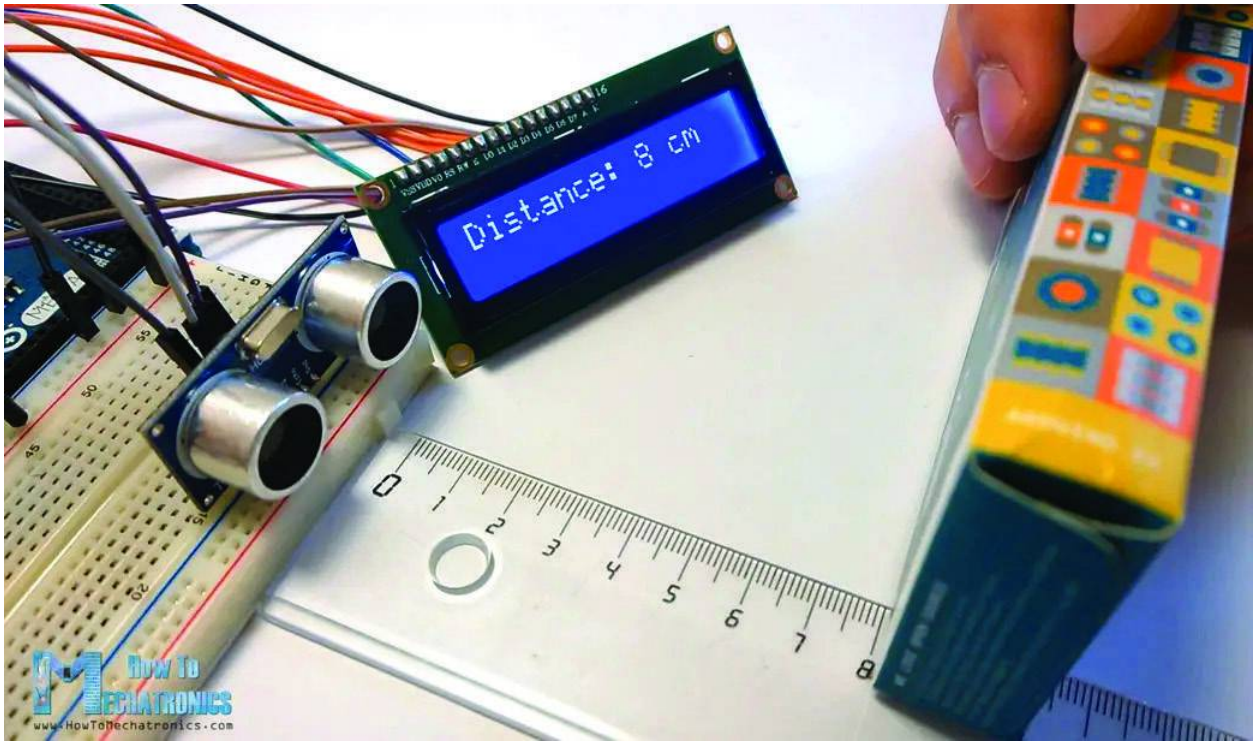


Figure 9: HC-SR04 sensors can precisely sense the presence and measure the distance to objects using ultrasonic waves (Dejan, 2022).

In conclusion, one ultrasonic sensor and one corresponding speaker will be aligned with each of the five zones, concealed either in the bridge handle or in a discrete floor-level housing. This creates the complete system: the visitor's movement is measured by the sensor, which then triggers the corresponding audio narrative from the speaker, bringing the painting's social scene to life. The project construction will be detailed in the next chapter.

5. Project development

With the requirements defined, the focus shifted to the physical implementation of the system. This chapter details the development process and the design iterations that occurred.

5.1 First test

To connect all of the sensors, Arduino Uno, a microcontroller, was chosen to connect all the pieces and run a piece of code on them. However, as the Arduino cannot natively reproduce audio, Processing, a simple software sketchbook and coding language, was used as a complement. In this setup, the Arduino processes the data from the sensors, while Processing triggers audio playback on a connected computer.

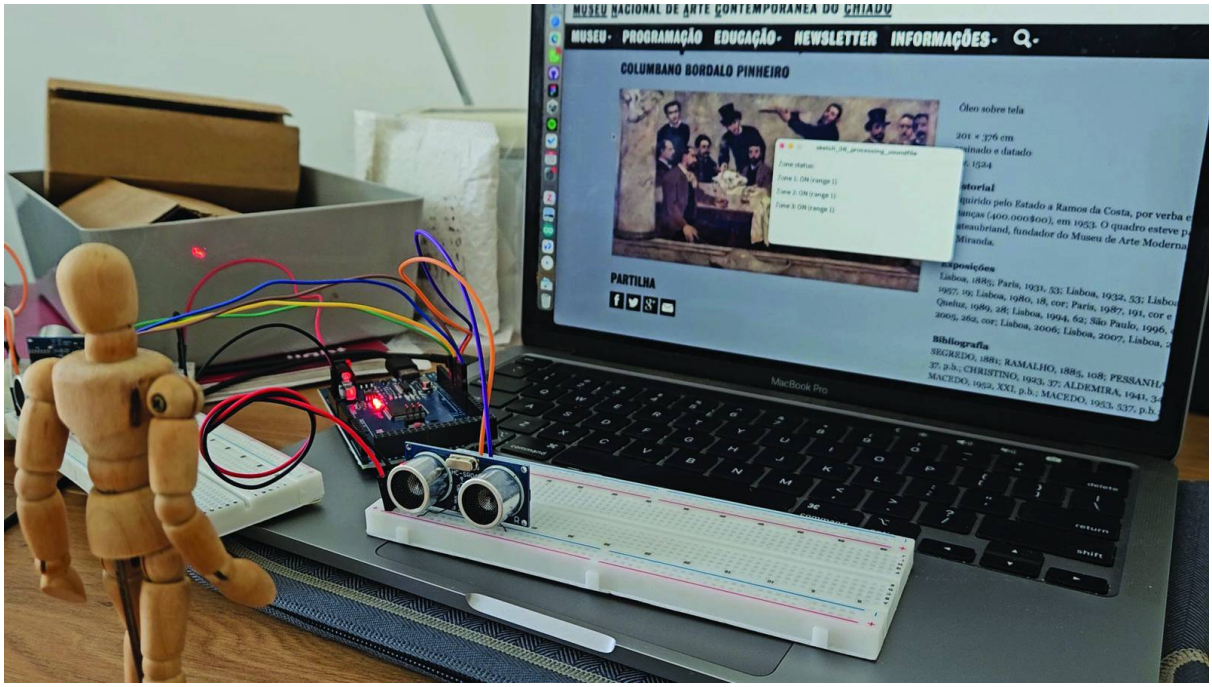


Figure 10: The HC-SR04 sensor connected to an Arduino connected to a computer. The audio files are played through the computer according to the person's position.

During this step, I noticed that my proficiency in coding was insufficient for the scope of this project, as the complexity of integrating sensors, wires, and the connection between Arduino and Processing was larger than expected. To overcome this challenge, Artificial Intelligence (AI) software was used. The AI chatbot was prompted with the system requirements and generated the necessary code to achieve the project's goals. Some adjustments and fixes were later done manually. All code files and wire schematics can be found in **Appendix D**.

5.2 Tests and progress

Although it was working well, the Arduino and Processing configuration had to be discarded as it didn't allow for the connection of multiple independent speaker outputs. The solution was to replace Processing with a DFPlayer Mini, an MP3 module capable of reading and reproducing .mp3 files directly from an SD card via Arduino commands.

Consequently, the Arduino Uno had to be swapped for an Arduino Mega. While the DFPlayer relies on serial communication, the Uno only possesses one hardware serial port. The Mega had to be adopted because it offers multiple hardware serial ports, allowing for the connection of multiple audio modules.

Once the system was working as intended, the next step was to solder all the components into a perfboard. This allowed for a much smaller and more robust form factor, essential for the tests done later.

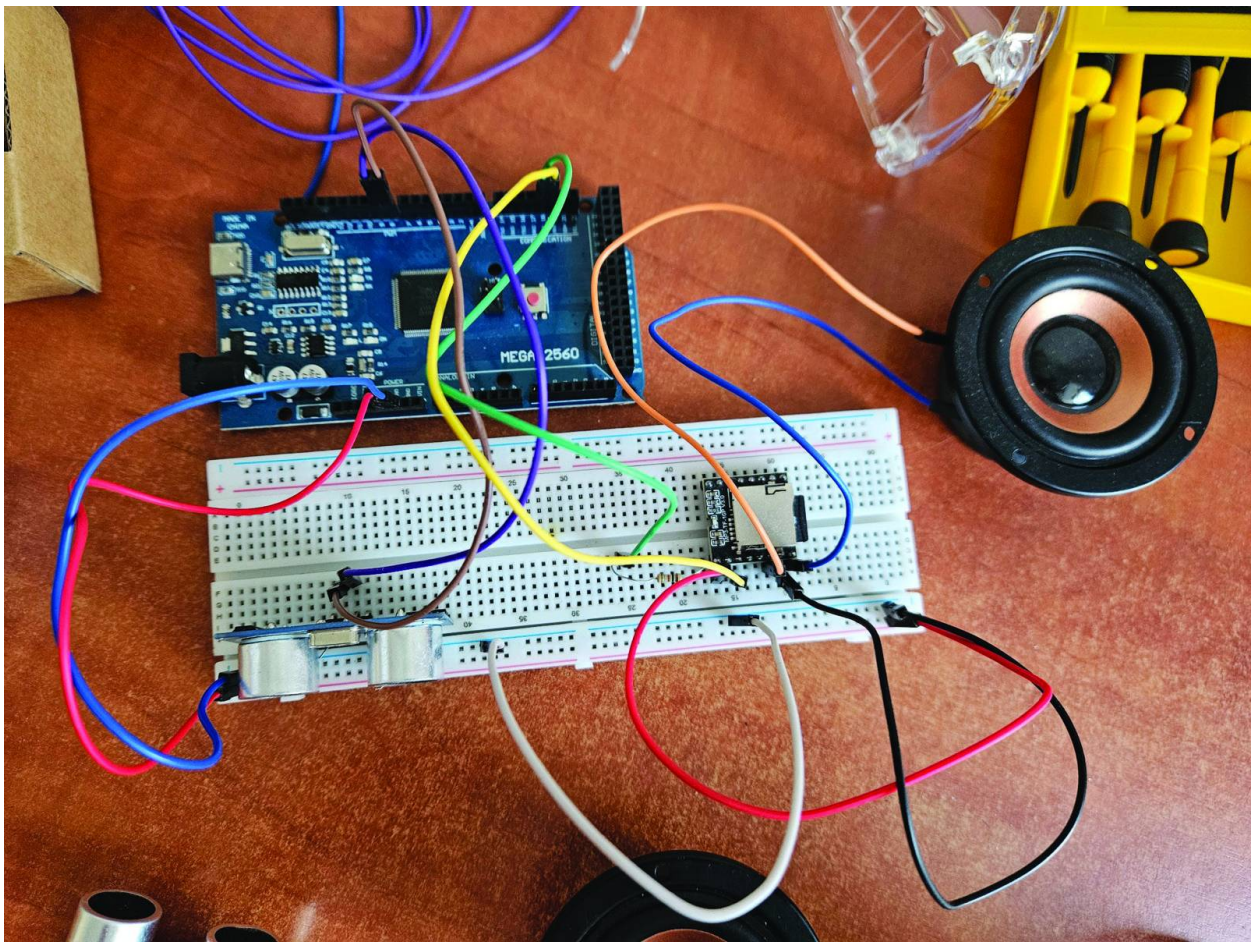


Figure 11: Arduino Mega, a protoboard and one of the speakers. In the protoboard (white rectangle) is connected the HC-SR04 sensor (bottom left) and the DFPlayer Mini (right portion). Electric power comes from a separate power supply.

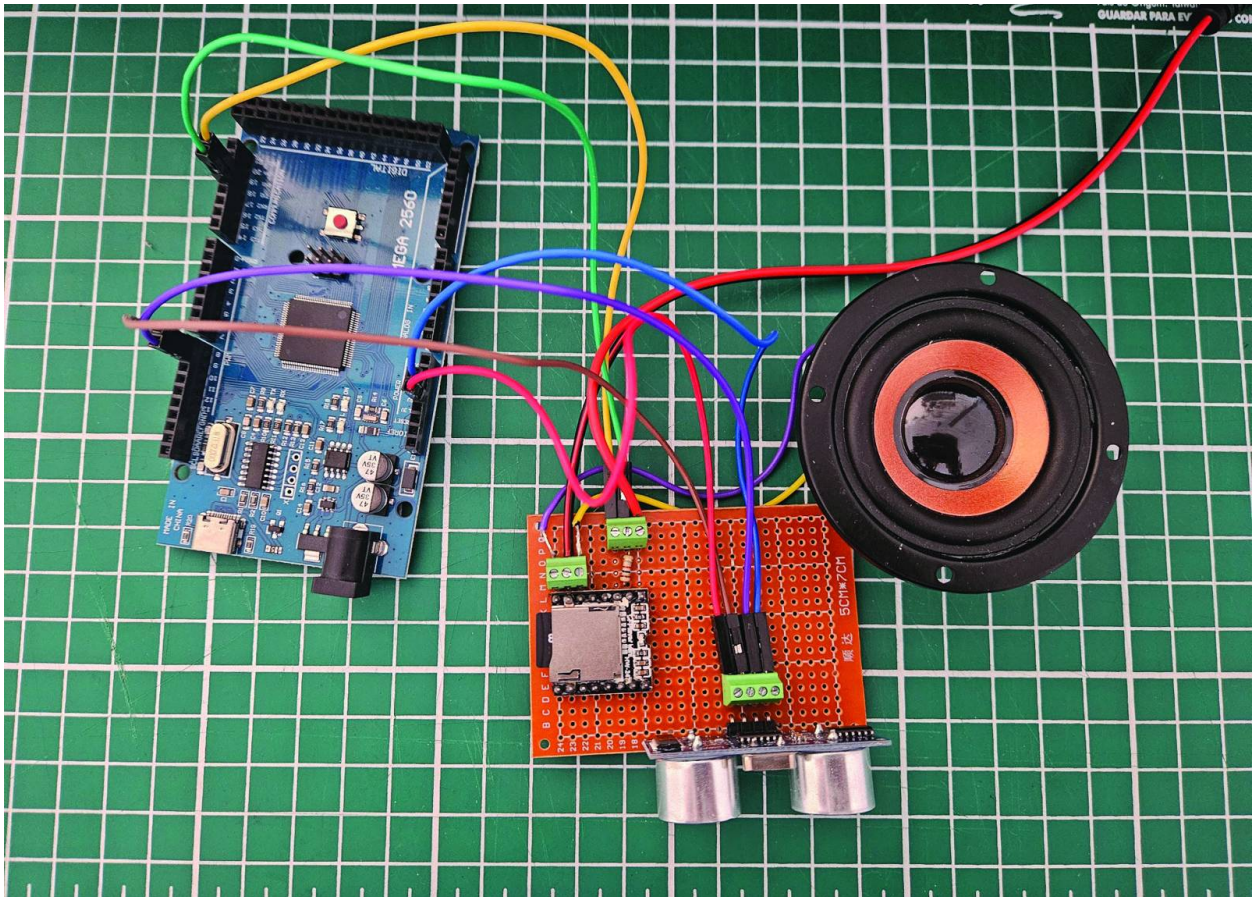


Figure 12: Arduino Mega connected to the perfboard. In it, there are soldered DFPlayer Mini, with a SD Card in it, and the HC-SR04 sensor. Terminal blocks (green squares) allow for an easy mounting and dismounting of the cables, including the ones for the speaker.

5.3 Narrative and storyline

Having one of the five prototypes working, it was time to write the narrative script. This process involved speculating the debates the members of O Grupo do Leão would be engaging in. The goal was to reveal the hidden reality: the narratives, storylines, and character's personalities that both the wall text and current system, based on the real object, ignore. To achieve this, extensive research was conducted through books, magazines, and interviews from the period. This allowed for a better discovery of who each person was and what they valued the most, creating a balance of creative freedom and historical accuracy. Most importantly, it enabled the creation of a dialogue that isn't just superficial chatter, it's full of the critical debates the Grupo do Leão had.

As members of the modernist movement, their artworks were not seen back in their period as valuable enough to be exhibited inside the few art institutions of Portugal ("O Ocidente : revista ilustrada de Portugal e do estrangeiro," 1885). This is transmitted to the visitor through the speech "Por enquanto parece que é só de Arte Antiga que nós vivemos [...]" (*For now, it looks like we only value Antique Art* [...]).

As a result, much of their work ended up being commissioned to decorate cafes and restaurants. This is transmitted through scenes where the restaurant owner, Diaz, refers to the fact their tavern is being recognized as a "Museum-Tavern" (Grupo do Leão (Grupo de artistas) & Sociedade Nacional de Belas Artes, 1941). Then, Vieira replies "Cervejaria museu! É para isso que existimos, para trazer a arte e as belezas do campo para dentro de espaços como este! [...]" (*Museum-Tavern! This is the reason we are*

here, to bring art and the beauty of the fields for spaces such as this one! [...]). In this quote, he challenges the elite, universal museum, the very institution that the painting is inside now, and argues for art to be public and decentralized.

Some other quotes reveal conflicts between realism and naturalism, the advancement of technological procedures, and their legacy for Portugal. The speeches were designed to provide hints on who these people were, what they did, and the effect they had in the artistic scene. Columbano Bordalo Pinheiro, the painter of this project's artwork, was also, later in life, the first director of the MNAC museum, the very one where the painting is inside now. He says "[...] o que nós discutimos aqui com certeza irá mudar a arte portuguesa! Imagina um dia estarmos nós nas galerias dos museus desse país? Ou até mesmo nós dirigirmos estes museus?" ([...] *our debates will definitely change Portuguese art! Imagine if one day we manage to be inside the art galleries of this country? Or even ourselves directing these museums?*").

It is important to note, however, that while this script's research and writing were all done by the researcher for the scope of this project, it should involve a broader set of individuals in future developments. This narrative is intended as a critical reading of the historical context, acknowledging that each person's background brings a specific bias to the writing process. The narrative functions as a critical reading of the historical context, moving away from the idea of an objective record to present an authored interpretation. One other way to accommodate different views and biases would be to allow for multiple sentences to be spoken, randomly, by each character in the painting, each one written by a different set of authors. This way, the visitors would be able to learn a broader, randomized set of characteristics from each one and, consequently, a less restricted and less singular point of view from the historical facts presented.

These lines are meant to allow for the active discovery defined in this project's goal, as they cut through the purely rational, visual gaze to present information in a way that's open, emotional, and still allows the generation of multiple meanings. The entire research, painter's biography, and speeches are in the **Appendix C**.

5.4 Final version

The last step was to move the soldered electronics into a final housing for user testing. To reduce the visual clutter of sensors and cables, a simple wooden box was designed to house all the elements. 5mm MDF was chosen as a low-cost and sturdy material. During this fabrication process, several iterative adjustments were made, such as creating a central "power bus" to manage wiring and using JST XH connectors to make the five units modular and easier to assemble or repair. The final enclosures were designed to hide the technology, allowing users to focus on the painting and the audio experience.

Although the boxes aren't particularly small, measuring 11cm in width, 6,55cm in height, and 8cm in depth, this was made to allow for better handling during the course of this project. As the units had to be constantly handled for adaptations, maintenance and iterations, it was important for the size to be big enough to allow for these manual handlings. Additionally, even if the designed box might be considered somewhat big, the selected painting presents a much larger shape, measuring 376cm by 201cm. This allowed for the system to remain unnoticeable during the tests, as it is relatively small when compared to the much bigger size of the artistic piece. In a future iteration of this project the sizing would be reviewed to be much smaller and less noticeable, as most of the needed adaptations would have already been

added to the design, allowing for an almost invisible hardware piece. The entire build process, with the technical details and wire schematics can be found in **Appendix D**.



Figure 13.1: Front of the box, showing how the sensor and speaker are positioned.

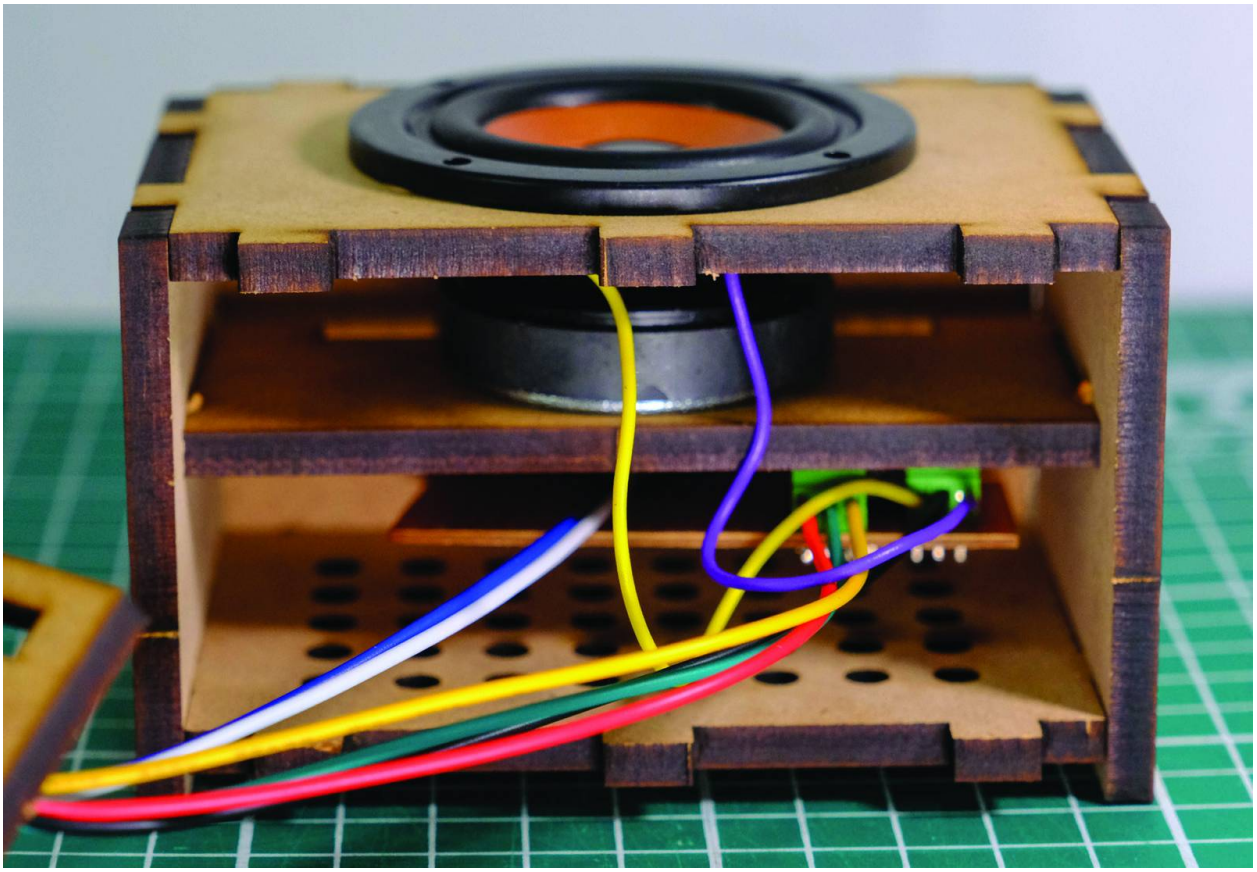


Figure 13.2: Back side of the box with its back panel removed, revealing the interior.

5.5 Chapter synthesis

This chapter has detailed the iterative journey of translating the speculative design concept from theory into a functional, physical prototype. It chronicled the pivot from an initial, computer-dependent test that used a combo of Arduino and Processing to a standalone system using an Arduino Mega and five DF-Player Mini modules. Key challenges in hardware, software, and physical fabrication were systematically identified and solved, from addressing coding complexity with AI assistance to engineering a modular and reliable system using a custom power bus and JST connectors. Concurrently, the speculative reality of the painting was built through extensive historical research, culminating in a recorded audio script. The result of this development is a complete, five-unit installation, housed in custom-built MDF boxes, that fully implements the proposed interaction model. This prototype is now ready for the final stage of the research: user testing.

6. User tests

With the functional prototype fully developed and assembled, the project now enters its critical evaluation phase. This chapter details the user tests conducted to validate the system's effectiveness and answer the core research question: Does this auditory augmented reality system successfully transform the passive viewing of the real object into an active, emotional exploration of its hidden context?

6.1 Test protocol

Inspired by Evans & Sterry (1999), who used a combination of post-visit questionnaires, unobtrusive observation (tracking visitor movement and behavior), and interaction logs from the device itself, which allowed for a more technical and quantitative analysis of the usability results, the test protocol consisted of three main sections:

1. Welcoming: User greeting, personal presentation, and a brief explanation of the project. This was followed by obtaining informed consent and confirming the agreement to be recorded or not.

2. Testing: The user was told to feel free to use the system however they wished, for as long as they felt like doing it. When finished, they would inform the mediator.

3. Post-test interview: Biographical questions, such as age, gender, and nationality, followed by open-ended questions about their visit and overall feelings.

During step 2 (Testing), if the user agreed, a video of them interacting with the system was recorded to allow for later verification of usability and engagement, and observational notes were also taken by the mediator. The system was also coded to save internal interaction logs about the interactions, capturing which zones were activated and for how long.

The entire protocol, consent form, and test results can be seen in **Appendix E**.

Additionally, there was a need to mimic the exhibition space from the museum in the test space. To accomplish this, a copy of the original painting was printed in a reduced scale. Instead of the original 376×201cm, the print was made at 260×140cm. This allowed for an easier-to-handle size while remaining big enough to allow for a proper spatial interaction with the sensors. This method was also preferable to using a projector to project the painting picture on a wall, since the user would block a part of the projection as they got close to the painting.

A sign was also placed to the side of the painting, mimicking its context in a real museum setting. The purpose of this sign was to allow those interested to discover each character's name, and to give subtle hints about the movement possibilities that the installation offered.

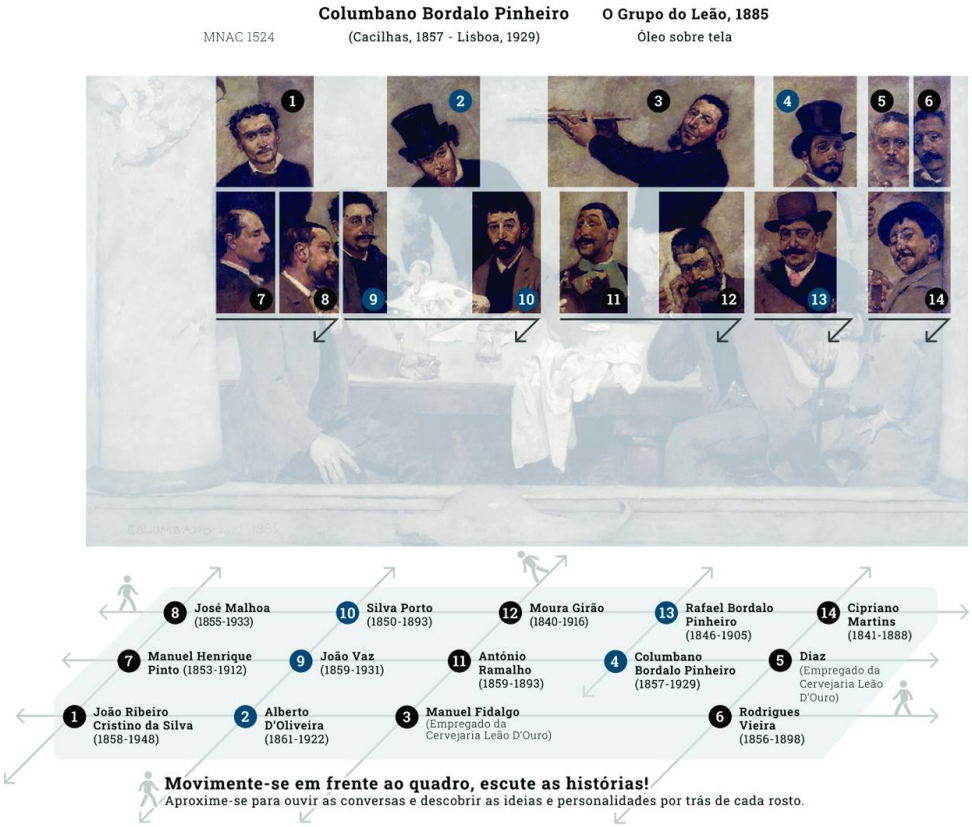


Figure 14: The sign that was placed next to the painting during the first tests.

6.2 First tests

The first group of tests, involving five participants (P1-P5), served as a critical baseline to evaluate the initial prototype's design assumptions. These users consisted of 3 women and 2 men, aged between 27 and 32. They had a somewhat low familiarity with museums, as they had only gone to, in the maximum participant, 3 in the last semester. They were familiarized enough with technology, using with no problem most technological devices. This phase immediately highlighted significant usability flaws and technical issues that needed to be addressed. The primary data gathered from this group was qualitative, centered on usability and discovery, and was supported by quantitative log data from participants P4 and P5. Due to technical difficulties, log data from P1 to P3 weren't properly saved, nor were the logs from Box 4 on any participant.

The most significant finding was the failure to discover the system's core proximity-based audio mechanic. The design assumed that visitors, guided by their curiosity, would naturally explore the z-axis, moving closer to and further from the painting. This assumption was proven incorrect, as an overwhelming 80% of participants (P1, P2, P4, and P5) completely failed to discover the proximity layers. Their interaction was limited to the x-axis (walking left and right), meaning they only ever heard one of the three audio tracks available in each zone. Only one participant (P3) successfully discovered the feature. Although P3 used the sign to guide their navigation through all the axes, some other users also used the sign but didn't understand the existence of the layers. This 80% failure rate demonstrated a critical flaw in the system's affordance; the intended interaction was effectively not happening.



Figure 15: User approached the painting during one of the tests. The painting is hanging on the wall, while the boxes with the system are in front of it.

Secondly, the same 80% of this group (P1, P2, P4, and P5) reported feeling confused by "interference" or "two boxes playing at the same time". The physical proximity of the five sensor boxes, combined with the lack of clear visual boundaries, caused users to accidentally trigger adjacent audio zones while trying to listen to a single one.

This qualitative complaint was confirmed by the sensor logs. Participant 5, who stated to be "a bit lost" on the post-interview, exhibited an uniform interaction pattern. In a span of just 4.1 seconds (from 22:20:42.298 to 22:20:46.437), their log file shows the trigger of five different events across three sepa-

rate boxes (Box 2, Box 5, Box 2, Box 5, and Box 1, sequentially). This movement is an explanation for the frustration they expressed. Their total session was the shortest of all participants (105.8 seconds), suggesting they left the experience after being overwhelmed. Similarly, Participant 4, who described feeling "uncomfortable", had a log file filled with short-duration triggers, such as 1.6 seconds on Box 5 and 1.1 seconds on Box 1, indicating she was unable to settle into a single narrative.

These are probably due to the lack of indications on where to step. Users were getting confused and staying either too close to one side or another, activating two sensors simultaneously.

Additionally, participant 5 expressed confusion about the storyline, noting "I had difficulty understanding the connection between them [the conversations]" and that he couldn't tell if "Manuel" mentioned in two different zones was the same person. Part of the testers also expressed confusion on the information sign, saying the numbers used to identify who each character was gave them the impression of a linear order to be followed.

6.3 Iteration and refined tests

First feedback to be addressed was then the zone discovery process. To fix this, colors were added to the floor to mark where each zone and level are. This fix is similar to the finding of Campos et al. (2011), who had to add a sign on the floor to clearly indicate where to navigate. This fix was then followed by the wall sign that had all the numbers removed and, instead, the same colors from the floor were repeated under each group of characters to indicate who the user would be listening to.



Figure 16: The new wall sign, now with a bigger indication to move in front of the painting and interactive zones identified by colors.

The text on the wall sign, indicating for users to move in front of the painting, was added but later proved to be unnecessary. As the whole idea of this project revolves around using the natural, pre-existing movement that visitors make in front of an art piece as the interface, the text indicating that people should behave as they would already naturally do was unnecessary. Additionally, the system is intuitive enough that most users could understand it without even reading the text. In the end, this extra piece of information adds visual clutter that was not needed. The discovery of the interaction becomes part of the experience itself, as the causal link between movement and sound is established through immediate, embodied feedback.



Figure 17: The new testing scenario, with the zones and levels correctly marked on the floor.

Additionally, the distance between the boxes was also adjusted to better avoid the interference problems. The box 4 had to be connected to a second computer in order for its logs to be properly saved, however, this time box 2 stopped working during the installation of the system due to unknown reasons. To solve that and not lose the day of tests, a "Wonder of Oz" (Martin & Hanington, 2012) approach was used: one of the computers was positioned exactly under the place where the box 2, now off, was sitting, and the mediator was remotely controlling the computer through an iPad. This way, when the user steps in one of the brown squares, the mediator could play and pause the audio files that were reproduced from physically the same spot as the box was. This solution was successful as no participants revealed to have noticed that this box was different from the others. However, since this one was being manually operated, it caused the loss of the logs from box 2.



Figure 18.1: The user approaches the painting through the markings on the floor.



Figure 18.2: User is identified by the box, that plays the corresponding sound file to their position.

6.4 Test results

The refined, adjusted version provided much better results. 100% of the 5 users perfectly understood the navigation system, versus only 20% in the first group. Additionally, no participants in the second group complained about the interference or had problems with two audios simultaneously playing. The logs also show how better these participants navigated with the new markers. P6's log for Box 5, for example, shows a continuous exploration, from layer 3 > 2 > 1 within a zone, that was absent from the first test group's logs.

Participant 6 took a picture of the sign and used it to navigate the experience, following the picture and connecting the names to the voices they heard, thus having one of the lower percentages of active time, as much of it was spent analyzing the sign. Participant 10, on the other hand, didn't look at the picture at all. They simply navigated through the zones and heard the audios. In their post-experience interview, they used words such as "fully immersed" and "transported to the setting", revealing how immersed they felt. These two profiles show that the installation can be successfully navigated both "mechanically", as an information-retrieval tool, and "intuitively", as an immersive narrative.

Participant	**Total Session Time (TST)**	**Total Active Engagement Time (TAET)**	**"Inactive" Time (TST - TAET)**	**TAET as % of TST**
P6	**397.2 s** (Longest)	**237.2 s** (Highest)	160.0 s	59.7%
P7	**286.1 s**	**206.9 s**	79.2 s	72.3%
P9	**222.6 s**	**160.8 s**	61.8 s	72.2%
P8	**183.5 s**	**148.9 s**	34.6 s	81.1%
P10	**172.1 s** (Shortest)	**161.4 s** (Shortest)	**10.7 s**	**93.8%**

Table 1: Participants from the refined group total and active time during the experience. This data doesn't include box 2 numbers.

In the emotional aspect, participants from both groups had mostly positive feelings. The second group had a small shift more towards the quarter indicating higher control, while the first group was split between high and low control. This suggests the refined version was more successful at generating feelings of active intellectual engagement and curiosity, which aligns with the project's goals.

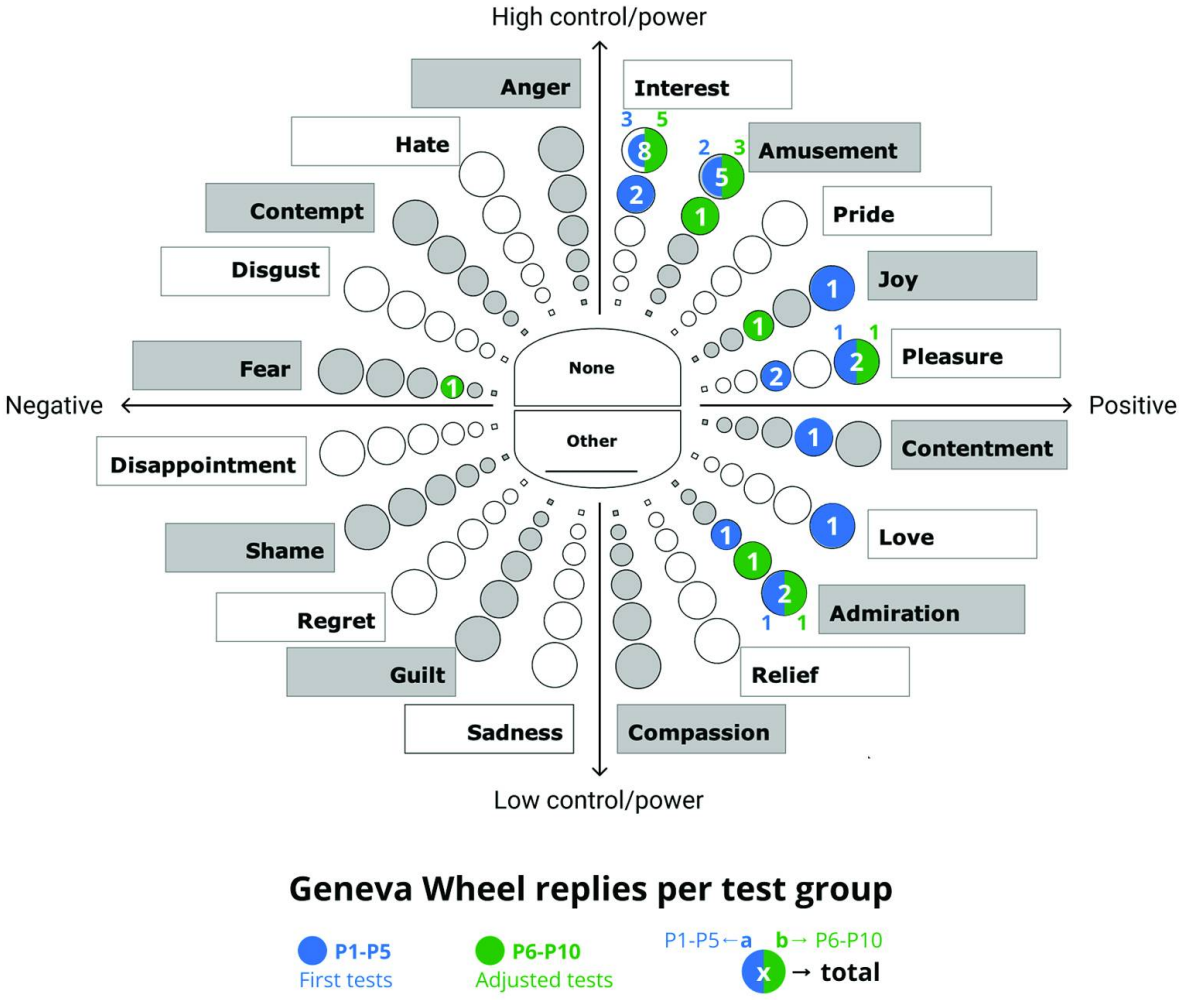


Figure 19: Results from the Geneva Wheel per test group and total.

On the SAM scale, a shift in the Excited scale can be seen towards the more active side in the second group, revealing that the better understanding might have made users feel more aware and active during the experience. Besides that, participants also marked some of the higher levels of control on the group 2, revealing that the audio interferences and lack of guiding might have made users from the first group feel lost and out of control.

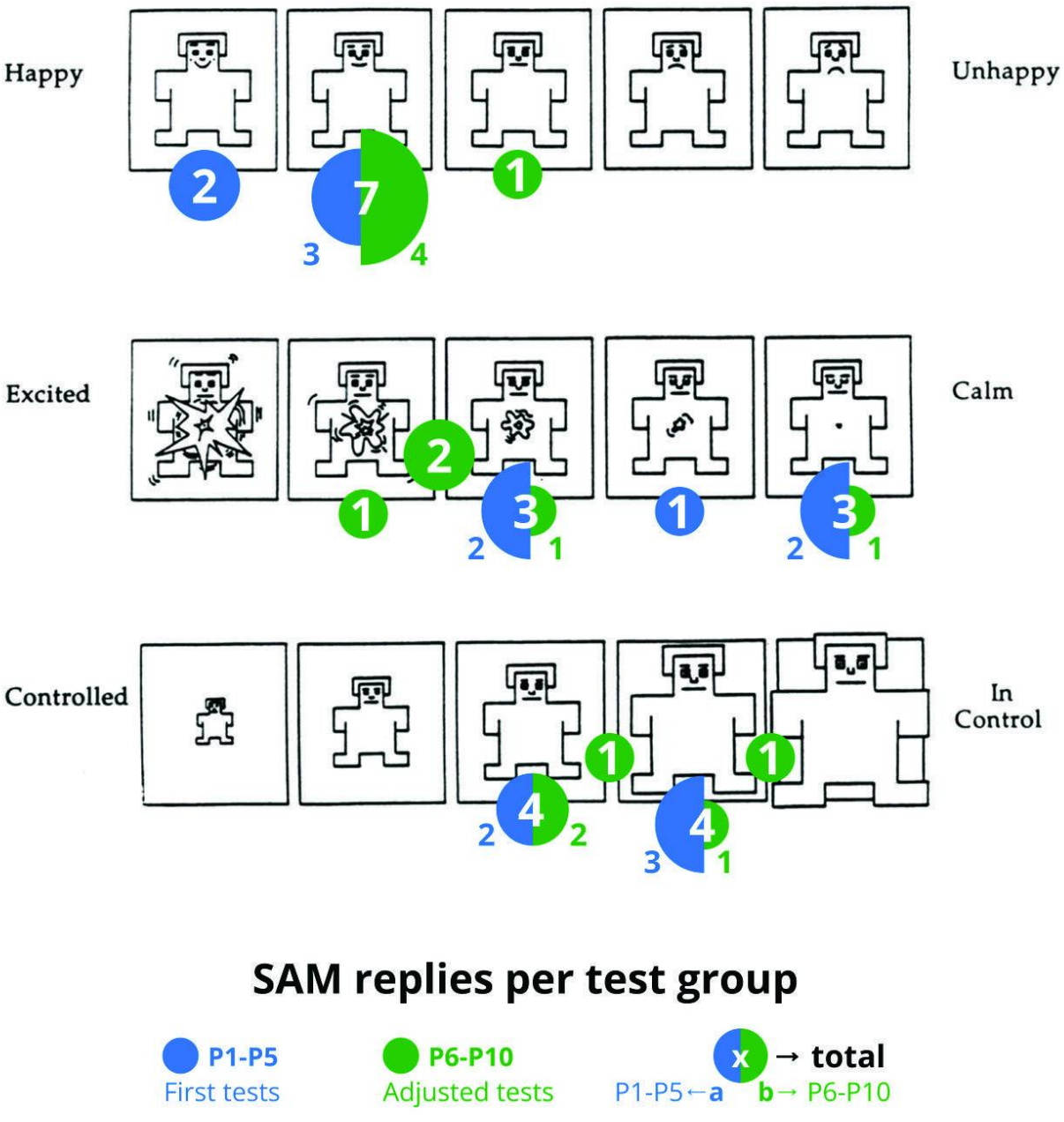


Figure 20: Replies on the SAM scale per test group and total.

7. Conclusions

This research began with a central problem in art museology: the visitor experience is predominantly passive, silent, and visual. Art institutions, focused on preserving a work's aura (Benjamin, 1969), present pieces as closed texts (Eco, 1995), limiting the public to observing the real object while failing to provide access to its reality, that's its social, historical, and emotional context.

7.1 Goals and results

The project's main goal was to enhance emotional connection between visitors and showcased artwork through an active discovery process. The test results confirmed this was achieved. All 10 participants reported positive feelings on the Geneva Wheel, with "Interest" (8 replies) and "Amusement" (5 replies) being dominant.

The qualitative interviews articulate how this connection was altered. The system transformed the artwork from a static object into a dynamic event. P1 called it a "living painting," while P10 felt she was "transported to the scenario and present at the moment the painting was made". Most profoundly, P3 stated the audio "helps a lot to see them as individuals who existed, and not as characters in a painting". This proves the system's ability to cut through the real object to reveal its human reality, achieving the project's core speculative goal (Secondary Goal 3).

To potentialize this feeling, it was also proved the need of visual affordances to allow for a better usability (SG 2). This was discovered by the project's biggest lesson, the failure of the first prototype. The initial design, which relied only on fully invisible technology failed, as 80% of participants didn't discover the proximity layers. Furthermore, 80% complained of audio interference, a fact supported by P5's log, which showed 5 triggers across 3 boxes in 4.1 seconds.

The iteration and refined version solved this, providing a definitive answer. Inspired by Campos et al. (2011), the addition of two simple affordances, the colored floor markers and a matching color-coded

sign, was the solution. The results were very positive, as now all participants understood and explored both axes of the system. The discovery rate for the proximity mechanic increased from 20% to 100%, while complaints of interference dropped from 80% to 0%. This improvement in discovery proves that for an invisible interaction to work, its boundaries and mechanics must be made visible and tangible in the physical space.

The system's core mechanic was the link between body movement and narrative. The data shows this link was the primary driver of engagement. The most immersed participant (P10) serves as an example, as they achieved a 93.8% active engagement ratio, spending only 10.7 seconds "inactive" during her entire 172.1-second session. This data, combined with her overwhelmingly positive answers in the interview, represents that her physical movement and narrative discovery were one seamless, continuous action (SG 1).

Finally, Secondary Goal 4 addresses the project's theoretical problem, on how this system could open up the presented closed and passive viewing experience. The answer lies in the system's ability to support multiple, equally valid user behaviors, demonstrated mainly by the data from P6 and P10. P6 had the longest TST (397.2s) and highest inactive time (160.0s). He actively used the system as an information-retrieval tool, taking a picture of the sign and methodically consulting it to discover facts about each character. On the opposite side, P10 had the shortest TST (172.1s) and lowest inactive time (10.7s). She actively ignored the sign and was pulled into the narrative, achieving an immersion state that made her feel like she was inside the tavern with the group. Both users were successful, and both were actively engaged. The system was open enough that could be navigated mechanically for information or intuitively for immersion. This strongly overcomes the one-way, passive information transmission of a traditional wall text.

7.2 Limitations and future work

This project, while conceptually successful, remains a prototype with clear limitations.

First, the prototype was fragile. The persistent problems with Box 4 and the total failure of Box 2 on the second day of tests, which necessitated a "Wizard of Oz" intervention, prove the system in its current form is not robust enough for a public installation. Although the Wizard of Oz improvisation preserved the user experience, as no participants reported awareness of the discrepancy between boxes, this failure shows the importance of a more robust hardware. While the precise cause of the malfunction could not be diagnosed within the current resource constraints, a potential solution would be to replace the hand-soldered connections with a custom-printed circuit board (PCB) integrating all sensors and players, thereby eliminating the fragility of the current prototype.

Second, the 10 participants of the tests do not represent a full museum audience. The second group, in particular, was composed of young users (ages 22-25) in design-related fields. Consequently, this sample excludes visitors who may be uncomfortable with novel technologies, meaning the device's reception among a "technologically hesitant" public, one of the archetypes identified earlier, could not be verified.

Additionally, user feedback provided a path for future improvements. P6's suggestion to add ambient tavern sounds, and P5's confusion over the "Manuel" narrative point to the need for a more layered soundscape and clearer storytelling.

Future work must first address technical robustness, likely by building stronger connections. Second, the sensing technology should be upgraded. Replacing the discrete ultrasonic sensors with a single overhead computer vision camera or using the pressure pads on the floor, as considered in the design phase, would eliminate crosstalk and allow for more fluid tracking. Pressure pads on the floor would even work natively as the floor markers, combining two needs in one, although they wouldn't work for wheelchair users. This comes to the following point: the reliance on specific physical movements, mainly walking laterally, and fixed sensor heights may exclude visitors with limited mobility or those who use wheelchairs. Future iterations should explore adaptive sensor arrays to ensure inclusivity for all physical abilities. Potential solutions include the use of redundant sensors positioned at multiple vertical levels to detect users of all heights. Alternatively, a computer vision system mounted overhead could track position regardless of whether a visitor is standing or seated. By decoupling interaction from posture, the accessibility requirement would shift from the technology itself to the architectural layout, simply ensuring the path has sufficient clearance for wheelchair navigation.

Finally, as P10 suggested, this concept should be tested on other artworks to explore how embodied audio can convey different emotions, such as anger, fear, or anguish. After all, this is a speculative project designed around a singular painting, and more work should be done to see how this same concept applies on more abstract artworks or on different supports. This approach of spatializing conversations is better suited to artworks dense in narrative, like group portraits or historical scenes. For a sculpture, the audio zones could become a 360-degree sound field. For a contemporary installation, the audio could become abstract soundscapes that react to the visitor's speed or stillness, translating the concept of un-silencing to non-figurative art. This project is a first step towards this broader potential, demonstrating that the visitor's body can effectively serve as the key to unlock the silent narratives of any art form.

The remaining challenges relate to the openness of art museums to this kind of interactive installation. Even though we could reduce the sensor's sizing to completely hide it, there would still be the intrusion of a new element, the sound, that was not considered by the original artist. The use of directional speakers could further mitigate this by confining the audio to the user's immediate proximity, ensuring the museum's acoustic atmosphere remains largely undisturbed for other visitors, although this would only limit the intrusion rather than eliminate it. However, it is essential to view such an interface as a "translator" that facilitates a deeper readability of the artwork. Rather than altering the nature of the piece, the system acts as a layer of mediation that brings the narrative and context of the work closer to the visitors. A possible advantage of, in the future, working with contemporary artists would be to be able to include them in this design process, ensuring the system is co-designed with the artwork itself.

7.3 Final considerations

This research set out a challenge to, first, bring Interaction Design closer to a more artistic side. To accomplish this, the main focus was to challenge the traditional museum experience as a passive path and transform it into an active place of discovery. The results confirm this was achieved.

The prototype successfully validated a new model for museum interaction. It created an open interpretation model by shifting the visitor's focus from the real object to its narrative reality. The final proof lies in its ability to serve both kinds of users, the ones seeking information but also those seeking total immersion.

This project offers a concrete answer to a long-standing challenge. It proves that we do not have to choose between preserving an artwork's aura or engaging a modern audience. By "un-silencing" the canvas, we can invite the visitor to stop being mere eyes without bodies and, for a few moments, to step inside the painting itself.

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Appendix A

Additional Theoretical Framework

A.1 Decolonial Perspectives: Questioning the institution

However, a deeper layer of critique challenges not just the methods of museum interaction but the very foundation of the Western museum itself. Françoise Vergès (2024) argues that the Western "universal museum" concept is far from being a neutral space for education and contemplation. Rather, it is essentially a colonial institution, which was created and perpetuated through the violence of slavery, imperialism, and racial capitalism. Its pretence to be universal is a figurative device to cover up a history of robbery, pillage, and the forcible removal of objects and human remains out of the Global South.

From this perspective, efforts merely to reform the museum, such as adding diverse artists or interactive displays, are insufficient. Vergès dismisses these as "window-dressing" or acts of "pacification" that allow the institution to co-opt critique and maintain its oppressive structure without fundamental change. True decolonization, she argues, requires a "programme of absolute disorder": not chaos, but the complete overturning of the colonial world order that the museum embodies. This necessitates imagining a "post-museum", potentially one without objects and focused instead on narratives, communities, and practices of liberation and repair.

While the scope of this research project is focused on transmitting existing knowledge through interaction, it does not aim for the complete institutional transformation Vergès calls for. However, her critique serves as a cautionary framework. Tsitoura and Witcomb defend that interactive devices are usually more focused on the commercialization of exhibitions and on the mere addition of technology without proper change of anything inside the galleries. Vergès forces us to confront the possibility that these very same well-intentioned interactive designs, as they are working within the existing museum structure, could inadvertently reinforce the very power dynamics they seek to alleviate. Our goal, therefore, must be positioned not as a definitive act of decolonization, but perhaps as a tactical intervention. By focusing on revealing the narratives, and the often-hidden contexts behind an artwork, this project draws inspira-

tion from the post-museum ideal, attempting to move the visitor's engagement towards the human contexts that produced it, thereby disrupting, even if on a small scale, the museum's traditionally monolithic presentation. The ethical vigilance prompted by Kidd must therefore extend to considering whether the interactive experience genuinely challenges the established order or merely becomes another tool of institutional pacification.

A.2 Arts and Design

While authors debate about the role of interaction inside museums, there is a whole spectrum of design methodologies and possible interactions that could fit in for the debate. Roussou et al. (2007), for example, experimented a method to allow for children to design their own art education program for the conservation department of The National Gallery of Art - Alexandros Soutzos Museum in Greece.

Through the concepts of participatory design, they hosted four 11 year old kids for this experience. The conservation department was chosen because even though it is essential to the well functioning of the institution, it is usually hidden, with visitors having little to no knowledge about their work. To solve this gap in knowledge, the method involved a series of visits and workshops for the kids, where they got to learn what and how conservation tasks are accomplished in the museum.

The next step was, then, to allow the kids to share what they learned in the museum through the design of their own education program. This gathered knowledge would be shared through a website, in which these same kids would now be able to define what, where, and how each piece of information would be displayed. The authors provided the kids with low tech art supplies to design a storyboard of the website, creating a first version of the user flow. Finally, the children were then guided to better design each area of the website they first imagined in the storyboard.

Concluding their method, now professional designers would transform the prototype into a real website. However, as interesting as discovering the kids point of view could be, the authors conclude how difficult and non-reproductible this whole process is. Each step took an enormous amount of effort from both the authors and museum staff, and the kids had to be taught through a long and time consuming series of workshops. They say "Even though the presence of the children in the labs was welcomed by the conservators, it was on a one-off basis; if it were to be repeated frequently, it would perhaps impose a greater workload on the conservators' already difficult and demanding workday" (p.4).

This way, their conclusion is how their experience, although successful in the goal of having kids design their website, was not able to achieve a reproducible guideline of methodologies for design practice by the broad public, as they are way too demanding on the effort of the workers and the long duration of it.

Commercial projects also share this dependency on personal, almost one to one, guidance. "AJ's little artists" (n.d.) is a guided tour where AJ, as she calls herself, guides kids and adults through creative experiences inside museums. First, guests are taken around the exhibitions, where she teaches history and art concepts to them. Later, they are then invited to draw their own version of what they learned there, taking home a piece that reflects their own interpretation of what was seen during the day.

If the first example sets the high dependency of the kids on the museum staff as a downside, in this case AJ refers to "Personalized Attention" when selling her tours on the "About" page. However they depict it,

both cases share the same scenario: a methodology for teaching concepts of art that only works when someone is closely watching their guest.

If these guidelines might only work with close guidance, how could we, then, allow for active interaction within a museum through a method that allows for users independence through the process?

Srouji (2017) presents a methodology to teach fundamentals of Art for university students, where he sets a series of tasks for students so they can learn the concepts of composition. This directness can also be described as an approach of "thinking through making", where these Art and Design students should learn about art concepts through the active manipulation of existent art pieces, making new things from them. As his guidelines focus on the transmission of core ideas related to composition, the author defends that the breakdown of an artwork to its essential components will allow for a better understanding of the compositional outcomes.

In defense of "learning by making", Stolterman (2008) is cited to explain that, as the current educational system is focused on learning the outcomes, it ends up being also much more focused on the transmission of the "finished products" rather than on the "processes" that allowed them to exist.

"If we are to consider a work of art, it contains, in essence, all the notions of composition that we, as faculty, are to pass on students enrolled in preparatory art & design courses. The choice of a painting as a starting point imposed itself naturally. An artwork, particularly a painting, is a register of all the decisions taken by the artist to its final state. The thinking, the process, visual decisions and technical applications lie within the apparent image." (Srouji, 2017, p. 114).

To apply his set of methods, the first thing mentioned is the choice of the artwork. The piece to be dissected by the student should be one of their liking and of their choice, as allowing this level of freedom will make for a more involving learning experience. Then, after the choice is made, the guideline goes on to deconstruct the artwork to its simpler elements, that are:

A. Color Analysis: reproduce the colors used in the artwork chosen.

B. Outline: make a linear drawing of the work.

C. Contour: make a linear drawing of the work.

D. Basic shapes: reducing the work – based on its outline – to general shapes, then to more specific ones.

E. Geometric shapes: reducing the basic shapes to geometric shapes

F. Light and dark: a tonal, light & dark distribution of the work.

G. Masses: Reproduce the work using a tonal (Gray Scale)

H. Texture & surfaces: understating their distribution& importance in the work, if used in the work. (Srouji, 2017, p. 140)

When the students deconstruct a piece by following these aspects, it should bring them to the essential components that construct a painting, allowing for a much brighter visualization and understanding of the artistic process.

Finally, he finishes by mentioning two important aspects. First, about the intentionality of an author, as it is common for students to question if whoever produced the artwork had really thought of all these notions and to what degree they had intentionally put them in action. Here, the artist's intention doesn't matter, as what counts is that these aspects exist, these concepts were used and they shape the composition of the artwork. However, the second aspect is that this is a methodology meant for University students in courses related to the area. This means that some aspects of the visual thinking processes are inherent to these students' learning, whose prior knowledge might differ from the variety of backgrounds from visitors of any specific museum.

This way, this methodology enables students to actively dissect and discover the minimal elements of an art composition while maintaining a good level of independence throughout the process. However, this independence might be assisted to some degree by the student's prior knowledge on the area, so this cannot be considered a good toolset to be used with the variety of visitors' knowledge in museums.

Therefore, while Srouji's methodology cannot be directly applied to a general museum audience, its core principles, such as active deconstruction, thinking through making, and focusing on an artwork's compositional elements, provide a useful framework. This project, therefore, investigates how interaction design can translate these academic principles into an accessible and engaging experience that allows all visitors to think through making in the museum gallery.

Appendix B
Detailed Field Research

B.1 Baseline: The closed text experience

The primary and most dominant method of information transmission remains the traditional, passive format. This baseline experience is built on two core actions, to observe and read. As described by Umberto Eco (1995), these art pieces are presented with closed descriptions, not leaving room for the visitor to make any level of interpretation.

Visitors are first and foremost directed to look at the art, with their movement guided by an organized path that moves them from piece to piece (Witcomb, 2003). The only information provided on this path comes from printed wall texts, title cards, and, in some cases, paper handouts or guidebooks.



Figure 21: On the left, a visitor looks at the paintings on the wall. On the right, a sign provides the basic information on all of these pieces.

In some cases, technology was present but did not provide any level of interactivity, reinforcing the passive baseline. In the Gulbenkian Museum, for example, a TV displayed a series about AI Chatbots'

mistakes when answering about art. However, this screen was accompanied by a traditional wall of text explaining the project. The technology, in this case, functioned as the art piece itself rather than as a new, interactive format for enhancing visitor understanding.

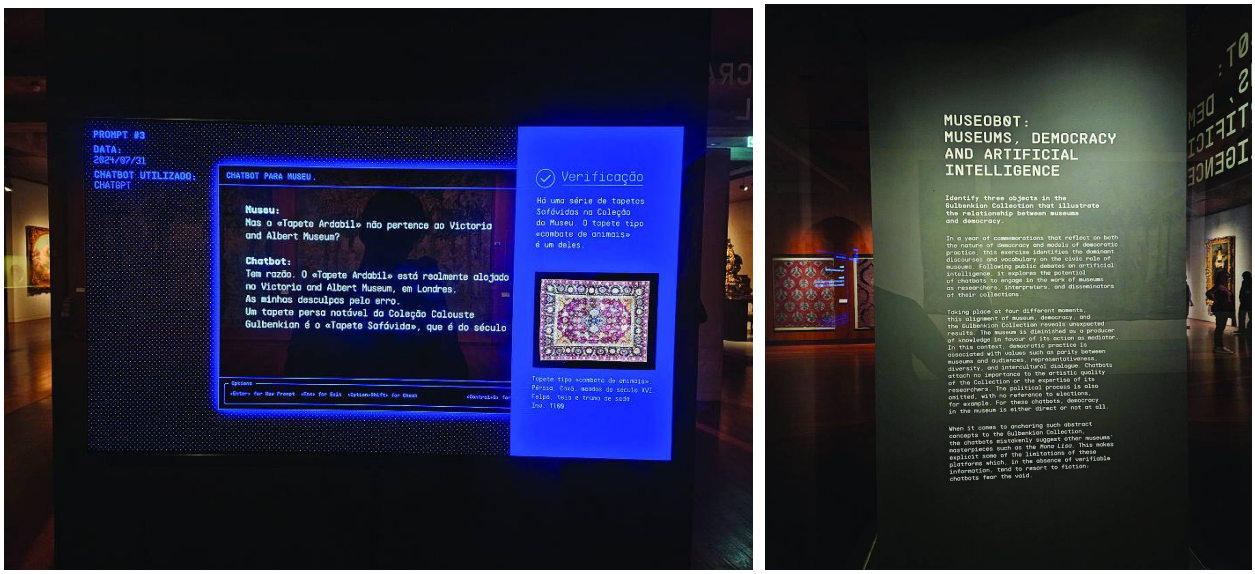


Figure 22: On the left, a TV showcases AI's mistakes when prompted about art. On the right, the text provides detailed information on this piece.

The Museum of Ipiranga in São Paulo, which I have visited previously, though not for this specific research, used technology to add another layer of information to an art piece. This museum is about Brazilian history, mainly its independence. The museum's highlight is a painting depicting the moment independence was declared: it occupies the entire wall of the main room, a space that was built specifically to house this piece.

There, an interesting piece of technology was implemented: a transparent television. Its transparency allows it to be positioned directly in front of the painting without obscuring it. More important, however, is that the TV content mixes with the physical painting, creating a mixed-media overlay.

This video feed plays facts and curiosities, allowing visitors a deeper look into details they might have missed. For example, some video segments highlight specific figures, such as the men on horseback ripping symbols of the Portuguese military from their uniforms. This allows the visitor to watch the analysis on the screen while simultaneously locating these same details on the actual painting behind it.

Even though this device adds another layer to the original painting, it remains a closed, finished interpretation and historical guide. The information is made more engaging by the technology, but it does not, by any means, open up the piece or allow for genuine visitor interaction. Its sole purpose is to transmit historical information in a more novel and accessible way.



Figure 23: A transparent television is showing drafts and studies of the painting that sits behind it.

My visit to MNAC was accompanied by a friend to see if any other doubts or perceptions would arise. When looking at one of the paintings, "Kultur - 1962" by Joaquim Rodrigo, my friend asked what Kultur meant, leading us to look up the definition on the museum's website. This was the peak of interaction during our visit, and it only happened because of a visitor's own curiosity. However, this engagement was still limited to observing the static piece on the wall and reading a closed interpretation, but this time on a screen.



Figure 24: On the left, the painting that led to the visitor's curiosity. On the right, the consulted website with the definition of the painting.

This way, the information presented in this category is fixed, authoritative, and non-negotiable. This observation confirms that the conventional museum experience, even in contemporary wings, is still largely predicated on the passive, eyes without bodies scheme (Morales, 2012) identified in the problematization. This baseline serves as the control against which all other interactive attempts must be measured.

B.2 The text on the wall, now digital: Superficial interactivity

Several cases of technology use with little to no impact on the museum system were also seen. A clear example can be seen in the Industry Museum, in Gent. There, visitors are invited to learn more about the different kinds of materials that are used to make the textiles and fabrics we wear. To mimic the act of purchasing clothes, the different materials are all displayed on shelves with barcodes, and it's up to the guest to pick up the hand scan scanner and scan the barcodes. The information is then displayed on a TV, and it consists of a simple text and a picture. This case shows how little difference the use of interactive technology adds to some of the modern museum experiences that seem designed more to use flashy tech to attract customers, rather than using profound technology to change the flow of communication, as it was defined by Tsitoura (2010). Instead, it even adds one extra step, as the user now needs to scan the barcodes to read the information that could therefore have simply been displayed on the wall accompanied by the materials.



Figure 25: On the left, the materials displayed on shelves followed by barcodes. The user holds the scanner. On the right, a television displays the fabric information after the scan.

Most of the findings that relate to this superfluous addition of technology happen to exist with the use of touch gestures. In the House of European History, visitors borrow a tablet that works as their map and digital guide during the visit. Similarly to the Evans & Sterry (1999) multimedia application, the tablet reproduces the museum settings, allowing visitors to touch on any of the pieces to view more information about it.

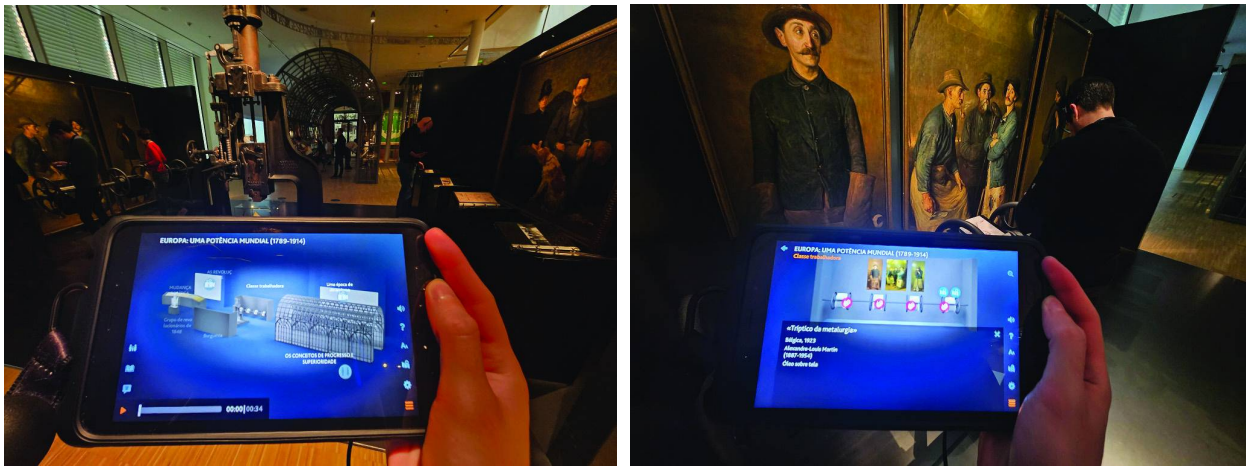


Figure 26: On the left, the tablet displays a digital map of the museum room. On the right, information about the exhibited pieces.

Using modern location technology, the tablet automatically adjusts to the visitor's current room. Although this is a clear example of technology that doesn't add more than what could have been written in a text on the wall, it is justifiable in this particular case. European Union institutions need to accommodate all of its 24 official languages, and it would be impossible to display all these languages on the walls.

Another clear example of this need being fulfilled by the use of technological devices is in the Parlamentarium, a museum setting about the history of the European Union and its institutions. There, visitors borrow an iPod Touch from the museum that allows them to, through the NFC tags accompanying the displays, access the information from the pieces in their own language.

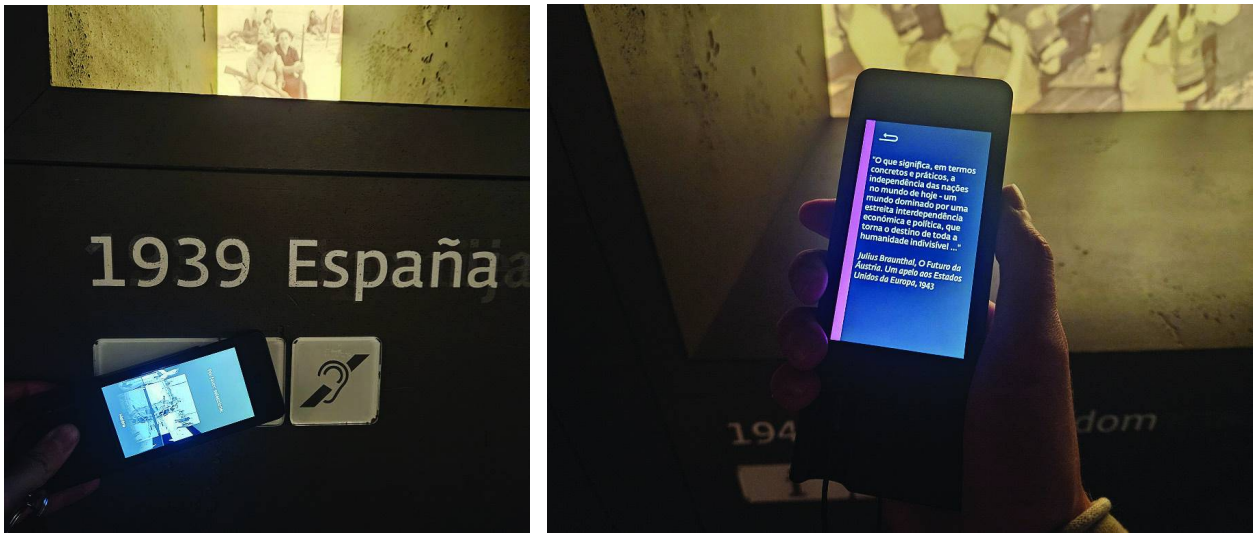


Figure 27: On the left, a visitor touches an iPod to the NFC tag on the wall. On the right, the iPod shows the information about the piece under display.

These examples, therefore, perfectly illustrate Witcomb's (2003) critique: they are "didactic tools based on some form of mechanistic activity to elicit information." While the barcode scanner appears to be a case of "flashy tech" for its own sake (Tsitoura, 2010), the EU Parliament examples are pragmatic and necessary design solutions to a multilingual challenge.

However, all three examples fail to fundamentally change the visitor's role. They remain passive readers of a closed text (Eco, 1995). They do not use embodied movement to create meaning (Kühnapfel et al., 2024) or attempt a tactical intervention to reveal hidden narratives over simple facts (Vergès, 2024). This clarifies the goal of this research: not to design a better digital guide for delivering information, but to create a narrative discovery system that transforms the visitor from a passive reader into an active explorer.

B.3 Personal, non-scalable active guidance

As noted in the theoretical framework, a common critique of digital interactives is that they often fail to move beyond a one-way flow of communication. During the field research at CAM, it was observed some non-digital, human-led interactions that provide a powerful alternative model, confirming Tsitoura's (2010) argument that hands-on or participatory exhibitions, often lacking advanced technology, can offer greater opportunities for meaningful engagement.

Two distinct scenarios were observed, both effectively converting the passive exhibition into a more active, social place. First, a woman was gathered with a small group of children in front of a painting. She was actively guiding their observation, pointing to specific parts of the work and explaining the artist's choices. This approach transformed the viewing experience into a dynamic, dialogic process, as her prompts directly generated a series of questions and curiosity from the children. This way, she was turning them from passive observers into active inquirers, she was providing the children with tools to generate meaning instead of providing a closed, formatted explanation.

In the second scenario, the museum staff was positioned within the galleries to provide small interactions with the visitors. These "hosts" would actively approach visitors who seemed to be interested in the artworks and initiate a conversation, asking what they thought of the piece. This talk would, sometimes, evolve the guest's observations to a deeper reflection on the artwork's context.



Figure 28: On the left, a woman arouses the curiosity of a group of children. On the right, one of the museum workers helps a visitor further connect to the artwork.

Both of these scenarios successfully achieve the project's goal of fostering a more active and engaged visitor. However, as identified in the theoretical framework, section 2.2, these models, while effective, share a common limitation: they are entirely dependent on intensive, personal guidance. As a result, this approach is not scalable, as a single educator or staff member can only engage a few visitors at a time. This leaves the majority of visitors in the gallery with the same original problem of a passive and pre-set experience.

This project challenge is, then, to design an interactive experience that can replicate the process of discovery and guided inquiry seen in these human-led interactions, but in a way that is independent, scalable, and accessible to every visitor at their own pace.

B.4 Active discovery

From the Industry Museum in Gent comes two examples of interaction that highlights the potential of interactive media to transform museum settings. First, on the top floor, visitors can see the city's skyline through the building's large windows.



Figure 29: A touch display is mounted on a rail in front of the window. It serves to display facts about the buildings on the skyline viewed through the glass.

There, what could be just a nice view becomes an active discovery of the city's industrial history. A touch-screen is attached to a rail in front of the window, displaying a digital version of the same view. When the visitor slides the screen along the rail, the digital image moves in sync with the real-world skyline, displaying exactly what's visible above the screen. Icons appear over important buildings, allowing guests to touch them and learn about their history and importance to the city.

This interaction, consequently, meets the criteria for meaningful engagement established earlier. It avoids the mechanistic activity critiqued by Witcomb (2003) because it doesn't revolve merely on pressing buttons to elicit information. Instead, it requires the visitor to physically move to discover some of the hidden histories on the city's skyline. This mechanic is a direct application of the principle found by Kühnapfel et al. (2024), where physical movement is linked to deeper engagement. The view, which could have been a simple path to the main exhibition, becomes a place for active exploration, where visitors are welcome to stay and discover more at their own pace.

In a second example from the same museum, in the exhibit on industrial printing, rather than passively consuming information, the visitor becomes a producer. The process begins when a digital machine

prints a “minizine” that, customized with the guest’s name, will work as their personal guide through a series of steps. Through a series of hands-on stations, the visitor is walked through the processes of printing, engaging with the different kinds of stamps, typography, print colors, zincography, reliefs, and some more.

This way, instead of simply reading closed texts about printing, the visitor is guided through a workshop-like process to discover by himself and under practice how these processes are done. This approach is similar to the thinking through making methodology advocated by Srouji (2017), where learning is achieved by actively deconstructing and manipulating the components of a craft. It also embodies the participatory ideal defined by Pitman-Gelles (1981), as it requires the visitor to “handle materials, operate equipment and participate in work”. By creating their own finished product, the visitor internalizes the process rather than just observing the finished product, resulting in a far more memorable and effective learning experience.



Figure 30: On the left, the display allows users to write their name and print their minizine. On the right, one of the discovery activities, where visitors can paint on top of a relief to explore one of the methods.

Although the Minizine is a good model of creative participation, its focus is on a fabrication process, a model that, as noted in the introduction, is more common in science and industry museums. Even though the Industry Museum has art exhibitions, its core interactive pieces are on the more scientific side. Art museums face a different and more abstract challenge: how to apply these same principles of active, hands-on discovery not to a physical process, but to an intangible one, such as the exploration of social and historical context.

B.5 Synthesis

This field research confirms the central problems identified in the theoretical framework. The museum experience, particularly in art institutions, remains dominated by the passive observation of artworks. When technology is introduced, it often falls into the category of superficial interactions, either as a flashy tool or as a digitalized wall text. As the critiques from Witcomb (2003) and Tsitoura (2010) predicted, these solutions fail to fundamentally change the visitor's role from a passive consumer to an active participant.

The most meaningful and engaging interactions observed were human-led. The guide engaging the children and the staff member talking to adults successfully transformed the experience into a social and reflective place. However, this model can't be scaled up and leaves the majority of visitors unsupported.

Although the Industry Museum's examples were more on the scientific side, they successfully adopted some of the discoveries found on the theoretical framework, such as the importance of physical movement and active deconstruction of pieces (Kühnapfel et al., 2024; Srouji, 2017).

Appendix C
O Grupo do Leão

The audio narrative developed for the prototype is a historical speculation based on the lives, relationships, and debates of the 14 figures depicted in the painting O Grupo do Leão (1885) by Columbano Bordalo Pinheiro. This section details the group's history and the individual biographies that were consulted to create the script.

C.1 Context and History

The "O Grupo do Leão" (The Lion's Group) was the adopted name of a collective of naturalist artists and intellectuals who gathered at the Leão de Ouro (Golden Lion) tavern in Lisbon during the 1880s.

According to contemporary accounts, the group's usual cafe was set to close. The members, then, asked their favorite waiter, Manuel Fidalgo, where he would be working next, as they decided to continue to meet wherever he continued to serve. (Lapa, n.d.)

The group followed Fidalgo to a new restaurant on Rua 1º de Dezembro, in Lisbon's city center. In a collective effort to support their new home, the artists decided to decorate it themselves, turning the establishment into a "Cervejaria-Museu" (Brewery-Museum), as it would later be called by the press. The contributions were varied, as Leandro Braga carved a gilded lion for the tavern, José Malhoa, Ribeiro Cristino, and Silva Porto contributed with landscape paintings, and even Columbano's sister, Maria Augusta Bordalo Pinheiro, embroidered a lion for the curtains. (Silva, 2018)

The main highlight was Columbano's painting, a snapshot that captures the group in a casual meeting, an interrupted moment as a photographer had just walked in. Columbano's modern approach, likely inspired by Fantin-Latour's group portraits, was to preserve the unique identity and intimate reality of each member, rather than subsuming them into a generic whole. To achieve this, he used a variety of modern and traditional techniques, such as studio poses, quick sketches, and ferrotypes, resulting in a composition that feels like a montage or even collage. (Lapa, n.d.; Silva, 2018)

The painting is, therefore, a complex social document. It captures the group's hierarchy, with Silva Porto seated at the center as the head of the group. It captures a moment of conversation, with Alberto de Oliveira leaning in to present a catalog. It even includes the tavern owner, António Monteiro, who was allegedly added as the 14th figure to avoid the tragic number 13 of the Last Supper. (Gonçalves, n.d.)



Figure 31: Cervejaria Leão de Ouro, with the painting hanging on the left side of the entrance. ("O Ocidente : revista ilustrada de Portugal e do estrangeiro," 1885)

It is this rich social reality, the friendships, debates, and individual personalities, that the audio prototype was designed to reveal.

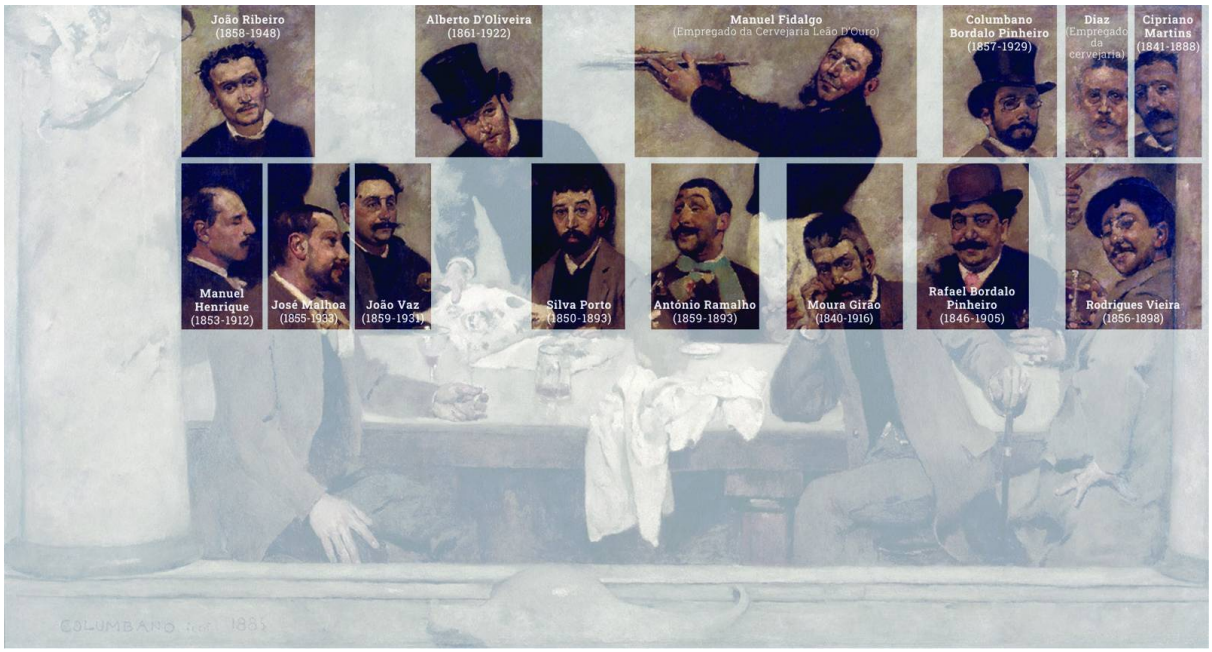


Figure 32: The painting edited to highlight each of the group's members.

C.2 Member biographies

All the biography information below comes from the catalog of the exhibition "Grupo do Leão & Sociedade Nacional de Belas Artes" (1941). The scripts containing each character's speech come right after the bibliographical information, both in portuguese, the project's audio language, and then in a translation to english. These speeches are extrapolations with the goal of mixing an informal, casual conversation style, with the transmission of the important information obtained during this research.

The 14 voices were recorded by 9 Portuguese men, some of them professional artists. They had freedom to make small adaptations to the script to make it sound more natural, and were given direction on how they should sound (for example, in doubt, affirmative, etc.). Their names are credited in the following list.

João Ribeiro Cristino (1858-1948)

Lisboa, 1858. Aged 27 at the time of the painting (1885).

Engraver and landscape painter, active in the naturalist scene between 1881–1889. Contributed illustrations to magazines.

Speech:

Ê Manuel, deixe disso! Só pensa no campo! As paisagens podem até deixar seus quadros bonitos, mas são os acontecimentos daqui da cidade que, bem ilustrados, vendem revistas!

Translation:

Oh Manuel, give it a rest! All you think about is the countryside! Landscapes might make your paintings pretty, but it's the events here in the city, when well-illustrated, that sell magazines!

Voice actor: Henrique Patrício

Alberto de Oliveira (1861-1922)

1861. Aged 24 at the time of the painting (1885).

Editor of the celebrated Catálogos Illustrados (Illustrated Catalogs), which featured, as a novelty for the time, zincograph reproductions of original drawings by the artists, depicting some of the paintings on display.

Script:

Olhe o nível dos detalhes destas ilustrações! É isto que eu digo! A zincogravura é a melhor novidade das nossas revistas, os leitores não param de elogiar a fidelidade das figuras nas páginas!

Translation:

Look at the level of detail in these illustrations! This is what I'm talking about! Zincography is the best new feature in our magazines, the readers won't stop praising the fidelity of the figures on the pages!

Voice actor: Carlos Martins

Manuel Fidalgo (waiter)

There is no data on his life. The only information besides the fact that he was the group's favorite waiter is that he would sometimes need to ask for the artists to speak in lower volumes, as the loud tone was catching the attention of other clients.

Speech:

Senhores! Trago os vossos pratos!

Sei que a arte é importante, mas falem mais baixo ou assustarão a clientela!

Translation:

Gentlemen! I'm bringing your dishes!

I know art is important, but please speak lower or you will scare away the clientele!

Voice actor: Gabriel Garanhão

Columbano Bordalo Pinheiro (1857-1929)

Almada, November 21, 1857. Aged 28 at the time of the painting (1885).

His father was a painter of merit. With his brothers, also devotees of art, they formed a dynasty of artists.

A portraitist of singular merit. He is the author of powerful "psychological portraits" of important figures from a country in transition. An intimist painter and "observer of souls".

"He unveiled the secrets of the soul" with his sober, intimist, and mysterious palette, and so many others had their souls exposed in a mysterious play of light and shadow that he utilized.

With the establishment of the Republic on October 5, 1910, Columbano was one of those chosen by the provisional government to join the commission tasked with selecting the design for the new national flag. He is said to have been the main person responsible for the choice of colors and design for the new flag, which was first hoisted on December 1, 1910.

He was the first director of MNAC, from 1914 until his death in 1929.

Speech:

Não sei se já te disse, irmão, mas não sabe o orgulho que eu tenho deste grupo... são tantas boas ideias, o que nós discutimos aqui com certeza irá mudar a arte portuguesa! Imagina um dia estarmos nós nas galerias dos museus desse país? Ou até mesmo nós dirigirmos estes museus?

Translation:

I don't know if I've told you, brother, but you have no idea the pride I feel for this group... So many good ideas! What we discuss here will surely change Portuguese art! Imagine, one day, us in the galleries of this country's museums? Or even directing these museums?

Voice actor: Dinis Ramos

Diaz (owner)

There is no data on his life. The only information besides the fact that he was the owner of the tavern, and that, allegedly, he was added to the painting as a way of avoiding the fatidic number of 13 members of the Last Supper, is about the tavern itself, that was called a "Museum-Tavern" in some of the magazines from the period, such as this one:

"A Tavern-Museum

[...]

By my faith, my friends, I know not if this fortunate house is a brewery, or a 'restaurant', or a café, or a tavern, or what; it just rather seems to me that it is a beneficent and hospitable museum, where a person who prides themselves on good taste can ecstatically digest, in a captivating contemplation of works of art." ("O Ocidente : revista ilustrada de Portugal e do estrangeiro," 1885)

Speech:

Senhores, vossos quadros fazem um enorme sucesso! A clientela até vem a nos chamar de cervejaria museu!

Translation:

Gentlemen, your paintings are a huge success! The clientele is even calling us a brewery-museum!

Voice actor: João Sassetti

Cipriano Martins

A young painter who gave private lessons, leaving behind a small body of work. Little is known about his life. No biographical data is available, nor are many of his works. It is only known that he participated in the Grupo do Leão.

Speech:

Meus amigos! Desculpem a hora, meus alunos hoje atrasaram. Agora deixemos as preocupações lá fora! Aqui na Leão d'Ouro, brindamos! À arte! À amizade! E a estes momentos que nos juntam! Saúde!

Translation:

My friends! Forgive the hour, my students were late today. Now, let's leave our worries outside! Here at the Leão d'Ouro, we toast! To art! To friendship! And to these moments that bring us together! Cheers!

Voice actor: Vasco Carrilho

Henrique Pinto (1853-1912)

Cacilhas, March 15, 1853. Aged 32 at the time of the painting (1885).

From a very young age, he showed a vocation for drawing; he attended the Royal Academy of Fine Arts in Lisbon. He had close relations with José Malhoa, and this, among other factors, must have led to him becoming part of the Grupo do Leão. During the holidays, he became enamored with the seductive landscapes of Figueiró, which had also attracted his friend Malhoa. There, he felt inspired to paint the theme of Landscape and Customs, and it was where he would later pass away.

Speech: Mesmo ao estar aqui, eu fecho os olhos e sinto-me em Figueiró... aquelas paisagens, aquilo que é uma vida boa...

Translation:

Even while being here, I close my eyes and feel like I am in Figueiró... those landscapes, that is the good life...

Voice actor: Bernardo Gomes

José Malhoa (1855-1933)

Caldas da Rainha, April 28, 1855. Aged 30 at the time of the painting (1885).

Artist, the "most Portuguese of Portugal's painters," pioneer of Naturalism in Portugal. He entered the Lisbon School of Fine Arts at age 12; he tried to study abroad but did not pass the (entrance) competitions. He scorned paint and paper and went to work for 3 years as a clerk (caixeiro) in his brother Joaquim's fashion shop. Slightly discouraged, during a break from commercial life, he painted the picture A Seara Invadida (The Invaded Wheatfield), which was a success at an exhibition in Madrid. People spoke of "the clerk who painted pictures." The painting's success returned him to painting.

For Malhôa, art held no secrets. Motifs that others would despise, he seized upon, managing to create truly prodigious works.

His work is profoundly emotive. With a healthy nationalism, he emphasized the joys and sorrows of the Portuguese people. He depicted in his paintings the rural and real country, the customs and traditions of the simple, common people, just as he saw and felt them. "Historian of the rustic life of Portugal."

In 1880, he helped found the Grupo do Leão, with Columbano Bordalo Pinheiro and Silva Porto, among others. It was a tertúlia (a social salon) of young artists held at the Lisbon brewery of the same name. The group would influence his decision to paint en plein air (outdoors), in the countryside.

Speech:

Senhores, não importa estar em Figueiró ou em Lisboa, importa é estarmos lá para representá-las. Nossos costumes devem ser valorizados, é de estar lá, para ver e pintar os acontecimentos da vida do nosso povo que vive a nossa grande arte!

Translation:

Gentlemen, it doesn't matter if we are in Figueiró or in Lisbon; what matters is that we are there to represent them! Our customs must be valued. Our great art comes from being there, to see and paint the life events of our people!

Voice actor: João Sassetti

João Vaz (1859-1931)

Setúbal, 1859. Aged 26 at the time of the painting (1885).

He considered himself a disciple of Silva Porto. He was distinguished by his cheerfulness and enthusiasm in conversations. A participant in the very first exhibitions of the Grupo do Leão, he painted, with a true feeling for color, the calm waters of the Sado river, delightful seascapes that elevated his name as an acclaimed artist. Seascapes seduced him, and there are few works where the waters of the Sado and Tejo do not appear.

Appointed professor at the Afonso Domingues Industrial School in 1884, he took over as director of that educational establishment years later.

Passionate about the riverside life of Setúbal, he celebrated it in all his forms. He was also a decorator, as seen in theaters, the School of Medicine, the Military Museum, the Assembly of the Republic, and the Hotel do Buçaco.

Speech:

Áh, Alberto... essas reproduções seriam ótimas lá na escola industrial, mas quero ver se consegue reproduzir as águas do Sado com essa sua máquina! [tom de piada]

Translation:

Ah, Alberto... those reproductions would be great over at the industrial school, but I'd like to see if you can reproduce the waters of the Sado with that machine of yours! [joking tone]

Voice actor: Gabriel Garanhão

Silva Porto (1850-1893)

Porto, November 11, 1850. Aged 35 at the time of the painting (1885).

At the head of the Grupo do Leão, he figured as its guide, a lover of the landscape, a cultivator of color, a man passionate about light.

After studies and work throughout Europe, which crowned his studies abroad, his work received special attention from Parisian critics. Once in Lisbon, a friend's invitation led him to accept the position of painting professor at the Academy of Lisbon, where he trained a generation of students who learned to "take the easel into the countryside and practice direct observation of nature." He thus played an important role in Portuguese artistic life. With his cult of the landscape, he painted it with a perfection that created devotees. In 1880, he presented for the first time at the "Promotora" exhibition, later participating in all 8 exhibitions of the Grupo do Leão.

He created around him a group of notable artists, some of whom carefully followed in his footsteps. It can be said that without the strong personality of Silva Pôrto, the Grupo do Leão would not have been what it was.

With his technique, his subjects, his unmistakable light, he was the inspirer, the guide, the Master of those painters who later became Masters themselves—rare temperaments of artists and of Portuguese men, who, around a quiet café table on Rua do Príncipe—a veritable Academy of Fine Arts—can be considered the precursors of the "Policy of the Spirit" (Política de Espírito) of our time, such was the yearning, the desire, the tenacity, the nationalism that they left stamped on their most Portuguese of works.

Speech:

Do que adianta as reproduções serem perfeitas se os originais não forem carregados de verdade? Por isso que eu sempre vos digo, aprendam a levar o cavalete para o campo e a exercitar a observação directa da natureza. É ali, só ali, que encontraremos a verdade na nossa arte!

Translation:

What good are perfect reproductions if the originals aren't loaded with truth? This is why I always tell you: learn to take the easel into the countryside and practice the direct observation of nature. It is there, and only there, that we will find the truth in our art!

Voice actor: Guilherme Prata

António Ramalho (1859-1893)

Lisboa, 1859. Aged 26 at the time of the painting (1885).

He was one of Silva Porto's first students at the Academy of Fine Arts in Lisbon, spontaneously assimilating his ***en plein air*** lesson. The following year, he was a founding member of the Grupo do Leão exhibitions. In 1882, he went to spend 2 years in Paris. He sent paintings to Lisbon, which revealed advancements but also betrayed that the painter was suffering from nostalgia for the countryside and the

luminosity of the Portuguese sun. He specialized in portraiture. In 1888, he began a decorative career.

Speech:

Manuel, a clientela devia era agradecer por poderem ouvir os conselhos do meu amigo e professor Silva Porto! Apenas ao sentir o sol dos campos na hora da pintura é que podemos representar o campo português, disto todos deviam saber e ouvir!

Translation:

Manuel, the clientele should be thankful they get to hear the advice of my friend and teacher, Silva Porto! Only by feeling the sun of the fields at the moment of painting can we represent the Portuguese countryside. Everyone should know and hear this!

Voice actor: André Lourenço

Moura Girão (1840-1916)

Lisboa, August 1840. Aged 45 at the time of the painting (1885).

A conscientious animal painter, whose work is spread throughout national museums and private galleries. For thirty-six years, Moura Girão held the position of restorer at the National Museum of Ancient Art, simultaneously producing many dozens of works in which he revealed his artistic temperament. He had a predilection for gallinaceous birds (poultry), painting them with a special truthfulness.

Speech:

Hei de ver se um dia, ainda em vida, as verdades que nossos quadros carregam irão chegar aos museus como o que eu dirijo! Por enquanto parece que é só de Arte Antiga que nós vivemos...

Translation:

I hope to see one day, still in my lifetime, if the truths our paintings carry will make it into the museums... like the one I direct! For now, it seems we only live on Ancient Art...

Voice actor: André Lourenço

Rafael Bordalo Pinheiro (1846-1905)

Lisboa, March 21, 1846. Aged 39 at the time of the painting (1885).

He debuted to the public in satirical newspapers of ephemeral life, which showed his great imagination as a caricaturist. He had in his father his best Master. His prodigious pencil became well-known; he was responsible for the graphic chronicle of the Carlist Wars in Spain for the Illustrated London News. Caricature calls to him, drags him, binds him; and the artist, obeying it blindly, founded O Binóculo and A Lanterna Mágica, beginning to conquer the popularity that would never again leave him. In 1873, he went to Brazil in search of fortune, but difficulties made him return. In Lisbon, he founded newspapers that were monuments of humorous critique. A notable caricaturist and decorator, he fell in love with ceramics. He aspired to restore to Portuguese art its stamp of originality, and, taking advantage of the flora and fauna of the Caldas region, he executed the most varied ceramic pieces. Cheerful and expansive, he was the most beloved artist of his time.

He created Zé Povinho.

Speech:

De museus eu não sei o que nosso Portugal dará, mas de política tenho certeza que minhas sátiras não terão falta de conteúdo!

Translation:

Of museums, I don't know what our Portugal will make… but out of politics, I am certain my satires will not lack content!

Voice actor: João Sassetti

Rodrigues Vieira (1856-1898)

Lisboa, March 17, 1856. Aged 29 at the time of the painting (1885).

From Lisbon, he attended the Royal Academy of Fine Arts. An inseparable companion of the Grupo do Leão, he accompanied them in their memorable gatherings. He managed to be named a professor of Drawing in 1887, placed in Leiria. The bucolic landscape of the Liz fields tempted him several times, appearing in various works. He also dedicated himself to sculpture.

Speech:

Cervejaria museu! É para isso que existimos, para trazer a arte e as belezas do campo para dentro de espaços como este! Arte tem de poder ser admirada por todos em todos os espaços!

Translation:

Brewery-museum! That's why we exist—to bring art and the beauty of the countryside into spaces like this! Art must be able to be admired by everyone, in every space!

Voice actor: Henrique Patrício

Appendix D

Prototype Fabrication Details

This appendix provides the technical specifications, schematics, and fabrication files necessary to reproduce the prototype. The system consists of five individual sensor boxes controlled by a central microcontroller.

D.1 List of Materials and Wiring Schematic

The final system consists of one central controller and five identical sensor boxes.

System-Wide Components:

- 1x Arduino Mega (or compatible)
- 1x 5V, 3A (15W) AC/DC Power Supply
- 1x Custom “Power Bus” distribution board (see Figure 38)

Per-Box Components (x5):

- 1x DFPlayer Mini
- 1x Micro SD Card (with audio files)
- 1x HC-SR04 ultrasonic sensor
- 1x 1K Ohm resistor
- 1x 4 ohm 5W speaker
- 2x 3 ports terminal block
- 1x 4 ports terminal block
- Solderable Perfboard and wiring

The components for each box were connected according to the schematic in Figure 33.

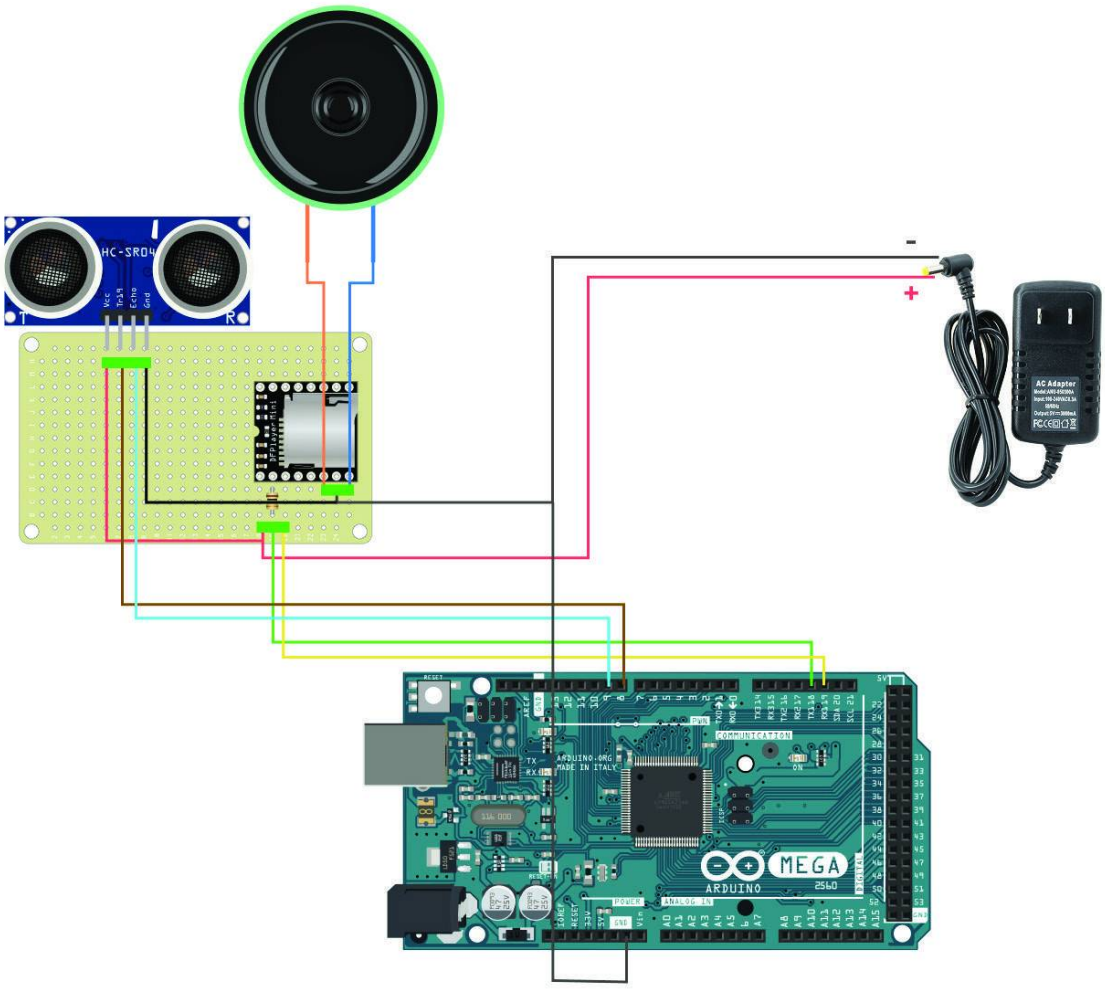


Figure 33: Schematic version showing the Perfboard, Arduino and Power Supply connections.

The components for each unit were hand-soldered onto a perfboard. Terminal blocks were used for all external connections (arduino, speaker, and power) to ensure a stable and modular connection, as shown in Figure 34.

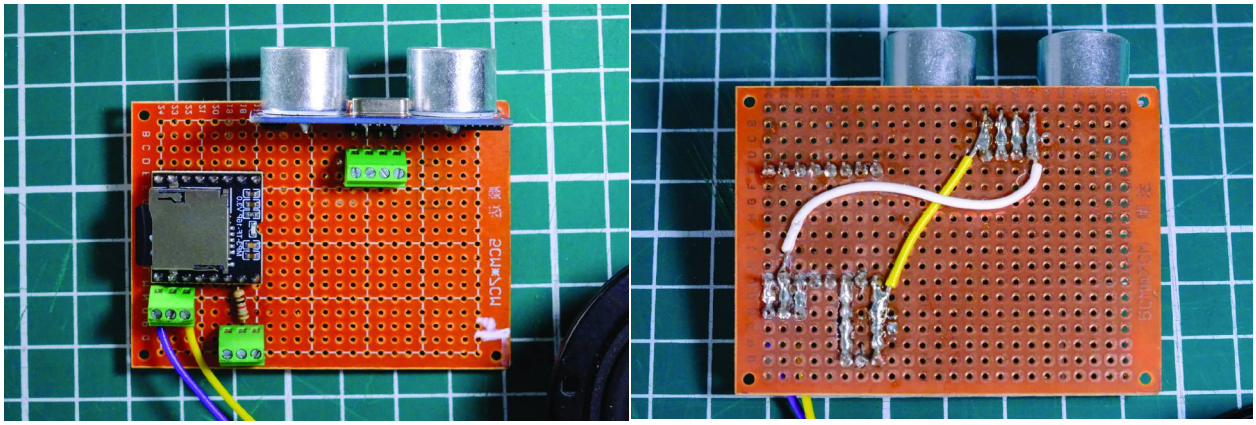


Figure 34: On the left, the top of the perfboard, with the HC-SR04 sensor, the DFPlayer Mini and the terminal block connectors. On the right, the cables soldered to connect everything.

D.2 Enclosure design

The enclosures were designed to be laser-cut from 5mm MDF. The design used a "two-floor" system, with the perfboard on the bottom and a separate shelf to support the speaker (see Figure 37 and 42).

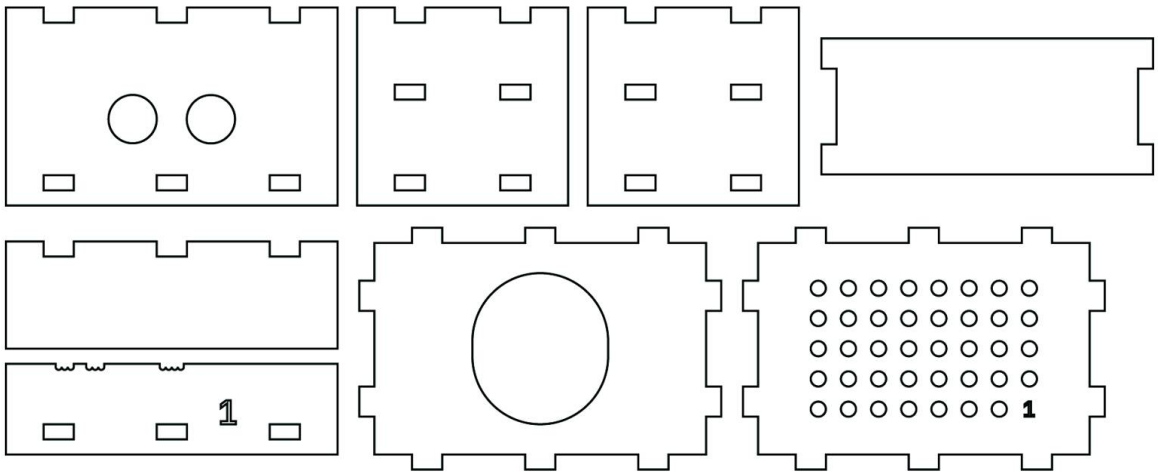


Figure 35: Vectorial drawing of the box. This was the file used in the laser cutter.

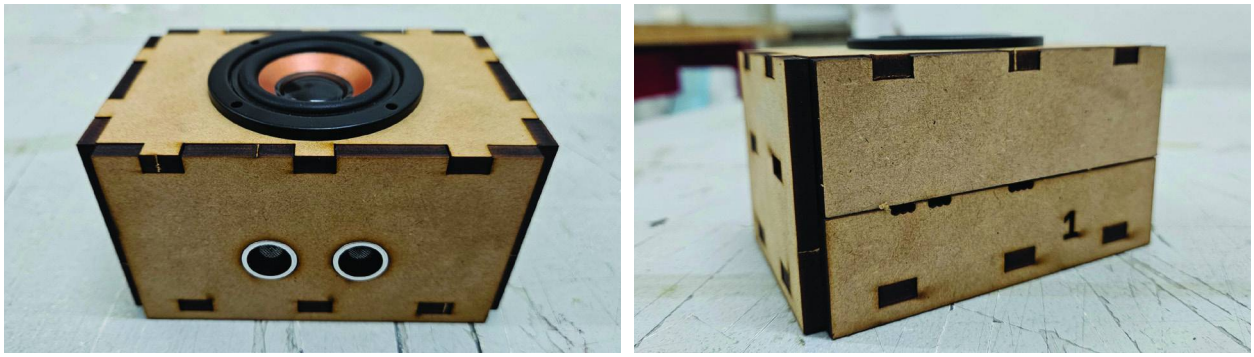


Figure 36: On the left, the front and top of the first box, housing the sensor and the speaker. On the right, box on an angle, showing the back panel with small holes for the cables.

This first iteration revealed two flaws. First, a dimensional error: a miscalculation in the external dimensions (1cm oversized) prevented the internal "second-floor" speaker support from fitting properly. Second, the cable cutouts on the back panel were too small to accommodate the wiring.

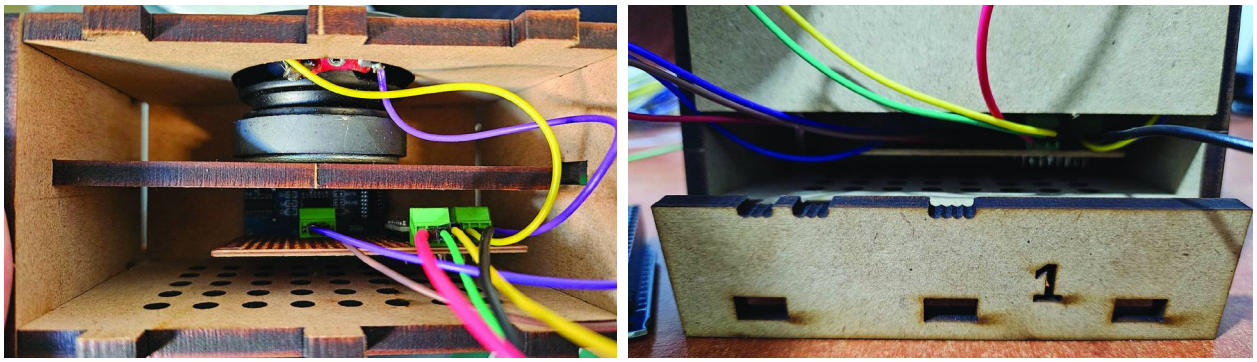


Figure 37: On the left, the wood support for the speaker doesn't go all the way to the right side. On the right, the cables are thicker than the spaces left for them.

D.3 Final assembly

The lessons from the first prototype led to three key design revisions for the final system. First, to solve the problem of powering five separate boxes, a “power bus” was built. This board consolidates the five power connections into one central point, which then connects to the main 5V power supply, simplifying the wiring (see Figure 23). This way, this power board could be kept right next to the Arduino, centralizing all power and data cables in one spot.

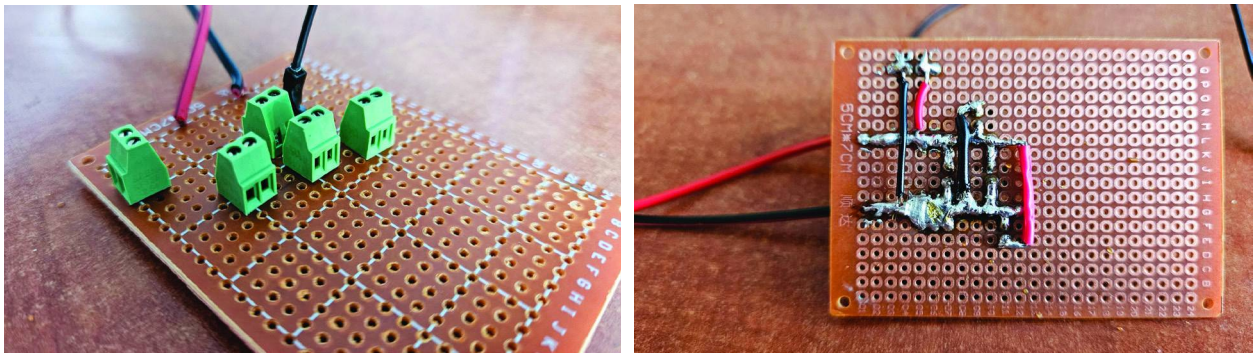


Figure 38: On the left, the connector blocks that allow all the five positive and negative cables to be connected at the same board. On the right, the ugly but functional soldered connections.

Then, to fix the cable-fitting issue and improve maintenance, the design was updated to use 6-pin JST XH connectors. This allowed each box to be a self-contained, modular unit that could be easily plugged into the main Arduino plus power bus unit. The back panel was redesigned as a single piece with a clean cutout for the JST port.

Finally, some adjustments were made to the enclosure. The external panels were reduced by 5mm to the correct size. The internal speaker shelf was resized to fit perfectly and given an indent to allow for easier sensor handling. The top panel was designed to sit on top of everything in a way that’s easy to lift, allowing for interior access when needed. Numbered cutouts on the bottom and back panels were added for easy identification during setup.

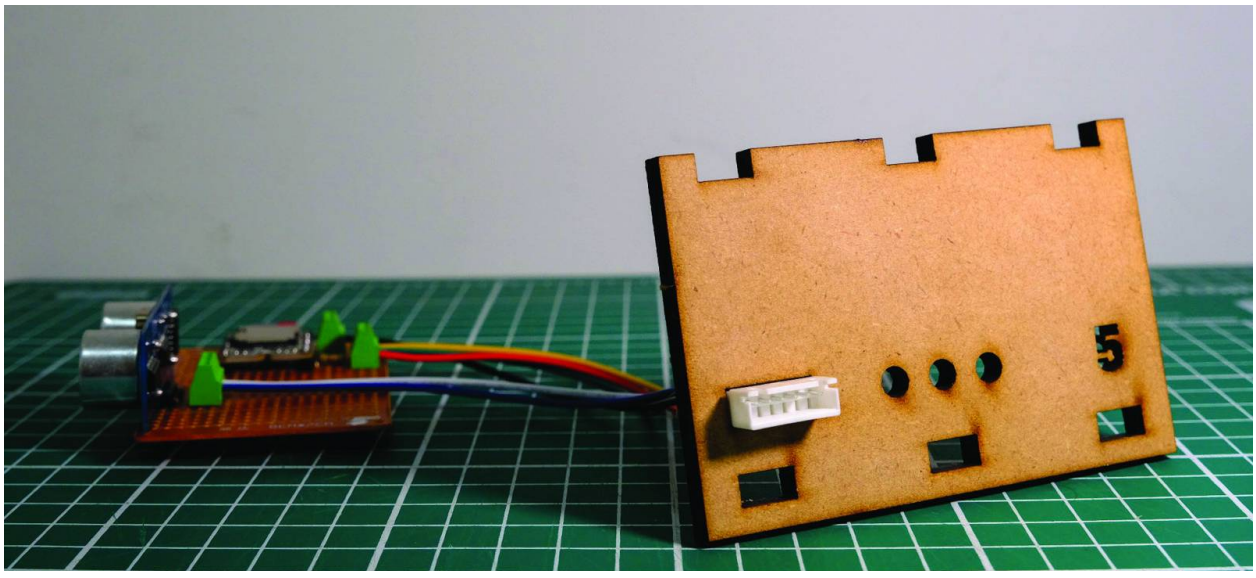


Figure 39: Back panel of box number 5. The JST XH cable is first passed through the panel, then connected to the board terminal connectors. The connector pointing outside carries all the power and data through a single port.

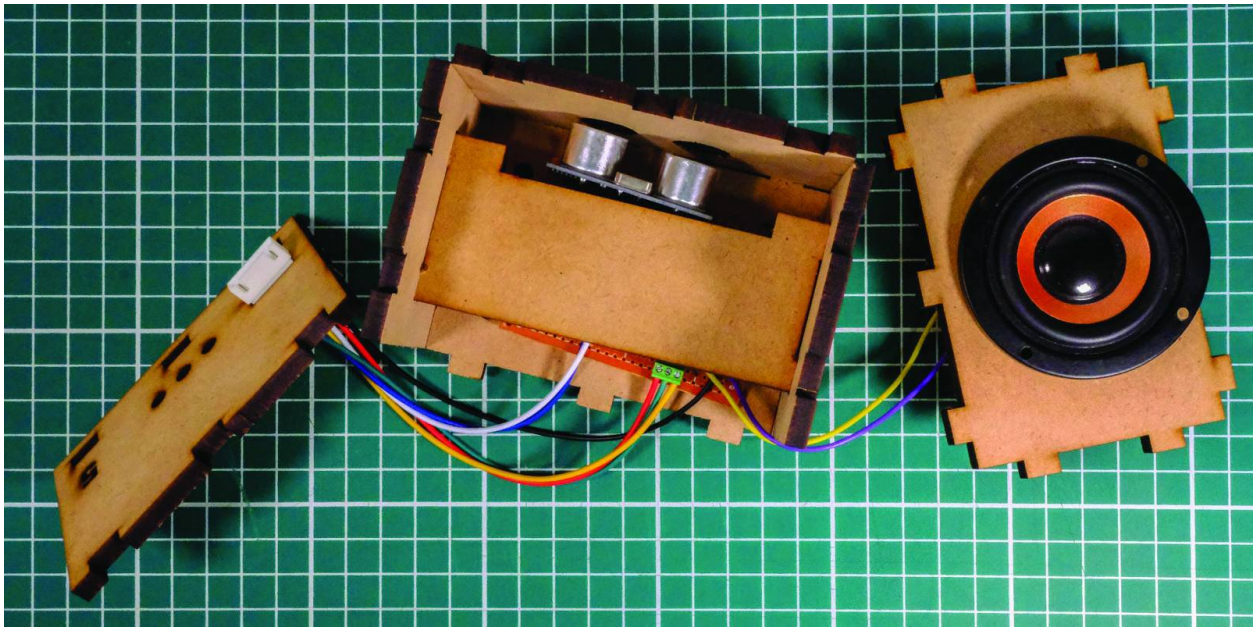


Figure 40: Dismounted box revealing the perfboard, where the sensor and DFPlayer Mini are soldered to, under the wood panel that will help accommodate the speaker. The back panel is then inserted.

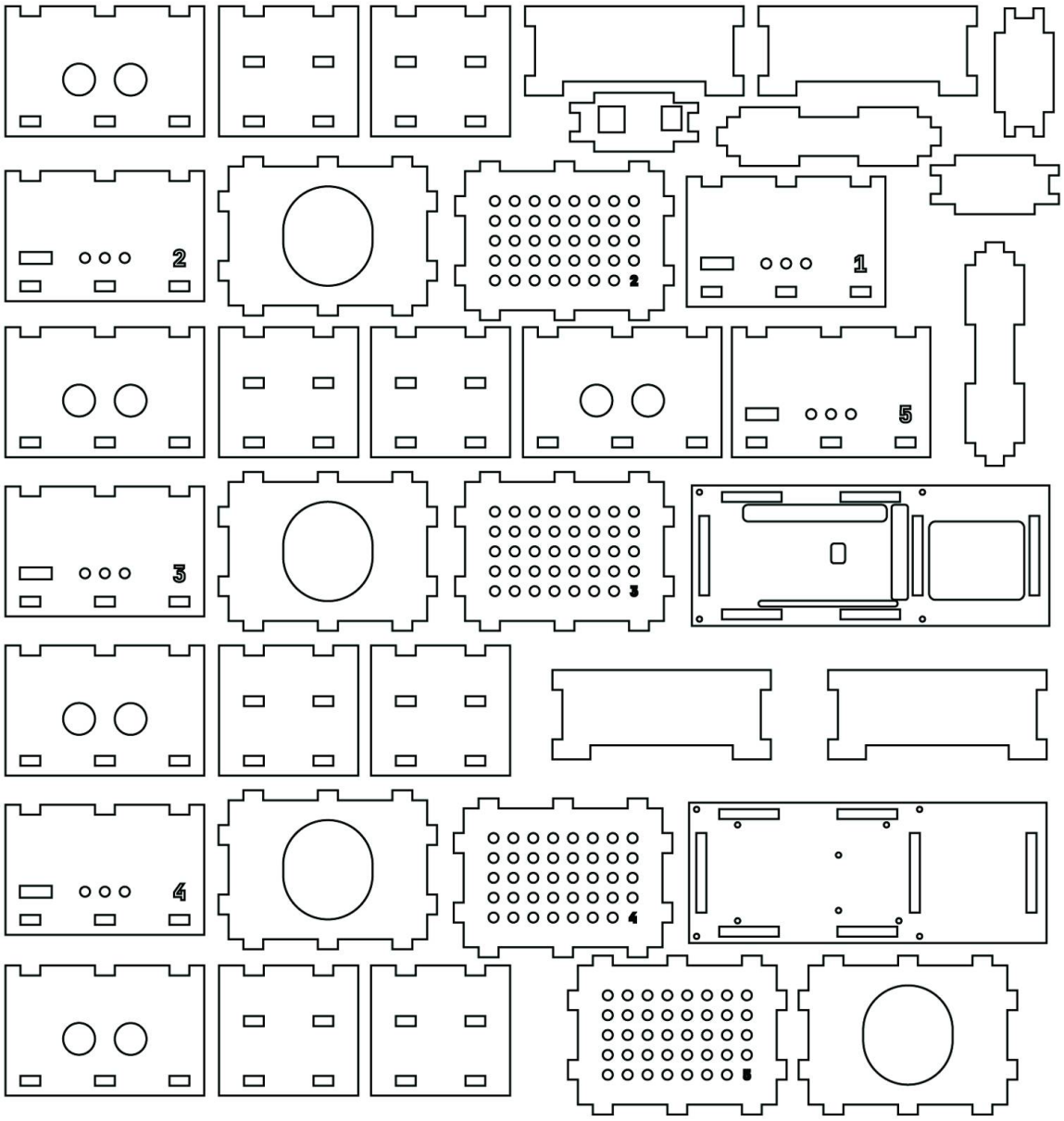


Figure 41: Vectorial drawing of all the final pieces that were laser cut in the final step.

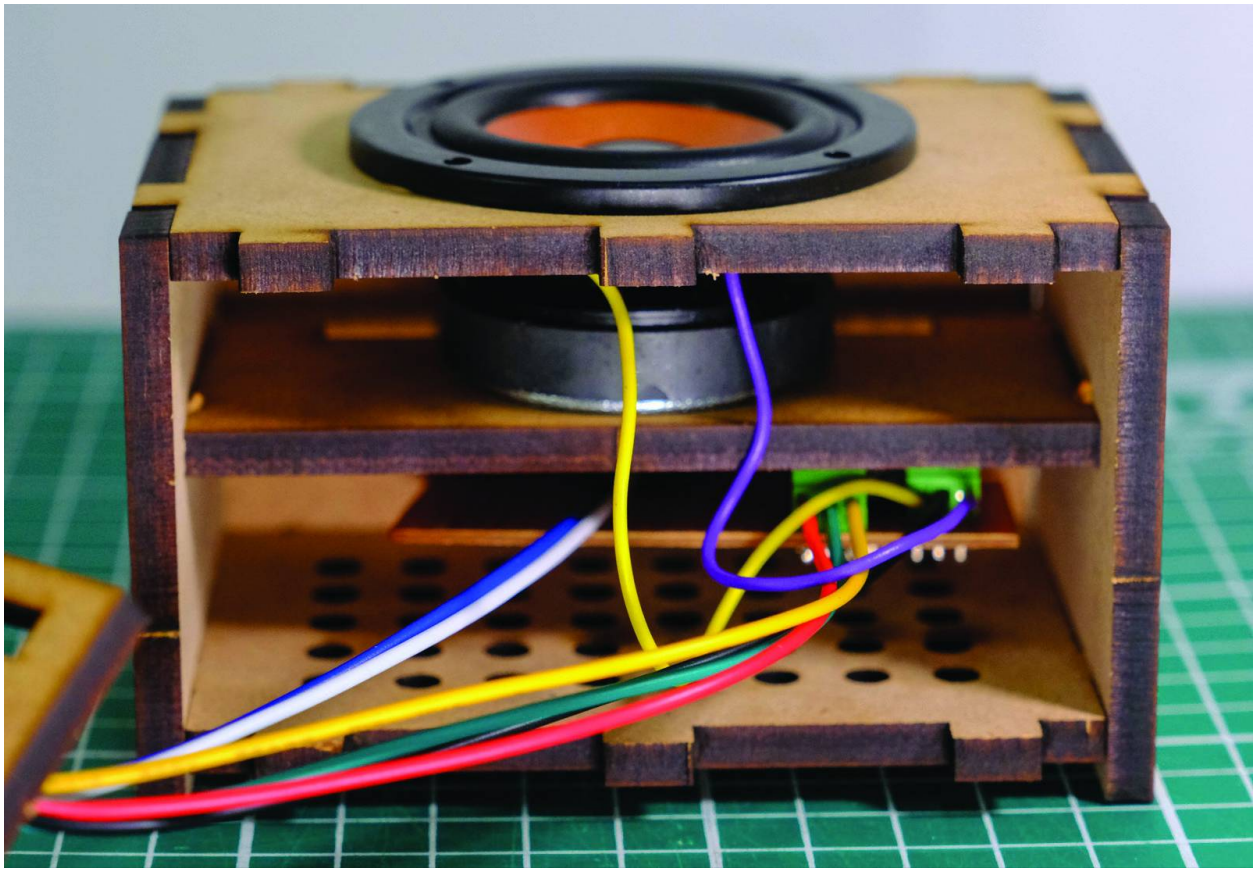


Figure 42: Back of an open box, showing how the “two floors” work. The speaker is supported by the top layer and, for better acoustics, sits on top a middle shelf. The soldered system on the perfboard is then inserted on the bottom section.

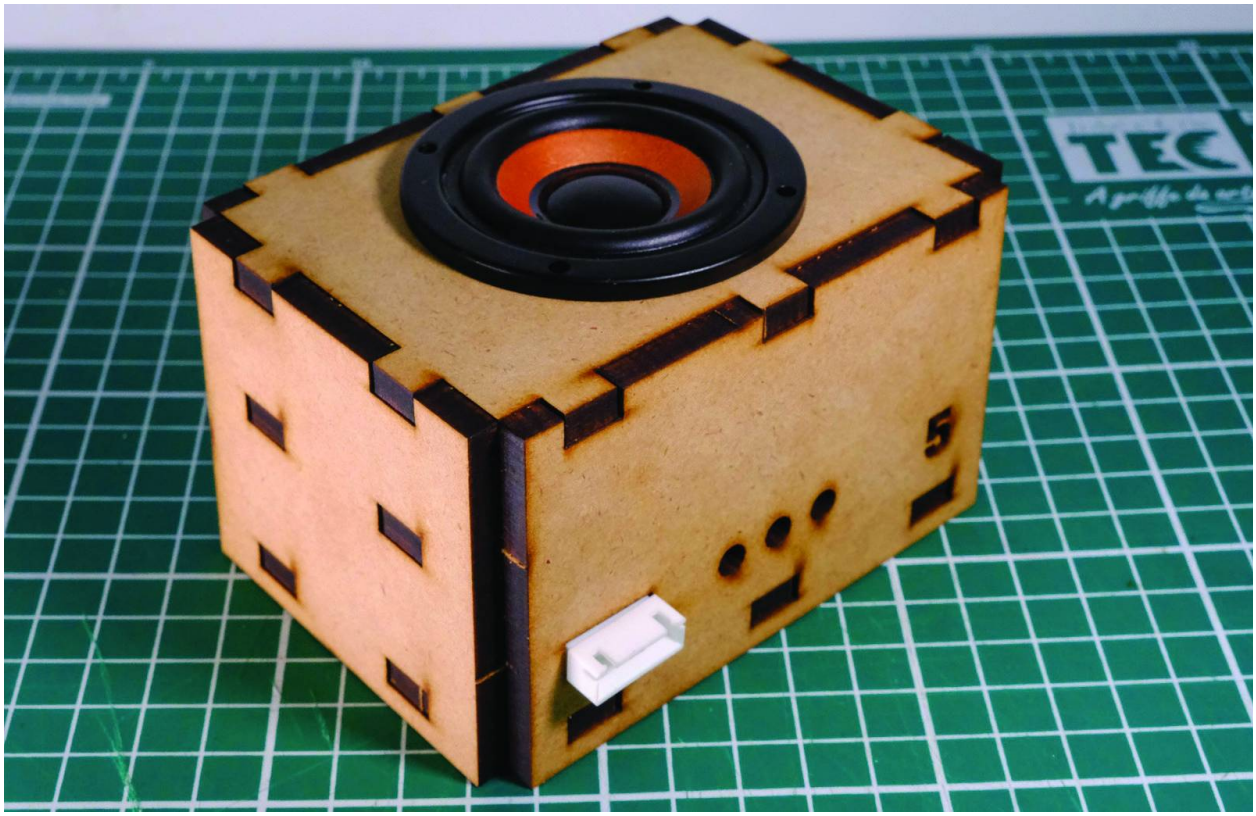


Figure 43: Box number 5 back, seen from an angle. The cable connector sits outside to make the connection easier. Extra holes were added in the middle in case any other cable was needed to go inside the box.

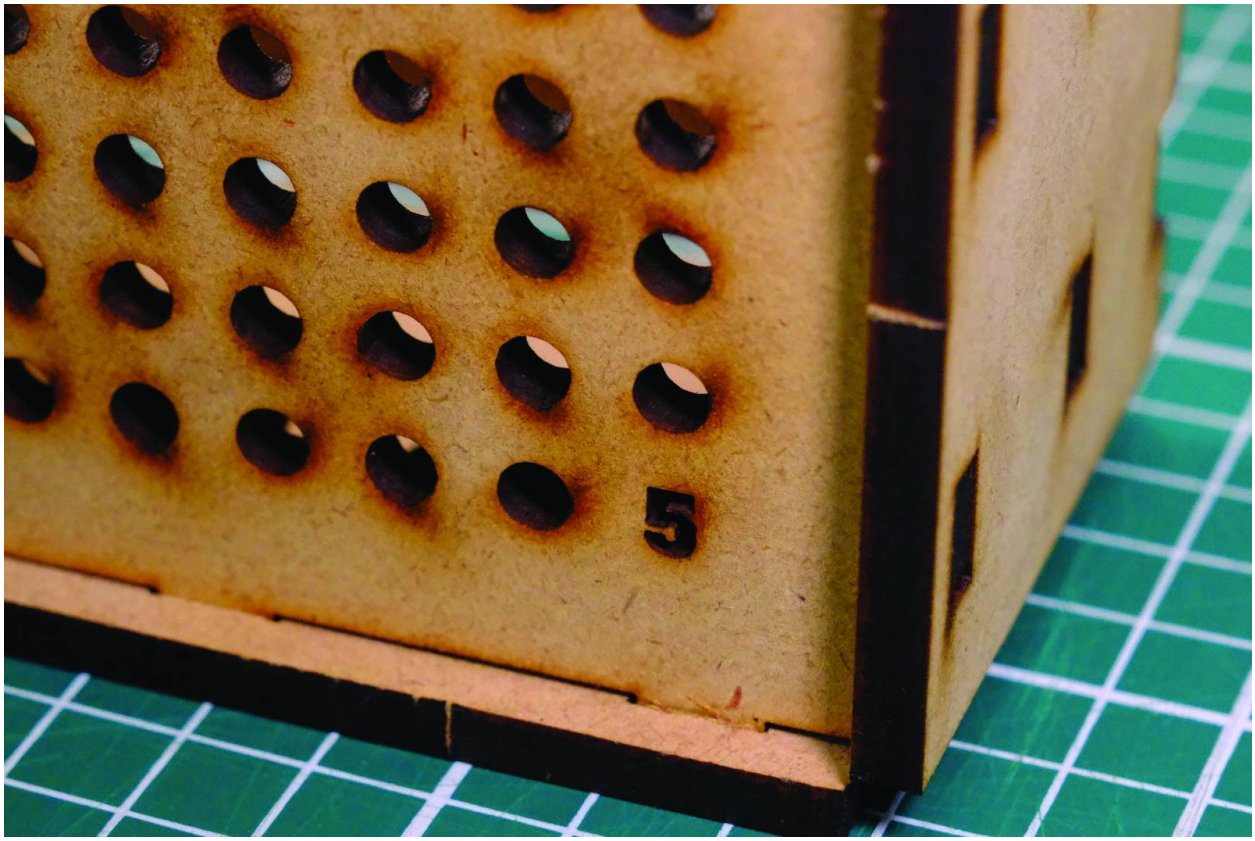


Figure 44: Box number 5 bottom, revealing the number cutout. The number is on both the bottom and the back panels, to make it easier to, when the back panel is removed during assembly, know which box the piece should go back to.



Figure 45: The boxes sit discreetly in front of the painting.

Appendix E

Test protocol and raw data

This appendix contains the complete documentation and raw data gathered during the user testing phase, as described in Chapter 6. This material forms the foundation for the "Test Results" (Chapter 6.4).

E.1 Test Protocol

Cada sessão de teste seguirá os seguintes passos:

Fase 1: Pré-Teste e Consentimento (5 minutos)

1. **Receção:** O moderador recebe o participante.
2. **Apresentação:** "Olá, obrigado por participar. Como leu no formulário, estamos a testar uma nova experiência interativa para um projeto de mestrado. O meu nome é Felipe Rabaça."
3. **Consentimento:** Apresentar o **Formulário de Consentimento**.
4. **Reforço Verbal:** "Como leu, este teste é voluntário e pode parar a qualquer momento. Lembre-se, **não há jeito certo ou errado de usar isto**. Não o estamos a avaliar a si; estamos a avaliar o projeto. Por isso, por favor, explore-o com total liberdade."
5. **Permissão de Gravação:** "No formulário, mencionámos a gravação áudio e vídeo da sessão. Isto ajuda-nos a analisar a interação mais tarde. Confirma que autoriza a gravação, sabendo que todos os dados serão anonimizados?" (Iniciar gravação apenas após confirmação verbal).

Fase 2: Exploração Livre e Observação (5-10 minutos)

1. **Instrução:** O moderador leva o participante até à instalação.
2. **Instrução:** "Vou-me afastar e ficar em silêncio para que possa explorar. Por favor, aproxime-se da obra e experiencie a instalação como quiser, pelo tempo que desejar. Avise-me quando sentir que terminou."

3. **Observação:** O moderador retira-se para um canto e regista observações comportamentais sem intervir.

Fase 3: Entrevista Semi-estruturada Pós-teste (10-15 minutos)

1. **Transição:** "Obrigado. Vamos agora conversar um pouco sobre a experiência."
2. **Execução da entrevista:** Ver o Roteiro de Entrevista.
3. **Conclusão:** "Muito obrigado pela sua participação. A sua perspetiva foi extremamente útil."

E.2 Informed Consent Form

The following document is the informed consent form that was presented to all 10 participants before the test began. It outlines the project's goals, the testing procedure (including audio and video recording), and the participant's rights, such as the right to withdraw at any time. All participants provided their signed consent before proceeding with the test.

Formulário de consentimento

Teste de experiência interativa em museu

Este teste é parte da investigação para o Projeto de Mestrado em Design de Interação de Felipe Rabaça. Este trabalho está a ser desenvolvido na Faculdade de Arquitetura da Universidade de Lisboa, sob a supervisão do Professor Dr. Victor Almeida.

O teste faz parte da investigação "Arte além da Observação: Projeto de experiências interativas em museus para um aprendizado ativo de conceitos artísticos". A proposta é que o participante utilize a experiência interativa proposta para que possamos avaliá-la.

A sua participação no teste é voluntária.

Sua participação envolve a utilização da experiência interativa em um ambiente que simula o espaço expositivo do Museu de Arte Contemporânea do Chiado, onde a pintura "O Grupo do Leão" está exposta.

Após o teste, será conduzida uma entrevista para perceber como foi sua experiência.

Lembre-se de que não há jeito certo nem errado de participar. Não estamos a avaliar o participante, mas sim o projeto do qual o participante está a experienciar. Todo jeito de utilização do sistema é válido, portanto, por favor fique a vontade para experienciá-lo como quiser.

Caso sinta-se mal ou mude de ideia, pode cancelar a sua participação no teste a qualquer momento sem que precise se justificar e sem qualquer consequência.

Durante o teste serão tomadas notas sobre a sua relação com o sistema a ser experimentado, e dados em formato de *log* serão coletados pelo próprio sistema para uma melhor avaliação posterior do funcionamento do projeto. Caso autorize, o teste será gravado para uma revisão posterior das imagens.

Todos os dados coletados serão anonimizados e utilizados estritamente dentro do ambiente acadêmico para os fins desta investigação. Nenhum participante será identificado a qualquer momento da documentação deste projeto.

Declaração de consentimento

Eu informo que li, compreendi e pude esclarecer quaisquer dúvidas existentes acerca da participação neste teste. Declaro que fui informado sobre os objetivos, procedimentos, riscos e benefícios da minha participação. Reconheço que minha participação é voluntária e pode ser cancelada a qualquer momento.

Assinatura	Data	Gravação de imagens
_____	___/___/2025	( ) Autorizo ( ) Não autorizo

E.3 Complete Tests Results

The following pages contain the complete, unedited data collected from all 10 participants. This raw data was synthesized and analyzed to produce the findings in Chapter 6.4.

The data is organized as follows:

1. **Participant Biographical Data**: Age, gender, nationality, area of study.
2. **Observational Notes**: The mediator's real-time notes on participant behavior, movement, and usability discoveries.
3. **Semi-Structured Interviews**: Full, transcribed responses to the post-test interview questions from P1-P10.
4. **Emotional Self-Assessment Results**: The raw data from the Geneva Emotion Wheel and SAM scale selections for all participants.

Informações do participante

Idade:

P1: 29

P2: 32

P3: 28

P4: 29

P5: 27

—Alteração: adição de posições no chão, melhor distância entre caixas—

P6: 25

P7: 22

P8: 22

P9: 22

P10: 22

Gênero:

P1: Feminino

P2: Masculino

P3: Feminino

P4: Feminino

P5: Masculino

P6: Masculino

P7: masculino

P8: Masculino

P9: Feminino

P10: feminino

Nacionalidade:

P1: Brasil

P2: Brasil

P3: Brasil

P4: Brasil

P5: Brasil

P6: Portugal

P7: Portugal

P8: Brasil

P9: Portugal

P10: Angola

Área de trabalho ou estudo:

P1: Design

P2: Financeiro

P3: Design

P4: Financeiro

P5: Design

P6: Design

P7: Filosofia

P8: Arquitetura

P9: Arquitetura

P10: Arquitetura e urbanismo

Visitou algum museu nos últimos 6 meses? Se sim, quantos?

P1: 3

P2: 1

P3: 1

P4: 1

P5: Não

P6: 4

P7: 5

P8: 13

P9: 6

P10: 15

Coleta de Dados

A. Roteiro de Observação Comportamental (foco em ações)

Descoberta da Interação (Affordance):

O participante aproximou-se da pintura? (Sim/Não/Parcialmente)

P1: Parcialmente

P2: Parcialmente

P3: Sim

P4: Parcialmente

P5: Parcialmente

P6: Sim

P7: Sim

P8: Sim

P9: Sim

P10: Sim

Percebeu a mecânica das 5 zonas? Em quanto tempo? (Sim/Não/Parcialmente)

P1: Sim, rapidamente

P2: Sim, rapidamente

P3: Sim, instantaneamente

P4: Sim, médio

P5: Sim, demorou um pouco para ler a placa e ganhar confiança

---

P6: Sim, instantaneamente

P7: Sim, rapidamente

P8: Sim, de início

P9: Sim, após completar a primeira zona

P10: Sim, após completar a primeira zona

Quanto tempo demorou a perceber a mecânica de distância (camadas de áudio)? (Sim/Não/Parcialmente)

P1: Não percebeu

P2: Não percebeu

P3: Sim, logo de início, antes mesmo das zonas

P4: Não percebeu

P5: Não percebeu

P6: Sim, instantaneamente

P7: Sim, antes das zonas

P8: Sim, junto das zonas

P9: Sim, logo de início ao passar sobre dois quadrados no chão e ver que o som mudou

P10: Sim, logo de início ao explorar os quadrados no chão

O participante testou ativamente as diferentes zonas e distâncias? (Sim/Não/Parcialmente)

P1: Zonas sim, distância não

P2: Zonas sim, distância não

P3: Sim

P4: Zonas sim, distância não

P5: 4 primeiras zonas sim, distância não

P6: Sim

P7: Sim

P8: Sim

P9: Sim

P10: Sim

Padrões de Movimento (Engajamento Físico):

O movimento foi fluido? (Sim/Não/Parcialmente)

P1: Parcialmente, hesitante por falhas no sistema

P2: Não, parecia não saber para onde ir com os sons,

P3: Sim, com algumas paradas para testar se estava no sítio certo para o som, mas fluido no geral

P4: Parcialmente, moveu-se por todas as zonas mas sempre desconfortável

P5: Não, parecia não perceber quando os sons acabavam e para onde ir

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P6: Sim

P7: Sim, por vezes parecia inseguro mas se moveu sem medo

P8: Sim

P9: Sim, com uma certa insegurança ao início de quem não sabe o que esperava, mas fluido

P10: Sim, certa confusão quando houve interferência nos áudios, mas fluido

Houve movimentos que indicam uma imersão auditiva (ex: fechar os olhos, inclinar a cabeça)? (Sim/Não/Parcialmente)

P1: Parcialmente, baixou os olhos para a caixa de onde sai o som como para ouvir melhor

P2: Não

P3: Sim, baixou o corpo e olhou para o lado, como quem aponta o ouvido em direção à origem do som

P4: Não

P5: Não

P6: Não, tirou uma fotografia da placa com os nomes e manteve foco na foto para saber onde ir a seguir

P7: Parcialmente, baixou os olhos para a caixa de onde sai o som como para ouvir melhor

P8: Parcialmente, baixou os olhos para a caixa de onde sai o som como para ouvir melhor

P9: Não, manteve o foco no quadro a todo o tempo

P10: Não, manteve o foco no quadro a todo o tempo

Usabilidade:

O participante buscou apoio? (moderador ou placa informativa)

P1: Não

P2: Sim, olhou brevemente a placa

P3: Começou a experiência por ler a placa informativa. Na última caixa olhou para mim pois um dos sensores não a captava direito, precisei mover a caixa para ajustar a posição

P4: Iniciou a experiência por ler a placa informativa

P5: Sim, começou pela placa, perguntou-me o porquê de alguns nomes estarem com cores diferentes por não perceber. Olhou para mim quando teve uma interferência de outro som começar sozinho

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P6: Sim, placa informativa

P7: Não

P8: Sim, placa informativa

P9: Sim, placa informativa

P10: Não

Expressou verbalmente confusão (ex: "hã?", "não estou a perceber")? (antes, durante ou depois da experiência?)

P1: Não

P2: Não

P3: Não

P4: Não

P5: Fez uma pergunta durante (ver acima)

P6: Não

P7: Não

P8: Não

P9: Não

P10: Não

Mostrou sinais de sobrecarga (ex: afastar-se rapidamente, desistir)? (foram até o fim ou se interromperam a meio)

P1: Não

P2: Parcialmente, no fim ficou confuso com múltiplos sons em simultâneo e acelerou

P3: Não

P4: Não

P5: Não

P6: Não

P7: Não

P8: Não

P9: Não

P10: Não

B. Roteiro de Entrevista Semi-estruturada

Impressão Geral (Warm-up):

Pode descrever-me, com as suas palavras, o que acabou de experienciar?

P1: Um quadro vivo, tipo onde as pessoas, basicamente quando ela chega no museu não sabe o que é aquilo, mas quando ela chegou ela conseguiu perceber o que passava, sentiu o quadro vivo

P2: É um tipo de realidade aumentada de imersão, nao sei como colocar em palavras, mas se sentiu bem no clima do quadro

P3: Se sentiu imersa, poderia chamar de experiência imersiva, mas esse termo já tá tão usado, imerso no acontecimento da história e História

P4: A sensação que teve foi que a cada momento que passava pelas caixinhas que fazem o som e olhando pra essa obra é como se conseguisse identificar e pelo menos se familiarizar muito com a pessoa que tá se comunicando, mesmo sem saber quem era era pensar ah essa pessoa tem essa voz pensando na expressão e sotaque

P5: Um quadro e os caras conversando

P6: um quadro interativo em qual quando me aproximo de certas partes começam áudios em que cada uma das partes, ou seja, cada personagem a ter conversas como acontece normalmente num bar cervejaria como eles estão

P7: Boa pergunta, não sei, informações, demasiadas informações que a certo modo não consegui reter e acho que não é possível reter o que sai das colunas, o som saído numa primeira experiência e não sei, acho que não sei responder só com uma primeira experiência, acho que foi a tentativa no final de tentar me situar perante as personagens e o contexto, confesso que o único homem que de facto consegui me conectar é o empregado, que acho que é o roxo do meio? Mas de resto sim acho que nao consegui, ou seja conseguem saber de que lado estariam mas não consigo ter 100% de certeza quem são

P8: Uma experiência audiovisual que usa sensores de proximidade para criar narrativas lineares nesse caso

P9: Uma nova forma de interagir com a arte eu acho

P10: o áudio baseava se na posição em que eu tava e era meio que a voz da pessoa que tava a falar era da pessoa a quem eu tava a olhar no quadro, quando eu tava mais no meio tava a falar o garçom, mais pra direita estava um senhor a falar da cerveja e ele tava com um copo de cerveja na mão, portanto parecia que eu tava dentro do cenário, que eu fazia parte do que estava a acontecer

Como se sentiu durante esta experiência?

P1: Ficou confusa pela interferência da distância entre os sons, atrapalhou a percepção das falas, mas depois que percebeu a mecânica ficou mais claro. Achou bem interessante dar para sentir à época pela voz, pelo sotaque

P2: Se sentiu bem imerso, é uma experiência bem diferente e potencializou a experiência de ver um quadro

P3: Curiosa e interessada

P4: Interessada nessa sensação de que tá ouvindo essa voz mas tá olhando pra uma obra que é estática, é uma sensação bem incomum de ter essa familiaridade de saber essa voz mesmo sem saber de quem é, essa conexão da obra com voz

P5: Um pouco perdido no inícios e a dinâmica de ter que ficar olhando a placa porque ele esqueceu o óculos e não enxerga de longe então teve que ficar indo e voltando

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P6: senti me muito bem, foi uma experiência bastante agradável e interessante, senti me motivado a continuar a experienciar as diferentes personagens

P7: Estimulado, confuso e curioso. (Pergunto confuso no que?) a confusão se deve pelo meu querer identificar as personagens e tentar mapear as personagens, mapear o som para a personagem levou a confusão, tirando isso nao é confuso, é interativo bastante simples de interagir, um passo pra trás, um pra frente, sons e vozes

P8: achei engraçado, achei interessante e sinto que é algo que não é aplicável a qualquer obra mas essa obra em específico funciona muito bem

P9: muita curiosidade, curiosa, houve personagens que me interessava mais, que de repente queria saber o que que o outro respondia, as falas de um

P10: foi interessante porque a voz das pessoas que eu tava a ouvir parecia corresponder com as caras, o que é um pouco estranho, o que acho que ajudou também essa percepção de que eu estava presente no momento que foi retratado na pintura. No início foi estranho, mas depois de eu entender o que estava a acontecer já conseguia perceber melhor qual perspectiva eu queria ouvir, porque no fim eu passei do meio pro final, onde estavam os senhores que chegaram atrasados, e mesmo sem saber isso já eu conseguia imaginar que o áudio ia falar qualquer coisa sobre os senhores de pé. Eu gostei, acho que foi uma experiência única, nunca vi isso no museu, mas achei bastante interessante a forma, naqueles minutos ou segundos que eu tava ali parecia que o que eu tava a ver no quadro tava acontecer e eu tava lá

O que mais lhe chamou atenção?

P1: Ficou curiosa porque nao sabe se tem que ir de direita para esquerda para ter a ordem, e se voltando teria mais diálogos ou se repetiria o mesmo. Chamou atenção a curiosi da experiência

P2: A diversidade de pessoas, pode ser por ser um quadro com muitos [membros], mas é algo que colocou como se ele estivesse participando, presenciando uma cena

P3: A possibilidade de eu mesmo, meu próprio movimento causar algo na arte que é estática

P4: O facto de eu estar me deparando com uma obra e sentir como se estivesse no ambiente em que as pessoas estão e o que elas estão falando, como se estivesse to lá e to ouvindo a vida dessas pessoas

P5: As conversas em si, mas tive dificuldade em entender a conexão entre elas. Chamou atenção que as conversas eram desconectadas, mas ele esperava que tivessem conexão, ou ele que não entendeu a conexão. Mas o sensor é legal, gostei

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P6: foram as conversas entre os grupos, saber que não eram só comentários ao calhas mas algo composto, como se fosse algo real

P7: Para além de certas vozes, que estão ligadas aos homens do quadro, acho que foram as diferenças das vozes e alguma anotação e como a entoação cria percepções que eu não tinha do personagem ou muda a maneira como eu olho pro personagem, o homem retratado. Muda ou seja a ideia que eu poderia ter criado de como que aquele homem falaria, se calhar não correspondia ao som que sai ou vice versa

P8: Acho que a linearidade, do jeito que a conversa vai progredindo a cada passo e que é uma subdivisão, separa o quadro em 5 diferentes retângulos e depois uma profundidade que você mesmo vai percorrendo. (Acha a linearidade ruim?) pode ser confuso porque uma hora eu estava em uma linha e queria ir para o lado, e aí seria um pouco confuso

P9: Nao sei

P10: Foi, no início, claro, porque eu não estava à espera de que eu iria ouvir a pessoa, a voz de alguém que parecia estar dentro do quadro, então foi uma experiência meio ok... o que está a acontecer.... E também na parte onde fala o garçom foi ok isso é interessante, porque a princípio achei que eu só iria ouvir a voz de quem estava na mesa, mas acho que também ter a voz do garçom, que não faz parte da conversa, também ajuda a entrar nessa imagem [gestos de retângulo com a mão], isso também foi bem interessante

Usabilidade e Descoberta:

Como é que a instalação funcionava? O que é que os seus movimentos faziam?

P1: Por aproximação, chegando próximos da caixinha tinha que parar para ouvir o que era falado

P2: Meus movimentos davam gatilhos pro inícios de diálogos

P3: No começo eu achei por alguma razão que quanto mais perto estava, se guiou pelo mapa, que pela distância intermediária ela ouviria e veria pela imagem cada um, mas depois que viu os números pensou se seria mais uma história linear ou se é como uma conversa de bar em que todo mundo está falando e é mais o ambiente que a narrativa, mas isso, de acordo com a posição se comunicar. Pergunto: Chegou a conclusão? Olha em alguns momentos achei que sabia, cervejaria museu e coisas assim, mas parecia que tinha algumas pessoas com alguns devaneios no início mas do meio pro fim, não sabe se por ter percebido o sistema melhor, deu pra ver umas 3 pessoas que pareciam mais narrativa com sentido, mas no geral seria mais realmente uma conversa aberta

P4: A cada passo que dava pro lado ela ouvia uma voz, um diálogo diferente

P5: Quando ele andava ele disparava o som relativo ao pedaço do quadro em que ele estava andando, pelo que eu entendi é uma forma de paralelamente olhar o quadro e ouvir o que eles estavam a conversar na mesa

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P6: onde eu me posicionava um áudio começava, portanto tendo 3 pontos na maior parte

P7: Hmm, chegando aos retângulos, passo pra frente, pra tras, direita e assim sucessivamente ou seja direita esquerda frente trás

P8: a instalação são sensores, penso eu, de ultrassom e proximidade e a uma certa distância ele mandava o sinal para tocar o áudio que era o começo de um trecho de conversa entre 3 a 2 personagens

P9: eu aproximava me dos lugares marcados e ouvia uma interpretação do que cada personagem diria na cena de arte

P10: pelo que eu entendi têm vários pontos onde eu podia ouvir a perspectiva ou a voz de uma parte da cena e era o mesmo áudio mas depois eu podia estar mais perto ou mais distante e tem vários pontos, então em cada ponto falava uma pessoa diferente ou retratava uma parte da cena diferente

Foi fácil ou difícil perceber como interagir com a obra? Explique

P1: Fácil, mas ao mesmo tempo como a distância [entre uma caixa e outra] ficou curta teve que prestar atenção para ficar em uma só

P2: Fácil, intuitivo porque como é sensorial ele me presencia e apenas meu andar já basta

P3: Foi fá- entre fácil e difi- não, foi fácil, tinha escrito que era para se aproximar e afastar, mas só percebeu depois que tinham os números, depois para ver os números acabava por ativar uma voz, mas de resto foi claro

P4: Foi fácil, porque o facto do posicionamento das caixas estarem localizadas [visíveis] e o local delas em comparação às pessoas, a posição delas em relação a cada pessoa na obra, deixou mais fácil ter essa percepção de que a voz saindo da caixa é como se fosse a pessoa que tava vendo de frente, então a relação pessoas por caixas ficou mais fácil

P5: Fácil em algum sentido, percebi rápido que disparava áudios diferentes conforme andava, mas senti falta de um feedback não só auditivo, talvez uma luz que acendesse no quadro na área conforme a parte em que eu estou, tipo uma luzinha que acende para indicar onde aquela conversa está, porque o primeiro mencionou um Manuel mas o segundo também mencionou um Manuel, então não sabe se tinham dois ou se eram o mesmo. Difícil perceber o que era o quadro porquê não tinha a explicação do quadro na placa

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P6: muito fácil, extremamente auto explicativo, ao experienciar um consigo entender como o resto funciona

P7: Foi fácil, tirando o facto de não haver uma numeração, ou seja ter de adivinhar se começo de cima para baixo ou de baixo para cima, se há alguma lógica a priori suposta pelo "criador", mas de resto é bem fácil

P8: foi fácil, mas sinto que para mim foi fácil porque já conheço esse jeito de sensores, mas mesmo que não conhecesse acho que seria óbvio que se começa a conversa pelo primeiro passo e depois avança, mas alguem que nao saiba o que é essa caixa poderia achar que o piso é só um padrão do museu

P9: foi bem intuitivo, foi fácil. As cores, a identificação de cada personagem, acho que o facto do sistema estar de fora e visível, os cabos e fios, deu pra ver que era um mecanismo

P10: no início eu tava um pouco perdida, porque achei que ao aproximar ia ouvir coisas diferentes, porque comecei na esquerda distante, e me aproximei e ouvi o mesmo áudio, mas depois percebi que era a mesma voz mas só em posições diferentes, então baseado nisso depois consegui me posicionar onde eu queria ver, portanto qual perspectiva eu queria ver e ouvir o quadro. Na ponta direita eu tava mais perto do quadro, porque também já entendia melhor a dinâmica, e na parte direita tinha mais coisas a acontecer, o senhor com copo, senhores levantados, tentei ficar mais perto para ver melhor. Na parte do meio estava mais distante, que era para ver melhor a cena toda. (Pergunto o que ela quis dizer com mesma voz, se achava que era a mesma pessoa dentro do quadro ou a mesma pessoa que gravou a voz) Pelo que eu entendi é a mesma voz, não é só uma pessoa do quadro a falar, tem várias pessoas

a falar, mas numa perspectiva, então no meio por exemplo o garçom e o senhor com o livro ou jornal aberto, na direita os senhores atrasados, o com a cerveja, mas no áudio pareciam ser a voz da mesma pessoa mas retratando pessoas diferentes

Aprendizagem e Contexto (O que aprendeu?):

Quem eram as pessoas representadas no quadro?

P1: Pintores portugueses, pelas falas

P2: Não lembro, lembro do manuel

P3: Pareciam boêmios, pessoas relevantes para a época, não sabe exatamente, acha que foi mencionado mas não fixou, mas como falaram de museus pareciam artistas, mas é a própria representação da boêmia para ela, mas são artistas importantes da época

P4: Nome não sei, sei que estava escrito na placa. Não peguei bem a profissão, mas entendi que faz algum tipo de arte e outro é cervejeiro ou algo assim

P5: Não sei, vários homens, um Manuel... suponho que eram pensadores ou filósofos ou poetas, alguma galera mais intelectual. Um mencionou professor então suponho algo mais nessa linha

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P6: Homens com um certo caráter ou poder social que estavam envolvidos na arte no século 19

P7: Claramente são aristocratas, pensadores na altura, vou supor que seja século 19, ligados à arte, uma crescente iluminista, pronto altura do século 19 português

P8: Tinham artistas pelo que eu percebi, escritores não? E empregado de mesa

P9: professores de arte, inventores, empregado de mesa de restaurante

P10: Se nao me engano tinha o garçom, tinha o professor, acho que o professor que chegou atrasado, tem um senhor com jornal, que tava sentado, tinha um que tava a falar de algo de Portugal, então acho que são um grupo de pessoas intelectuais, de amigos ou parte de uma sociedade

Conseguiu perceber sobre o que é que elas poderiam estar a falar? (Contexto histórico do quadro)

P1: Acha que talvez a interferência tenha prejudicado mas tavam falando das obras que eles faziam na mesa e o que poderia ser feito se fossem mais visualizados ou algo assim, meio que o quadro retrata o momento de artistas falando sobre arte na mesa, informal

P2: Não deu porque alguns falaram juntos

P3: Sobre arte, sobre um deles estava falando sobre impressão, parecia falar sobre experimentações e qualidade da arte no papel, parte de mim acredita que pode ser quase uma celebração de algo, pode ter

relação com essa coisa de museu. Algo do tipo, talvez poderia ouvir todos e depois ouvir talvez ajudasse a perceber mais ainda

P4: Acho que não todo, mas o pouco acredito que seja o que cada um faz da vida. Esses dois, a cerveja e o outro de arte que ele faz, e lembro que teve um garçom servindo alguma coisa

P5: Parecia conversa de bar mas nao entendi muito a fundo o que era pra ser

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P6: sim, cada um estava a ter a sua conversa, o grupo verde falava dos quadros e representacao de Figueiró e Lisboa, bordalo pinheiro a falar sobre a representação política, achei piada nos comentários dos empregados e como os comentários são respondidos pelos personagens

P7: Sim, éeeh arte portuguesa, uma nova, a criação da arte portuguesa moderna entre aspas, que com o século 19 vem a modernidade e pronto são esses grupos sentados a mesa a falar de museus e expectativas que têm suas e pra arte, e de certa forma também enaltecerem-se, é discussão mas também é muito mais uma explanação do individual

P8: percebi que eram conversas casuais, eu pessoalmente me distrai um pouco tentando entender como o sistema funcionava, culpa minha, mas eram conversas sobre o ambiente em que estavam lá

P9: duma possível invenção nova

P10: pela fala e forma que falavam uns com os outros, e também logo ao ver o quadro, a roupa que estavam a usar e isso tudo, já sei que não é do tempo de hoje, agora em termos de contexto ou do que tavam a falar sei lá, acho que era tipo talvez algo relacionado a política, penso que algo ligado a política, tinha o professor, o senhor com jornal, o senhor a falar de portugal e do estado do país, essas coisas todas

Descobriu alguma coisa nova sobre ou nesta pintura ou sobre aquela época que não soubesse antes?

P1: Acha que tudo, não tinha conhecimento da época e olhando o quadro sem as falas não entenderia o que se passava

P2: Não

P3: Sobre a época acho que essa questão das experimentações enfim o que mostra justamente a questão da arte não vir pronta e ter que experimentar, alguma coisa de jornal mas nao lembra, nao sei, no máximo da época que jamais ouviria 14 homens falando de arte num bar bebendo [hoje]

P4: Não, acho que nao tive essa atenção

P5: Não sei se as pessoas estavam falando com uma voz diferente mas achei que as vozes estavam diferentes do que eu imaginava, porque se eu só visse e imaginasse na minha cabeça a conversa seria diferente, o assunto, o sotaque, as falas, tudo contribuiu para ambientação

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P6: Sim, mesmo sendo das caldas da rainha não sabia tanto da posição política ou possível necessidade que bordalo pinheiro teria, não sabia que os pintores do verde frequentava Figueiró e Lisboa, que alguns eram mais extrovertidos que outros, fez me querer procurar mais artigos e coisas que tenham criado

P7: Sim, mas não me lembro o que exatamente, acho que uma posição histórica nova

P8: não

P9: não

P10: Não

Experiência e Emoção (O que sentiu?):

Em que é que esta experiência de dar a ouvir e a ver um quadro foi diferente do comum? (ex: ler um texto ao lado do quadro)

P1: Mudou completamente por ter a experiência viva do quadro e poder ver o que se passava, mas fica na pergunta de será que quem pintou gostaria de ter essa explicação? A visão de quem estava pintando versus quem quer perceber o que está acontecendo, porque chegar no museu e só ter uma placa pequena com o nome nao da essa informação

P2: Pela imersão, normalmente o quadro é unidimensional e agora se sente na pintura

P3: Acho que cada um ter uma voz ajuda muito a vê-los como indivíduos que existiram, e não como personagens de um quadro, e essa parte da audição pelo menos permitiu ficar bem imersa na cena em si e acho que esse movimento de me aproximar e me afastar também me lembra muito quando eu to falando com alguém e quero ouvir melhor eu me aproximo e me afasto parece uma comunicação realmente com o quadro, esse sentido da audição e do movimento do corpo que é menos estático que ler um texto

P4: Achei bem mais fácil, mais fluido porque eu consigo escutar e olhar ao mesmo tempo o quadro, então fica mais fácil acompanhar as palavras sendo ditas e olhar pro quadro e ter essa sensação de que a obra tá transmitindo melhor do que ler um texto que fica ao lado

P5: Achei complementar, não substitui o texto, senti falta de ter uma contextualização básica antes e se eu tivesse interesse imergir mais nos áudios, me levou a um lugar diferente com certeza do que se eu só tivesse visto o quadro sozinho

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P6: acho que ganhei muito mais informação, normalmente vejo um quadro e ponho minha própria interpretação, dessa vez consegui uma exploração muito mais aprofundada. (Pergunto se ele acha que o projeto tirou então espaço à interpretação própria) Não, acho que acrescentou, normalmente teria lido a placa que acompanha o nome e tido uma certa noção de quem são, mas ao interagir desta maneira consegui saber quem eram, o que faziam, que personalidades tinham, foi muito mais aprofundado

P7: A questão dos personagens do quadro ganharem vida, o quadro ganha vida entre aspas, e por ser também o contexto associado de diálogo que já de si eles estão a olhar para nós, então sim de certa

forma ganha vida ganha alguns traços de conexão com o quadro diferentes dos que possivelmente teria se visse sem o som. Ou seja se fosse também só o som a sair sem nenhum controle meu perante ao som teria visto o quadro e minhas sensações teriam sido totalmente diferentes de eu ter visto o quadro e ter controlado, ter tido controle sobre minha experiência do quadro

P8: Imagina, é comum muitas vezes quando se está num museu brincar com os amigos sobre o que é que as pessoas estão a dizer no quadro, e isso é a materialização disso, é algo engraçado, da vida ao que está lá, mas isso é algo que pode deixar pouco à imaginação. Isso dá informações, responde muito sobre o que se passa no quadro, mas pode tirar um pouco espaço para pensar sobre o que se passa lá

P9: traz um contexto, uma explicação de forma diferente sem ser alguém a explicar, sem ser uma explicação direta me dada

P10: acho que foi mais imersiva, eu acho, parecia que eu fui transportada para o cenário e eu que estava presente no momento em que a pintura foi feita. É diferente porque nos outros museus tu tas só a ver, nao ta dentro do quadro, é um espectador, mas nessa experiência audiovisual é transportada para dentro do mundo do quadro

Houve algum momento em que se sentiu mais ligado à obra ou às personagens? Pode descrevê-lo?

P1: Não, não teve nenhum momento uau, talvez por ela ser mulher e no quadro serem apenas homens

P2: Do início ao fim, por ser uma experiência tão diferente

P3: Tiveram 2 momentos não sei explicar porque mas quando o garçom chega com a comida e fala para falar mais baixo e quando a outra pessoa quer brindar pura e simplesmente porque coloca o quadro dentro de uma cena cotidiana, o facto de ter um garçom chegando com a comida e pedindo pra falar mais baixo situa como algo que realmente aconteceu e acontece

P4: Não

P5: Sim e não, me liguei mais ligado as vozes, o sotaque me ajudou a ambientar, mas nenhum deles me chamou atenção e a storyline não me cativou 100%

_____

P6: sim, especialmente com esse quadro é um quadro que gosto bastante, quando vou ao MNAC paro e olho, então já conhecia, mas dessa vez me senti muito mais apegado, consegui entender as relações e os espaços

P7: Sim, pronto a questão da voz do senhor [funcionário] e também claro a minha voz estar em um também me senti mais conectado a um deles, seria estranho se não

P8: a última conversa, dos roxos, eu tive mais interesse porque eu vi os personagens e vi que lá tinha um funcionário, e queria ouvir o que ele tinha a comentar sobre os intelectuais que tinha a frente dele

P9: ao tentar perceber qual era a personagem mais importante

P10: Acho que quando entra o professor e diz me desculpa que cheguei atrasado por causa dos alunos, mas nao sei

A camada de som ajudou-o a ver ou sentir a pintura de forma diferente? (Como?)

P1: Ficou curiosa de saber quem tava falando, ela ouviu diferentes vozes, imagina que seja alguém da parte em que ela estava, mas ficou sem saber quem tava falando o que

P2: Sim, acho que me senti dentro da obra, como se estivesse em outra época

P3: Sim, me colocar no tempo histórico e no contexto específico em que aconteceu e como falei dar voz a vários indivíduos diferentes e vê-los como pessoa e nao tinta

P4: Sim, fez com que eu entendesse a pintura de uma forma mais prática e mais fluida, quando você não tem a parte auditiva, e também sem a escrita, pode ter várias interpretações de uma obra, e nesse caso nao tira o facto de ter múltiplas interpretações para obra mas dá contexto do som para quem são aquelas pessoas do quadro

P5: Com certeza, parecia que eu estava junto com eles andando pela mesa e conforme ia passando ouvia conversas distintas. Acho que a transição foi meio abrupta, não sei se é porque o segundo não funcionou, talvez ao invés de interromper o papo mas só baixasse o volume faria mais sentido porque assim ele estaria a passar e ouvir a conversa mais alto mas ainda baixinho no fundo

_____

P6: sim, definitivamente. Acho que a pintura em si já é extremamente estilizada por representar o ambiente e sensações mas dessa vez me senti envolvido, como se eu também estivesse na cervejaria

P7: sim, foi pronto não é, foi por um lado a criação de uma nova conexão forma de ver o quadro, ou seja sair do imaginário a voz dos personagens, o que eles poderiam estar a falar, para algo real uma quase materialização do quadro e do ambiente de festa ou o que for que o quadro situa se em algo real, eu poderia estar na mesma sala através das caixinhas de som

P8: Sim, aquilo de resolver uma cena de imaginação que é, imagina, realmente amplifica a tridimensionalidade do quadro, isso de dar um passo a frente para ouvir o que a pessoa atrás da outra está a dizer, é algo que dá profundidade à obra. E as conversas, é uma conversa nova, não é algo da sua cabeça, e isso é interessante

P9: Não.

P10: Sim, acho que também a questão das vozes que foram usadas que, nao sei como, mas pareciam casar com os rostos que eu tava a ver, com as pessoas retratadas, e também a forma de falar que também parecia ser a pessoa que eu tava a olhar no quadro então acho que isto foi interessante, porque penso que se fosse por exemplo ainda uma experiência com áudio, se fosse a tua voz ou a voz de um dos meus colegas não teria o mesmo impacto

Crítica e Conclusão:

O que é que mudaria ou melhoraria neste projeto?

P1: A distância entre as caixas e talvez alguma sinalização de como deve percorrer ou se é pra ser aberto mesmo. Se tivesse alguma forma de visualizar, uma luz acender na cara de quem tá falando podia ser legal pra conectar o som e o visual

P2: Os sensores para serem melhor, talvez mais espaçados , e talvez mais diálogos

P3: Acho que o mapa, ficar mais visível para mesmo que a primeira experiência seja aleatória como a pessoa quiser, se a pessoa quiser repetir em ordem linear, se ele estiver mais visível ficaria mais fácil de guiar porque é difícil memorizar quando vão ser 3 vozes ou 2

P4: Não sei se são questões técnicas mas o primeiro tava com o áudio muito baixo, nao consegui ouvir, e às vezes quando entre duas caixas as duas emitem som ao mesmo tempo, e aí fica difícil acompanhar as duas ao mesmo tempo

P5: Acho que o que falei, luzes que acendem conforme passo para ver onde acende, e a posição da placa, deixar no meio da obra para poder ver de todos os lados melhor o nome deles

_____

P6: Acho que valia a pena ter algo que as pessoas pudessem agarrar, tipo uma folha de sala, algo que não fosse só a placa na parede, eu por exemplo tirei fotografia a placa para poder acompanhar sem ir e voltar. Nao lembro se tinham sons de cervejaria por trás, mas se não tivesse acrescentaria isso para acrescentar ao ambiente, copos a bater etc

P7: nada

P8: aquilo que disse, talvez se a pessoa começar pela ordem errada, a conversa pode começar pela primeira ou segunda, não sei se é possível, mas ainda assim outros prompts em que a conversa possa fluir do primeiro pro segundo mas do segundo pro primeiro, fica mais seguro

P9: talvez identificar as personagens e as cores, a ordem dos áudios, por exemplo no roxo o mais atrás é primeiro, segundo etc

P10: Pra começar a questão do som, no início uma das razões a qual eu me aproximei mais é que eu nao tava a ouvir bem, e também achei que seria interessante se ao aproximar tivesse uma voz diferente quando tá mesmo mais mais perto, porque também a tua perspectiva não é a mesma do quadro de quando tá mais perto e mais longe, então também talvez ter a mesma experiência de quando tá mais pros lados a voz muda, pra frente também seria interessante [nota: aqui ela achou que foi a mesma pessoa que gravou todas as 3 vozes de cada zona, mas não foram]

O que é que achou mais confuso ou frustrante na experiência?

P1: A interferência (duas caixas tocarem ao mesmo tempo)

P2: A interferência (duas caixas tocarem ao mesmo tempo)

P3: Não enxergar o mapa porque às vezes ela olhava para ver e às vezes conseguia entender mais pela voz do que pelo visual

P4: A interferência (duas caixas tocarem ao mesmo tempo)

P5: Entender a ordem dos áudios, estava com dificuldade, e às vezes ocupar dois sensores ao mesmo tempo atrapalhava, talvez uma marcação no chão ajudaria para saber onde posicionar. Sutil, só pra saber pra onde seguir, porque fiquei confuso de não saber quando o áudio terminava 100% ou não, porque às vezes terminava e outro começava mas não sei se era um fim ou repetição do outro. Talvez um feedback sonoro, um plim plim só pra marcar o fim [nota do autor: um terminava e outro começava ele se refere a questão de, por vezes, o corpo dele começar a ser lido pelo sensor ao lado após um leve movimento e ele acaba se movendo e interrompendo o som original)

P6: nada, foi muito auto explicativo

P7: Para além de umas poucas falhas, ou seja às vezes a coluna mesmo se fosse pro retângulo não saía som e eu precisava ajustar minha posição, mas tirando isso nada

P8: não achei nada confuso, a única cena que seria um pouco frustrante seria não deixar um pouco a imaginação sobre o que está a ser dito. E também a linearidade pode ser algo ruim em algumas personagens que estão em conversas mas estão a olhar pra outros cantos, então pode ser um pouco contra intuitivo a pessoa conversar com quem está atrás em um quadro que se comunica também de modo transversal

P9: perceber a ordem das falas

P10: acho que o áudio, não sei se foi pela porta aberta, mas quando tava desse lado estava mais ruidoso então tava mais difícil de entender as palavras que estavam a ser ditas. Depois também uma falha técnica, tinha vezes que eu tava no mesmo sítio mas o áudio parava voltava cortava, mas acho que no geral foi suave

Se esta instalação estivesse no museu, recomendá-la-ia?

P1: Sim

P2: Sim

P3: Com certeza

P4: Sim

P5: Com certeza

P6: Sim, completamente, adoro ir a museus e acho também que é uma maneira de trazer pessoas a museus, não só iria eu mas levaria também amigos

P7: sim

P8: Não recomendaria mas comentaria, iria ao museu, veria, acharia interessante, engraçado, e diria a amigos e familiares olha tem essa coisa que achei engraçada, deu graça ao que costuma ser paredes brancas e quadros

P9: com certeza, porque é uma nova experiência que eu nunca tinha nem pensado em algo assim

P10: Super, porque acho que é uma forma diferente e interessante de experienciar as obras, porque também muitas vezes ir a museus ou galerias tem muito essa questão de ok, já vi, já sei como é, então vamos pro próximo. Não tem muitas vezes em que as pessoas realmente param para tentar entender, tentar entrar dentro do mundo e perceber da obra, então essa questão do áudio e ter essas vozes em vários momentos acho que ajuda a ter esse momento de pausa, de reflexão, de tentar entender realmente observar e entender o que a obra está a tentar transmitir ao oposto de só ver a obra de uma forma muito superficial

Algum comentário, crítica, sugestão adicional?

P1: Gostei bastante da ideia, acho que isso também é uma forma de atrair também um público mais, digamos, leigo, se sinta mais incluído porque facilita a pessoa a se conectar com a obra

P2: —

P3: —

P4: —

P5: —

_____

P6: A experiência foi bem feita mesmo que um não tenha funcionado, consegui perceber como funciona e gostei do código de cores, ajuda a perceber quais personagens são

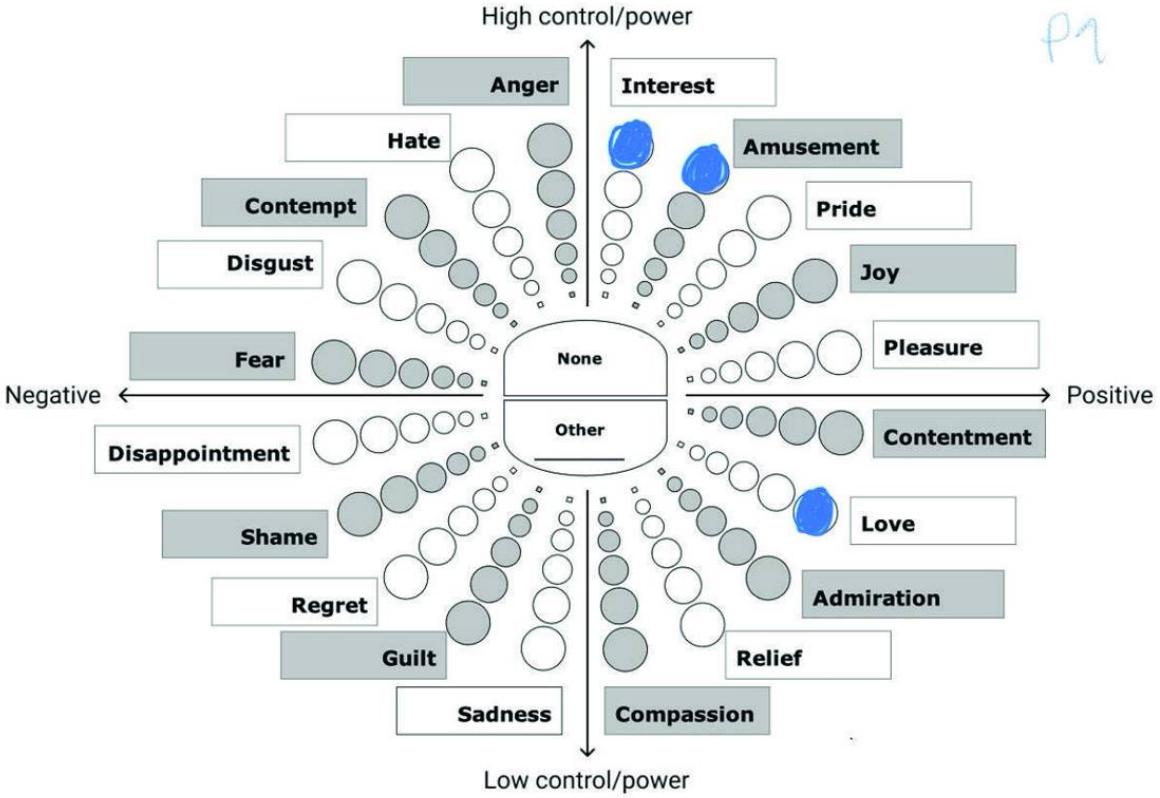
P7: —

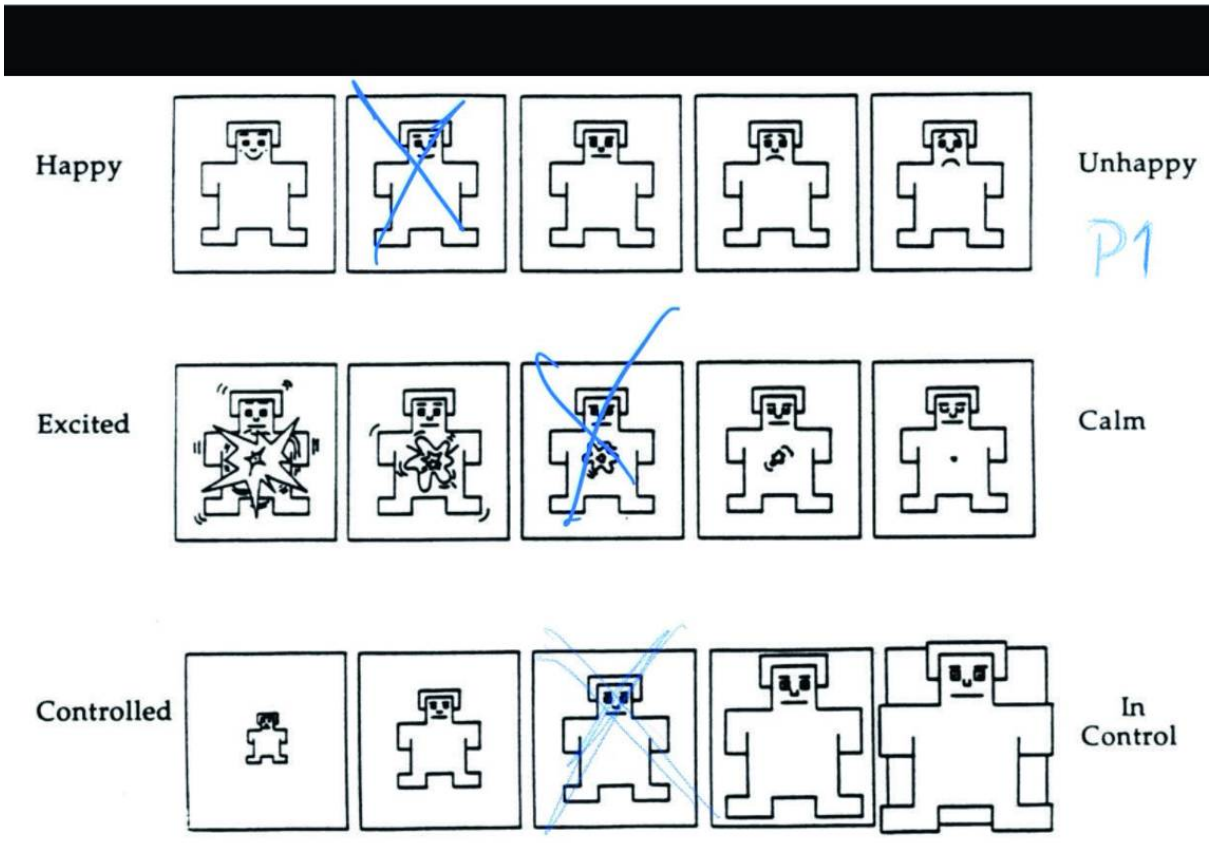
P8: —

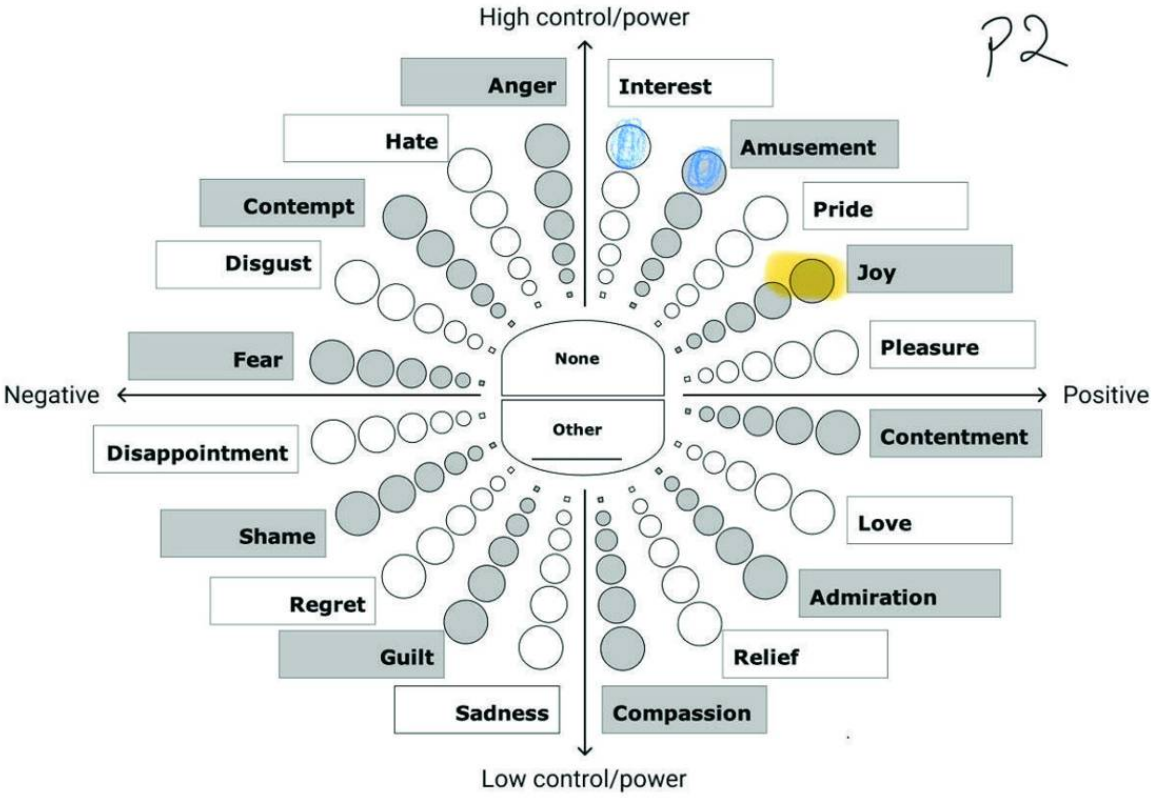
P9: —

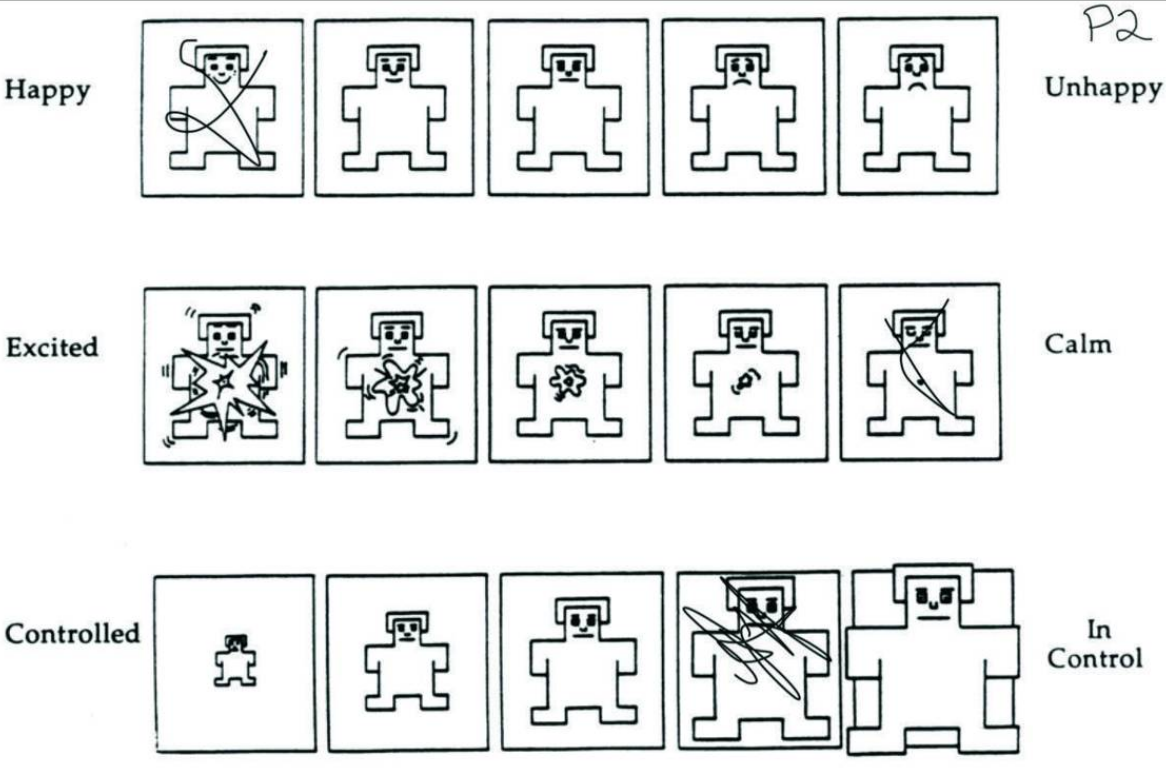
P10: Achei a experiência muito interessante, acho que seria super interessante ver como isso funcionaria em um quadro em que o tema é de raiva, medo, angústia, ou de felicidade assim euforia, acho que é super interessante e gostaria de ver com outras obras como é que seria transportado

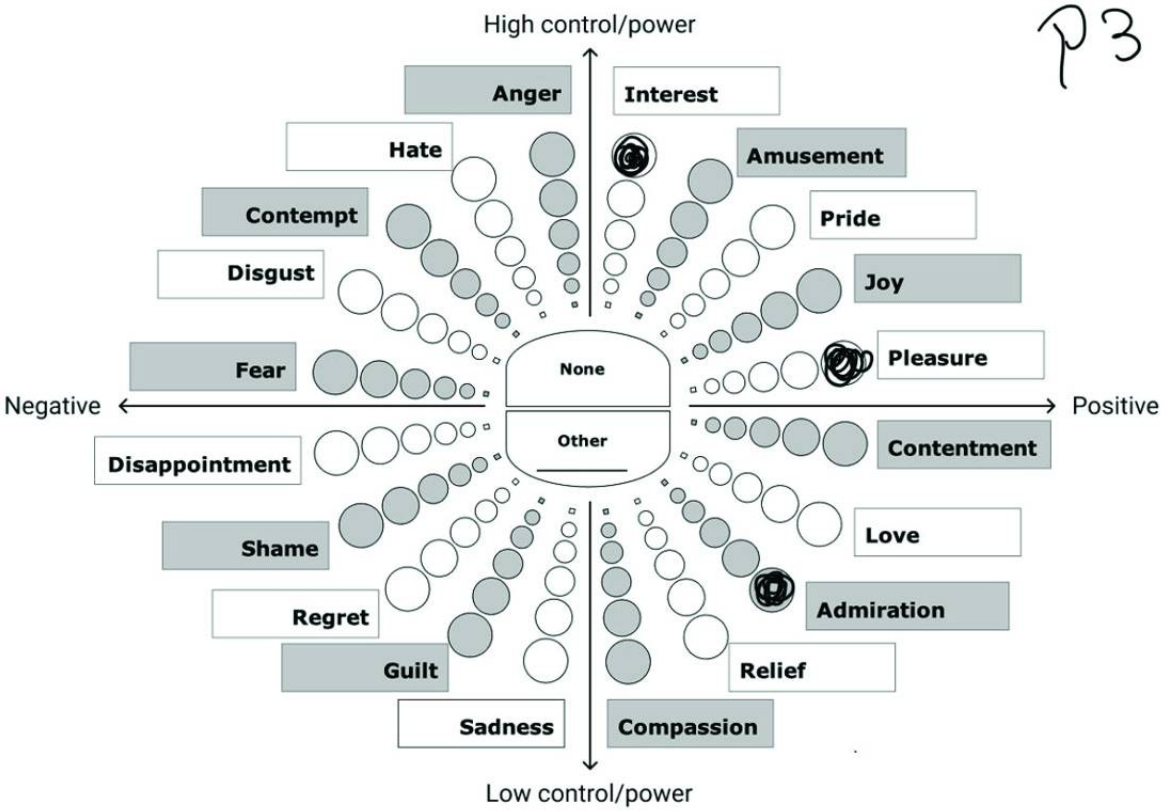
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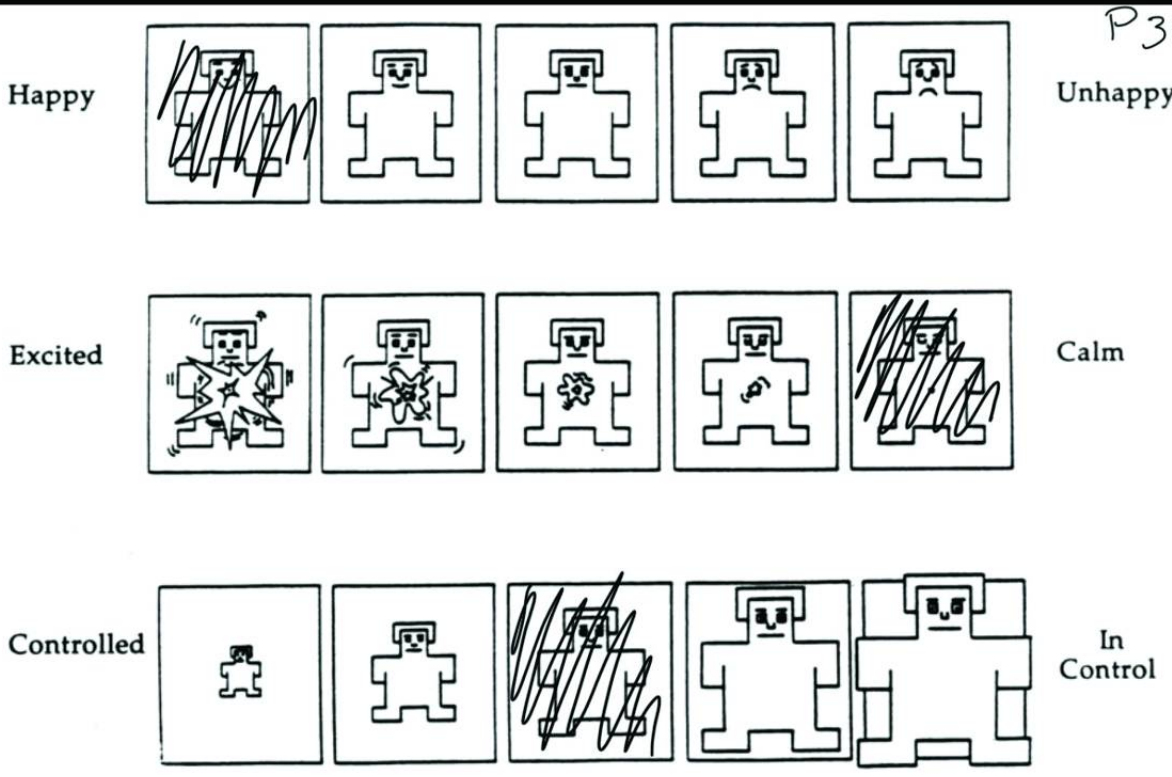




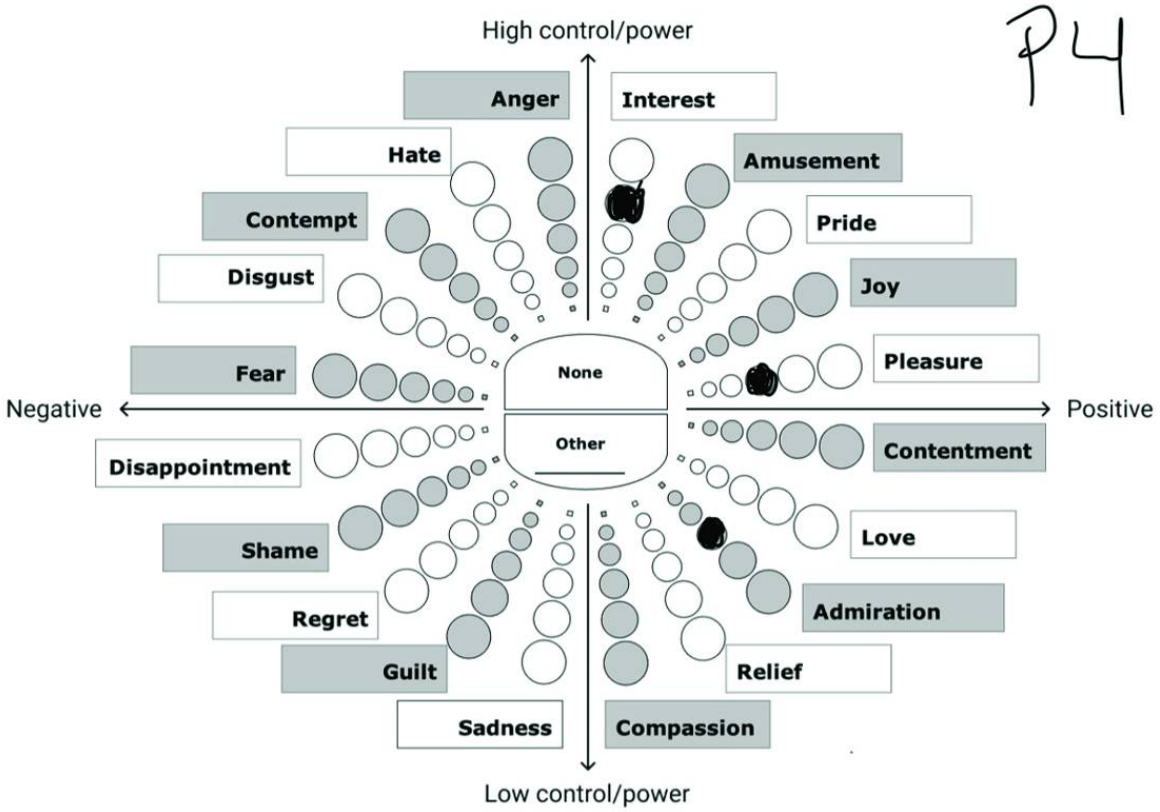

P2
High control/power
Anger
Interest
Hate
Amusement
Contempt
Pride
Disgust
Joy
Fear
None
Pleasure
Negative
Positive
Other
Disappointment
Contentment
Shame
Love
Regret
Admiration
Guilt
Relief
Sadness
Compassion
Low control/power

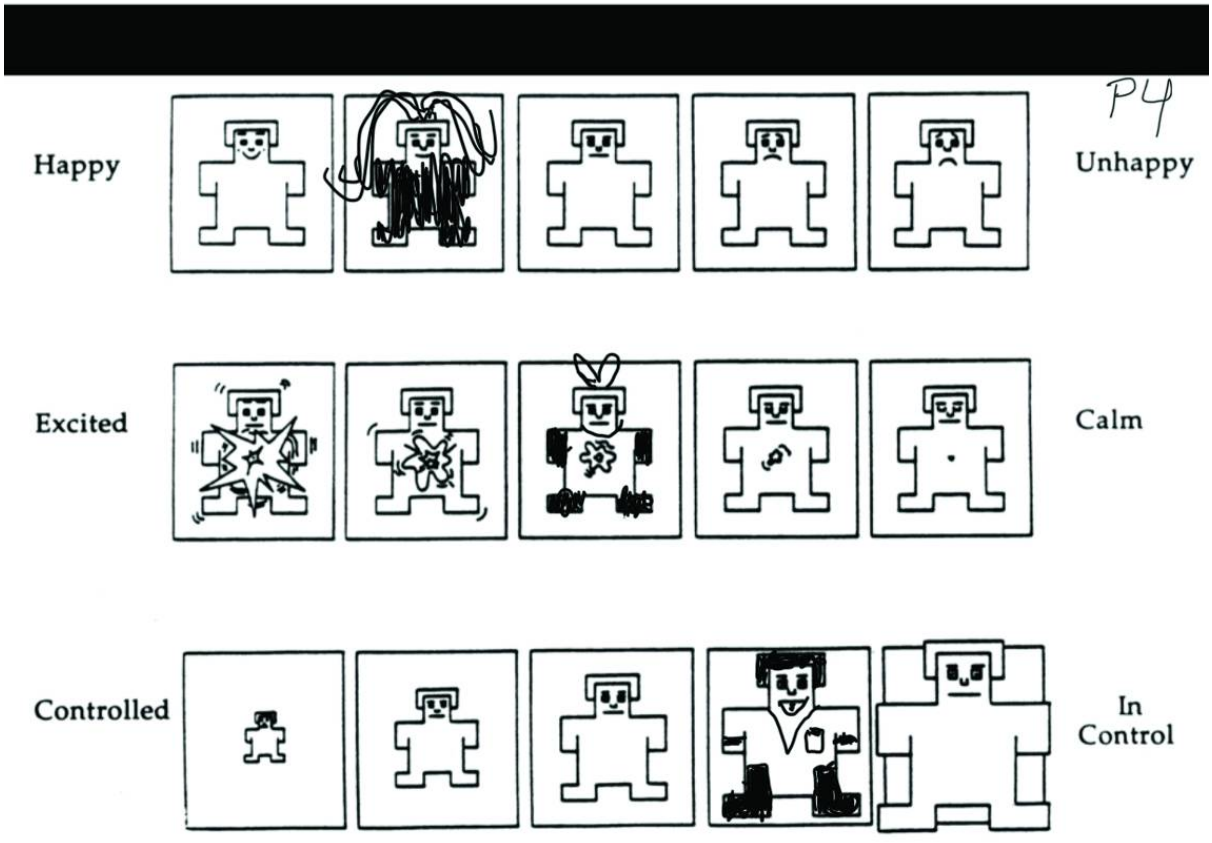

P2
Happy
Unhappy
Excited
Calm
Controlled
In Control


P3
High control/power
Anger
Interest
Hate
Amusement
Contempt
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Disgust
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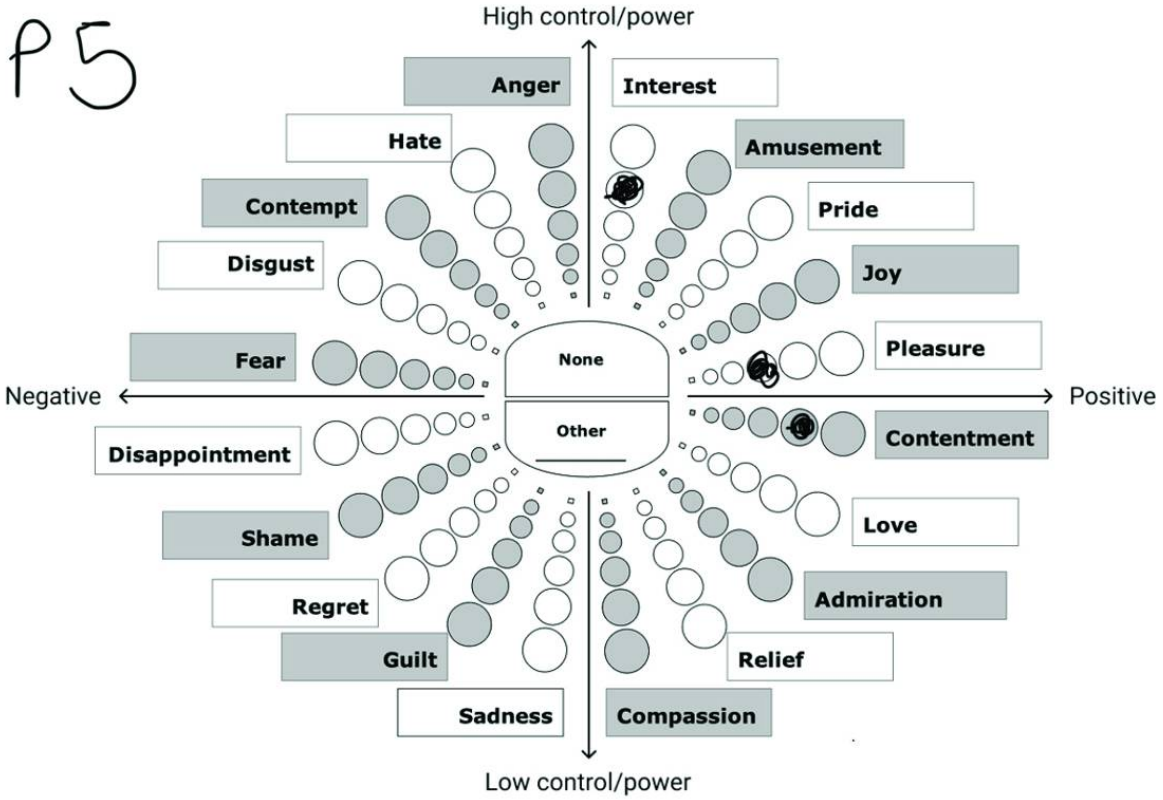

P3
Happy
Unhappy
Excited
Calm
Controlled
In Control

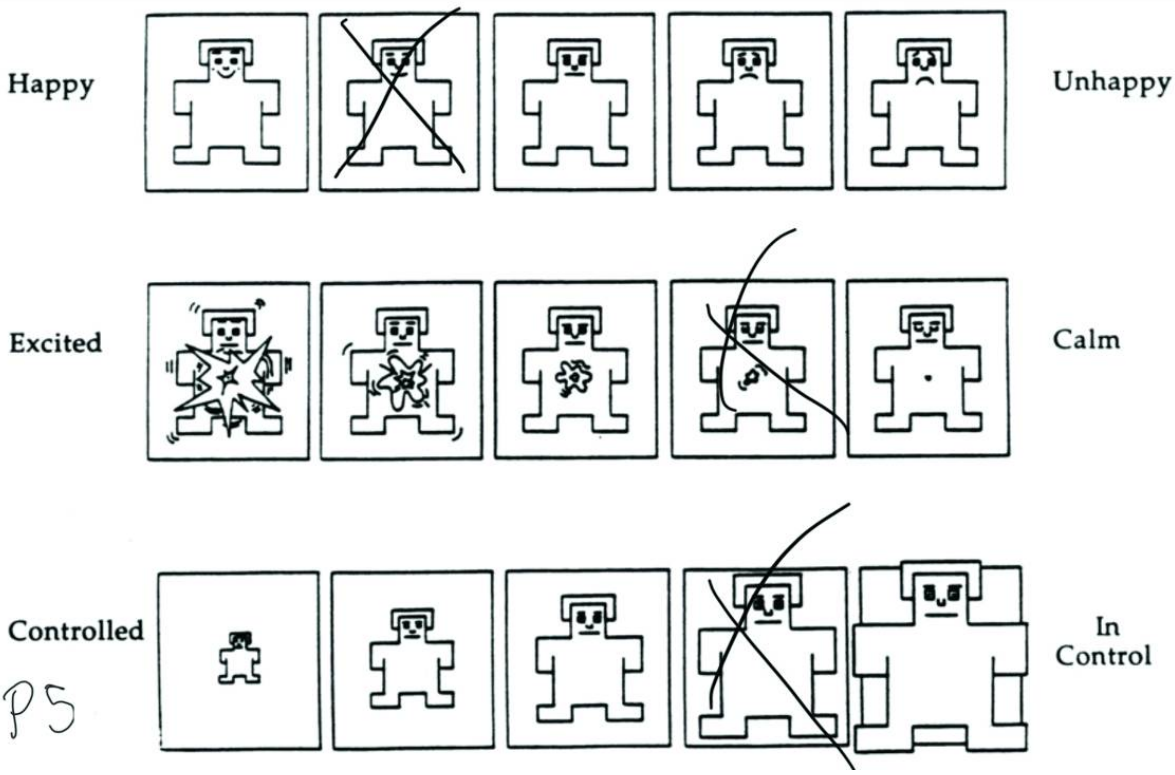
P4


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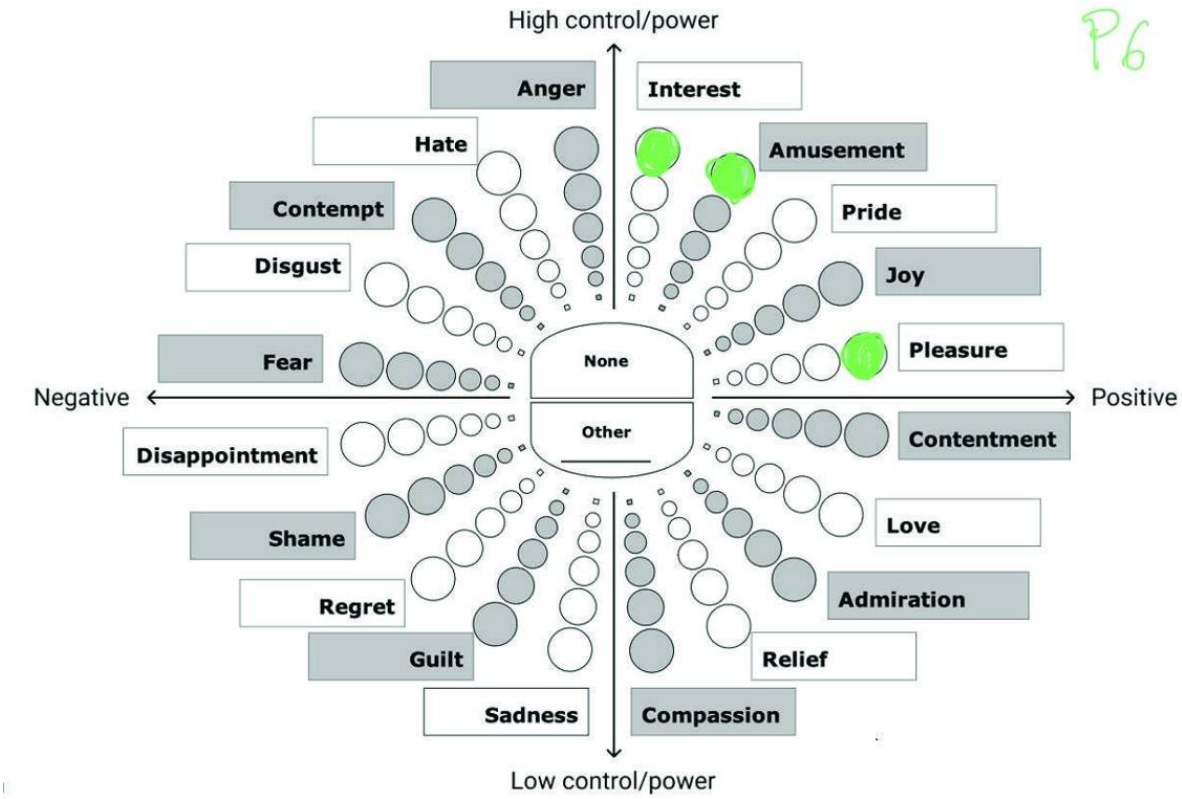

P4
Happy
Unhappy
Excited
Calm
Controlled
In Control

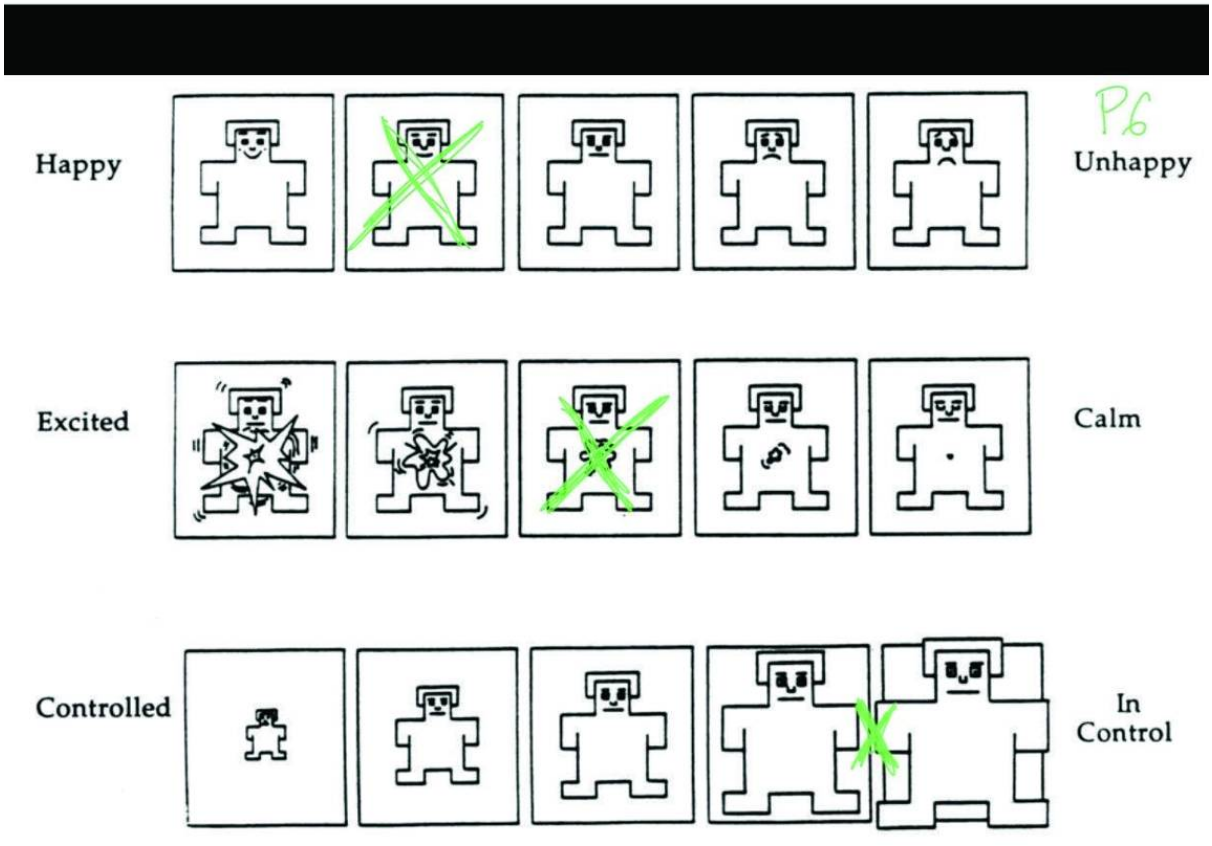
P5

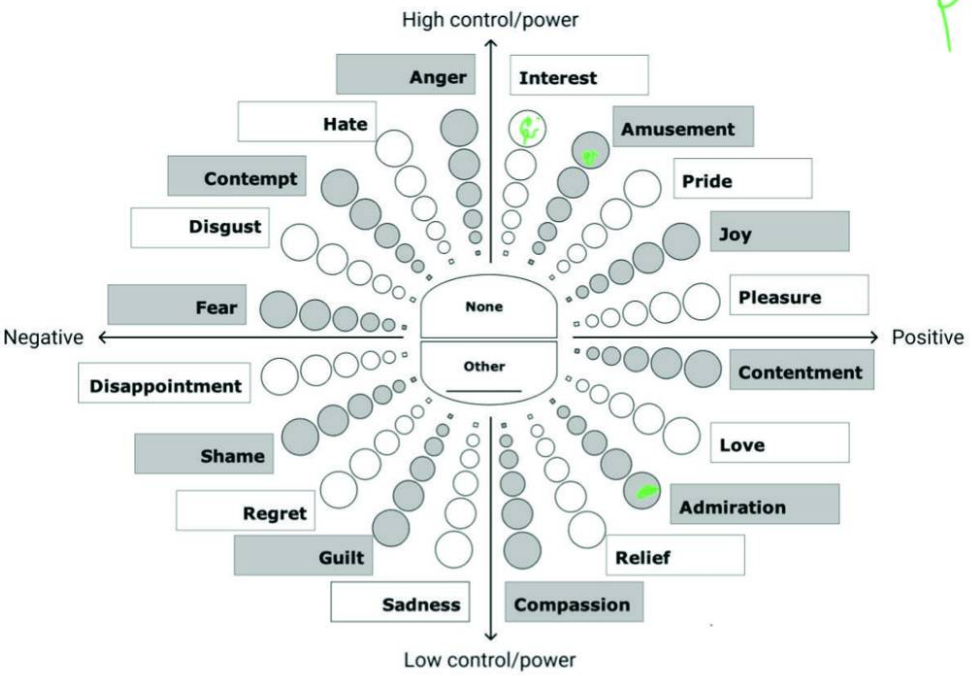

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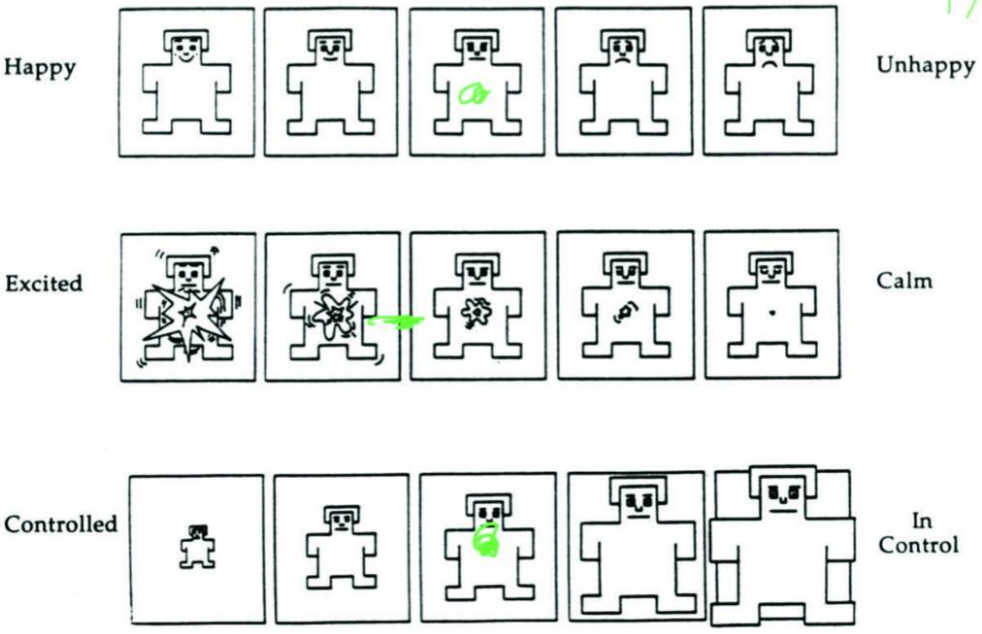

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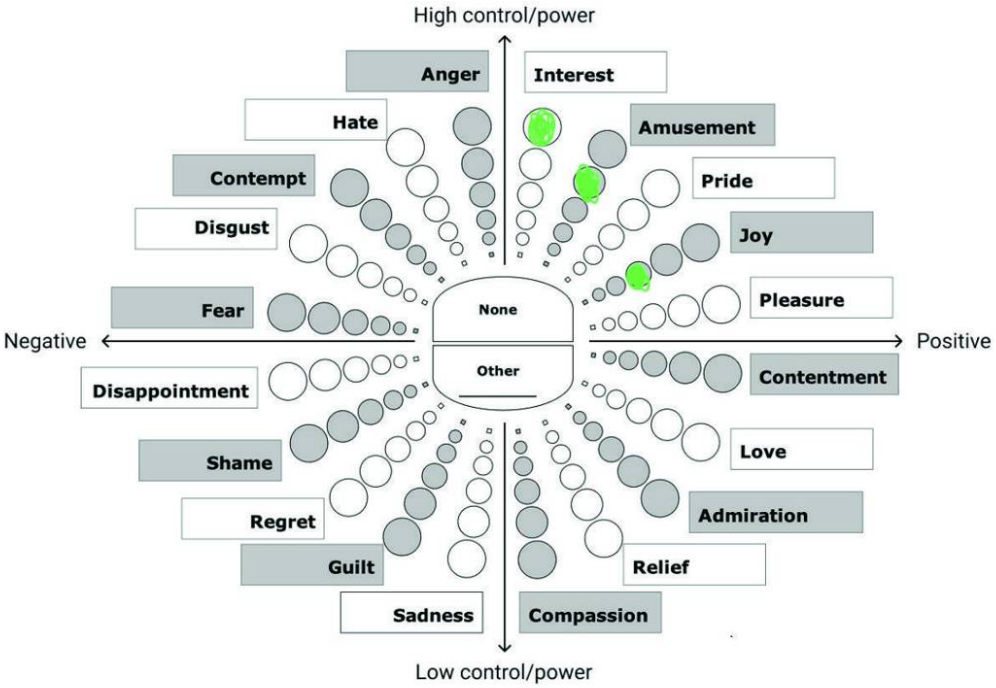
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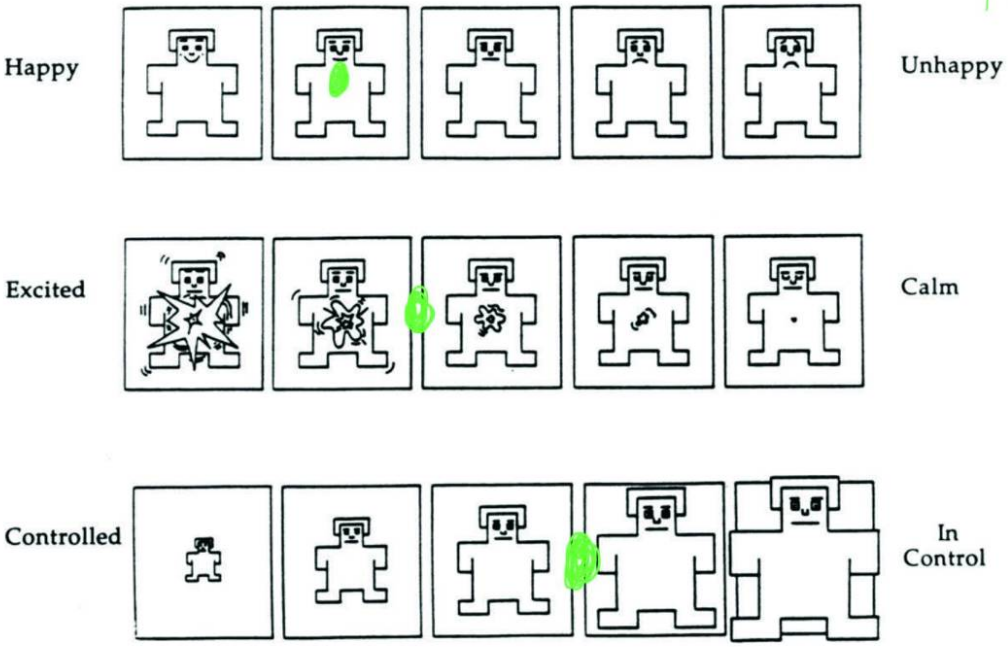

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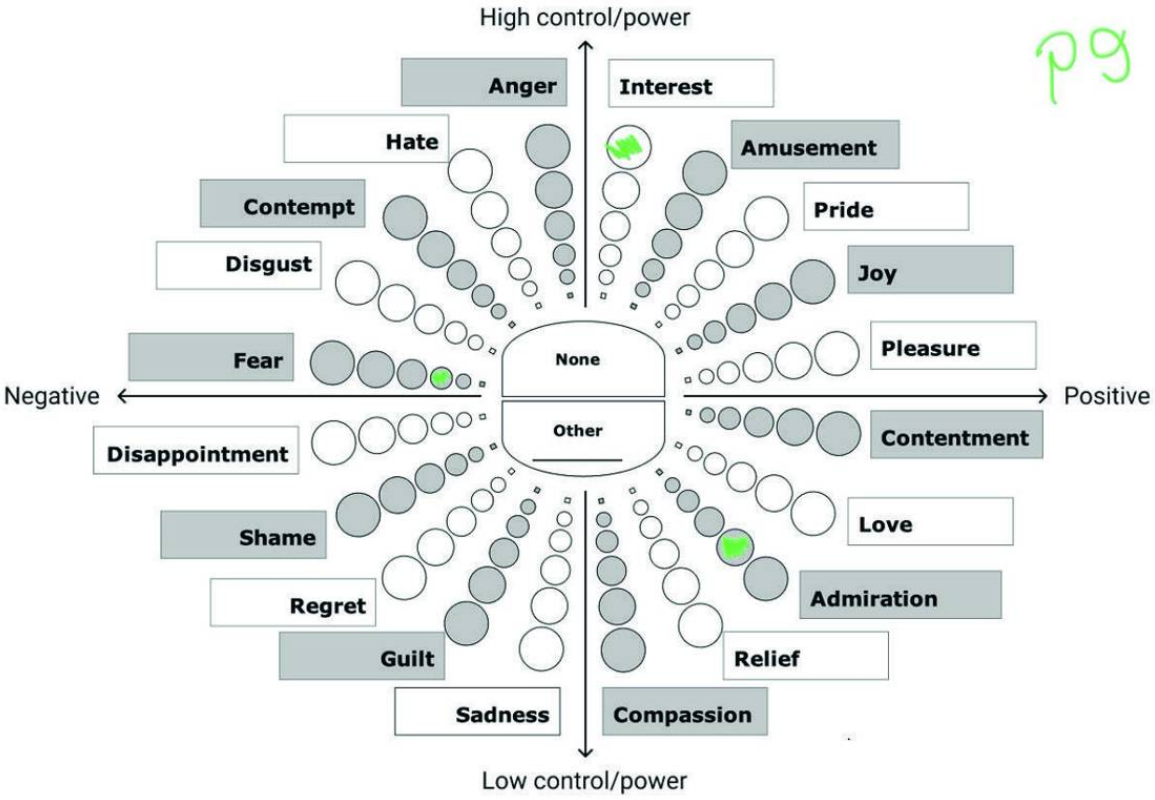

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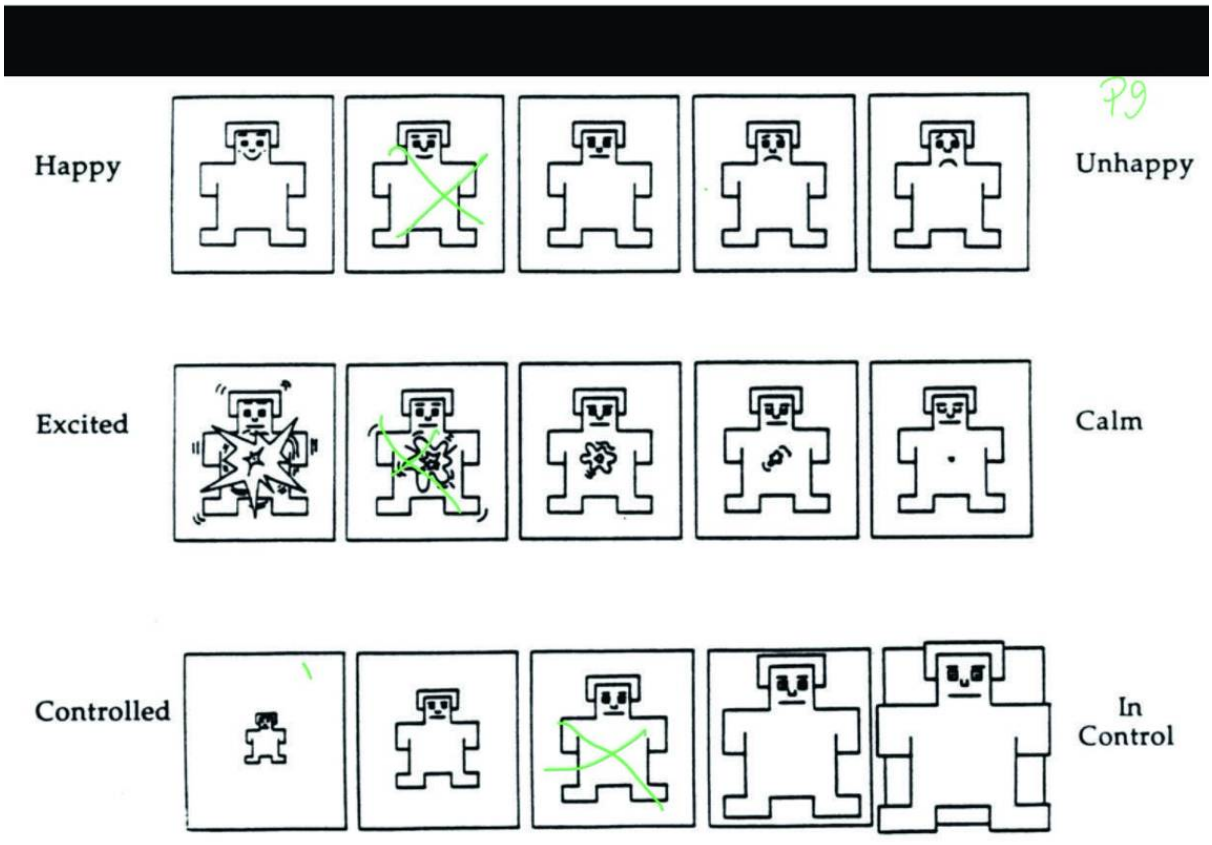

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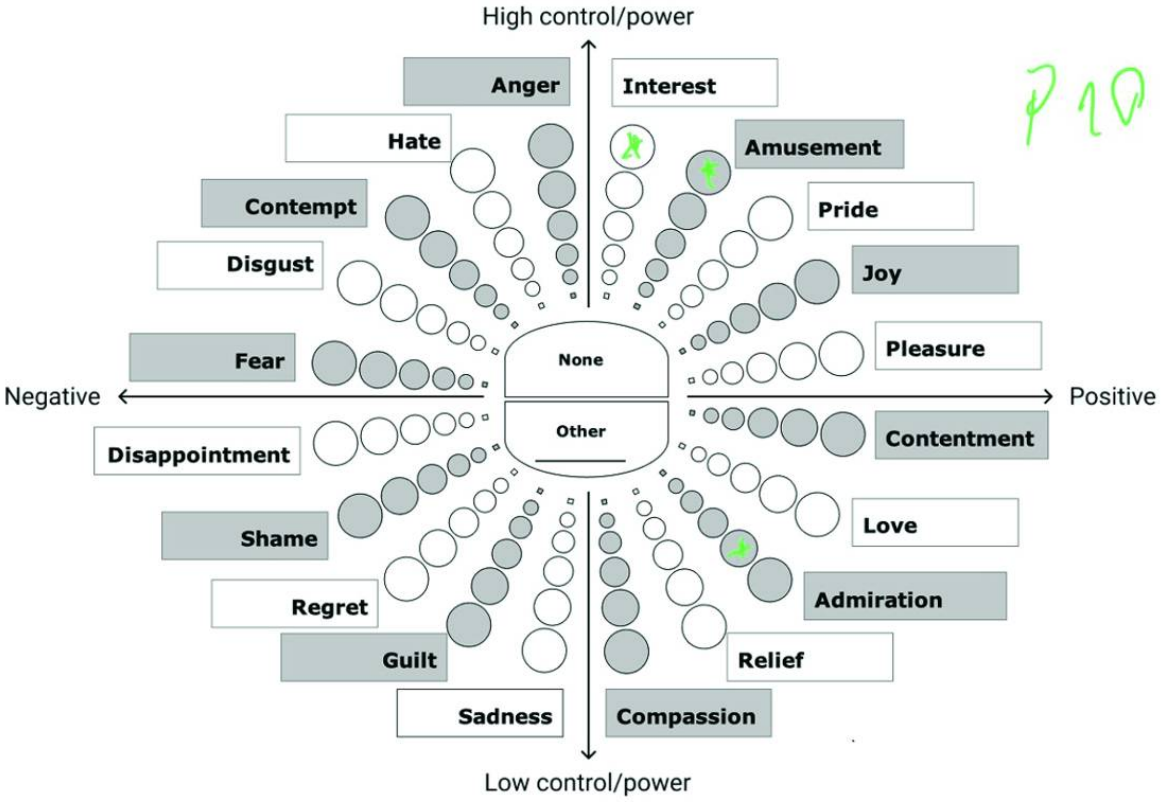

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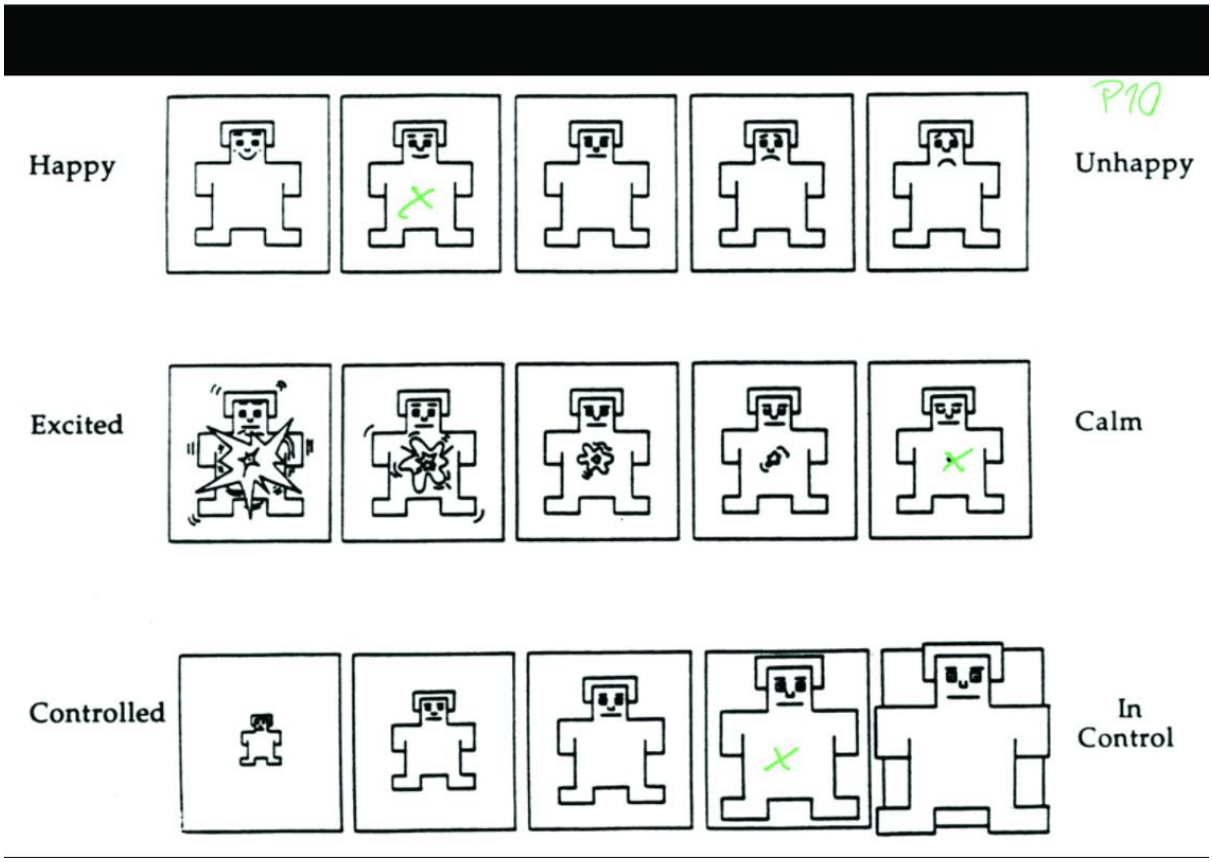

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