Measuring Presence in a Virtual Environment of the Aalborg University Multisensory Experience Laboratory

An experimentative prototype of a New Aalborg University VR Hub

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Abstract:

This report will document the process of designing, implementing and evaluating a Virtual Reality environment of the Multisensory Experience Laboratory at Aalborg University Copenhagen, through measuring presence and noting immersive tendencies in participants. The project also acts as a prototype Hub for future VR experiences at Aalborg University, coined under the AAUverse umbrella.

Firstly, the thesis introduces the reasoning behind creating a collective VR hub, based on XR demand increase & with current AAU app solutions being confusing for students at Aalborg. The thesis then describes and analyses necessary concepts such as XR, Virtual Reality, Virtual Environments, the concept of immersion, and presence. The thesis then covers the design reasoning, methodology and framework for designing the digital twin as well as the initial iterations of the AAUverse Hub UI.

The implementation covers scripts, the engine and other factors necessary to implement and get the hub and virtual environment running in VR. The thesis then describes the evaluative methodology used for the initial usability test of the prototype and the final presence test, as well as the test procedure for both tests. The findings of the evaluations are then covered, where it was found that the cumulative system usability score before iterative changes amounted to **67.5**. Indicating a system okay for use, but in need of certain improvements. The system was then iterated upon by feedback provided by participants of the initial usability test, with a background in relevant technical studies at AAU engaged in UI and UX design. The prototype was then decisively tested for presence, to measure if the digital twin gave participants an amount of presence within the virtual environment. The null hypothesis unfortunately could not be rejected, both due to a small test sample and current results indicating a too low presence reported by test participants of the primary presence test.

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1 Introduction

Ever since the initial research on stereoscopy in the 1800s paved the way for future technology, such as the conception and creation of the first Head-Mounted Display by the Harvard professor Ivan Sutherland in the late 1960s [10], the foundation for technological advancement within the umbrella that Extended Reality [XR] encompasses has slowly and steadily been making headway to being incorporated into contemporary technological solutions. The inclusion and facilitation of XR as a medium increased especially after the beginning of the 21st century [19]. XR has steadily created a role for itself in concurrent human-computer interaction, as well as pushed the boundaries & possibilities of interface-design [29]. This is statistically evident, as 66% of UK organizations use Virtual Reality [VR] [19] and worldwide business-to-consumer revenue from VR Headset sale has grown, roughly tripling from 3.4 billion USD to 9.9 billion USD from 2020 to 2024 [24].

The increase in availability and development within the field of XR technology, has caused an increase in applications, solutions, and experiences tailored for XR and VR. Belonging under a vast umbrella of use cases, this is seen in software developed for public institutions, corporate contexts, and for private consumers, which speaks to the acknowledgment that various mediums of XR are becoming more mainstream. The XR mediums being used in a vast numbers of ways, whether this be VR tour-guiding [6], facilitating learning & disabilities [12], digitalised corporate onboarding [26], artistically, or for gaming, each facilitating their own purpose. Notably the UMverse, the inspiration for this thesis [31].

Aalborg University, as a leading university within engineering and technology [5] [28], has a definitive role in fostering an environment where students both experience and participate in the creation of such solutions, along with receiving guidance and aid from supervisors and professors to research new technology and reach new breakthroughs through innovation. This task as a beacon of science and tech, is visible in a lot of cases - such as Aalborg University having various technological facilities and laboratories. In some cases, the university is lacking in digitalised tech-driven solutions already found in other universities, such XR experiences accommodating and engaging students. Roughly 18.000 danish students and 2700 combined international and exchange students walk the halls of Aalborg University in Aalborg, Esbjerg and Copenhagen [1] [2]. Studies show that new university students, along with international students, experience depression and anxiety in various forms when starting at a new place or moving abroad to a different country to study [8] [25]. Universities have various available information and student guidance when it comes to welcoming students, as does Aalborg University, but when navigating campus and socializing, students rely heavily on applications such as AAU Map [3] and AAU Student [4] both of which are daunting and confusing and dont provide an immersive experience in getting students familiarized with their new campus. AAU Map and AAU Student are especially daunting for students who missed out on the opportunity to get familiarized with campus physically or make friends during Aalborg University's yearly Open House. This master thesis therefore strives to create a foundation and hub for more XR-driven solutions, in an attempt to make Aalborg University's campus more inviting and make a version of campus able to be virtually experienced, initially starting with Aalborg University Copenhagen & in collaboration with the Multisensory Experience Lab.

1.1 IRQ | Initial Research Question

Thus defining how this master thesis wishes to create a more XR-centered prototype and foundation for students at AAU, an initial less fleshed out research question can be asked:

How can an VR application help students get familiarized with and provide an experience of the Copenhagen Aalborg University campus?

2 Analysis

Seeing as the UMverse [31], a VR based incentive to foster community and research at University of Miami, is a predominant inspiration for this thesis, the thesis will start off with Extended Reality as a foundation for the analysis, building upon its core concept to further explore the technological requirements and base of XR, branching out to explore the related psychological terms such as immersion and presence, and their impact on the virtual environments found in XR and cyberpsychological research and how it shapes the final research question of the thesis.

2.1 XR | Extended Reality

Extended reality **[XR]**, exists as an umbrella term for immersive technologies, covering over three technological classifications of systems and applications: Augmented Reality [AR], Mixed Reality [MR], and Virtual Reality [VR]. All of them classify certain blends of reality with virtual environments on the immersion spectrum. The immersion spectrum is visualised in **Figure 1**, showing where the three technological categories lie on the spectrum [34].

Each of the categories usually requires varying hardware to fulfill their degree of immersion, with AR applications typically running on the phone, while VR typically uses Head-mounted Displays, or on rare occasions enveloping users in physical CAVE systems [34].

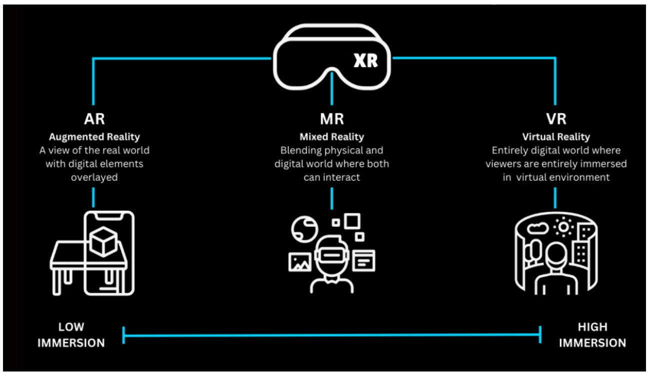


Figure 1: XR Umbrella [Source].

The history of XR is incredibly interesting and rich in technological advancement, this thesis however, will not be covering the historical advancements outside the introductory statement from the previous section, but a compelling overview of historical XR advancements can be found HERE to garner a better understanding.

2.1.1 Hardware Components

XR requires certain hardware capable of acting as a mediator between the person and system, while designed with the degree of immersion of the certain classification in mind.

VR almost always uses Head-Mounted Displays, such as the Meta Quest 2, whether capable of being standalone or tethered to a computer for improved fidelity. These headsets are capable of enveloping your vision fully, by blocking out real surroundings through a tight headset, and using stereoscopy to provide a sense of environments being 3D [34].

In AR cases phones are typically used, as it is widespread personal tech with cameras and necessary processing capability for required AR capabilities [34]. A light transportable technology, with most phones including the necessary sensors and cameras to perform tracking.

For the purpose of this thesis, due to the coordination with the Multisensory Experience Lab at AAU CPH, VR will be a primary focus due to it being the primary technology for research projects at ME Lab. The ME Lab also has Meta Quest 2 Headsets available for students to develop on.

2.2 VR | Virtual Reality

Virtual Reality [VR], being the most immersive of the technological classifications, is defined as a broad term for the mediation of reality with fully immersive technology. This can include video, or other content, and does not in all cases equate to the user interacting with a Virtual Environment, as defined in **section 2.2.1**, which involves agents or environments that change based on user input [7].

Figure 2: A Meta Quest 2 Head-Mounted Display, also commonly referred to as headsets.

As previously stated, VR is typically facilitated through VR headsets or Head-Mounted Displays [HMD], of which the ones typically used by the MELab are Meta Quest 2s as seen in **figure 2**. These headsets take over the users sight, using stereoscopy to create depth and a feeling of dimension, and block out the real environment around a person.

2.2.1 Virtual Environments

Virtual Environments, or VEs, when compared to VR, have varying definitions surrounding them. Early definitions, such as the definition given by SR Ellis in 2002, also incorporate the display facet defining it as "Head-referenced computer displays that give users the illusion of displacement to another location." [9]. The terminology of VR, AR and Cyberspace were linked or melted together, while newer definitions separate the various concepts more and provide more concentrated definitions. In 2011, Blasovich argues that Virtual Environments should be a term reserved for systems relying on high-fidelity tracking and displays to facilitate a simulated perception and interaction with an artificial environment while Virtual Reality would be described as any sort of mediated reality [7]. These definitions make the display less of a focus and merely a facilitator and mediator for Virtual Environments while being the primary factor of Virtual Reality. Blasovich's definition has become more common and accepted, as XR has found more footing in research and academia, hence why it will be used as the definition for Virtual Environments in this thesis.

This would align with using a Meta Quest 2 as a mediative technology for displaying the VE, and indicates the requirement of high-fidelity tracking, and a means of interacting with an artificial environment.

2.3 Immersion

XR classifies various technology and systems on an immersion scale, but what exactly does immersion entail and cover as a term?

Immersion, as explored and defined in academia, exists as a vast intricate network of theories and definitions. Some more related, intertwined or explored than others. Various academics, when looking outside of what in this thesis will be described as virtual immersion, or immersion related to virtuality, explore and relate immersion to activities or tasks, and even storytelling and narrative transportation.

Authors	A property of the system	A perceptual response	A response to narratives	A response to challenges
Slater (2003)	**System immersion:** A property of the technology mediating the experience. The higher the fidelity of displays and tracking, the greater the level of immersion.			
Witmer & Singer (1998)		**Immersion:** A feeling of being enveloped by, included in, & interacting with the virtual environment.		
Arsenault (2005)		**Sensory immersion:** A sensation of being enveloped by the multisensory representation of the virtual world delivered via high-fidelity displays.	**Fictional immersion:** The sensation of being mentally absorbed by fictional stories, worlds or characters.	**Systemic immersion:** The mental absorption experienced when facing challenges that match one's capabilities, including the challenges involved when exposed to nonparticipatory media.
McMahan (2003)		**Perceptual immersion:** The sensation of being surrounded by the virtual environment that increases proportionally with the number of modalities provided with artificial stimuli.	**Psychological immersion (immersion on a diegetic level):** The mental absorption experienced during exposure to the world of a game's story.	**Engagement (immersion on a nondiegetic level):** The state of focused attention on the game brought about by the desire for gaining points and/or devising a winning or spectacular strategy.
Adams & Rollings (2006)			**Narrative immersion:** A state of intense and focused attention on the story world & the unfolding events and acceptance of these as real.	**Strategic and tactical immersion:** A state of intense preoccupation with observation, calculation, & planning or with swift responses to obstacles.
Ermi & Mäyrä (2005)		**Sensory immersion:** The feeling of being surrounded by the multisensory representation of virtual worlds delivered through large screens and powerful sounds.	**Imaginative immersion:** The sensation of being mentally absorbed by a game's story, its world, or its characters.	**Challenge-based immersion:** The mental absorption experienced when facing challenges requiring mental or motor skills.
Ryan (2003 & 2008)			**Narrative immersion:** A state of intense focus on a narrative; can be divided into 3 subcategories: immersion (elicited by a strong sense of place and the joy of exploration), temporal immersion (caused by a desire to know what will happen next), and emotional immersion (brought about by emotional attachment to characters).	**Ludic immersion:** A state of intense absorption in the task currently being performed.

Figure 3: Presented Definitions of Immersion [18].

Figure 3 provides an overview of the more widespread definitions of immersion in relation to various subsections, as presented by various academics. These four general classifications and the overview created by Nilsson et al [18] separate theories into immersion being a property of the system, akin to immersion being a relevant spectrum of XR and the technology behind, as a perceptual response from an individual, a response to a narrative or as a response to tasks and challenges.

This thesis will have a focus on definitions of immersion as described by Slater, Witmer & Singer, and Arsenault. This is due to both Slater's and Witmer & Singer's work with immersion and presence within virtual environments and in relation technology, and their academic work of proposing various methods of testing presence and immersion. These definitions all mention a few key aspects, that will be a focal point of the design of the VR experience:

- High fidelity of displays & Tracking.
- Envelopment, inclusion & interaction with the virtual environment.
- Envelopment of a multi-sensory representation of a virtual world through high-fidelity displays.

2.4 Presence

Immersion is often times times correlated to the concept of presence, a term derived from the coined term of "telepresence" by professor Minsky at MIT in the 80s [17]. Telepresence itself is defined as the manipulation of real-world items through remote-access technology, but Presence in relation to technology started branching away in 1992, as Sheridan released an exploratory paper with three proposed determinants of presence in an attempt to create a more clear-cut definition of the subjective sensation felt during telepresence [20]. The three determinants brought up by Sheridan were:

- Extent of sensory information.
- Control of relation of sensors to environment.
- Ability to modify physical environment.

These determinants, and the initial definition provided by Sheridan, laid the foundation for later definitions such as Slater, Usoh and Steed's definition published in 1994 [23], and Lombard & Ditton's definition from 1997 [15].

Slater, Usoh & Steed expand upon presence, by defining it as: "The sense of being in a virtual environment rather than in the place in which the participant's body is actually located." [23] Lombard and Ditton, as opposed to Slater, Usoh and Steed's strictly virtual definition, presented six conceptualizations of presence, relating it to social richness, a sense of virtual environment realism, a sense of transportation with someone else "present and shared space, a sense of the user being a social actor with a sense of interactivity & control, a sense of the medium as a social actor, and finally as a sense of immersion through the senses or the mind. These definitions are also what cause a parallel between immersion and presence, but while presence is much more subjective and sensory, immersion relates more to fidelity of the system and technology itself.

This subjective feeling in virtual environments is what this thesis will strive to measure, in an attempt to transport users of the AAUverse into a virtual environment while they receive the experience of being at an actual location rather than it seeming like a virtual environment.

2.4.1 Place Illusion and Plausibility Illusion

In Slater, Usoh and Steed's conceptualization of presence, Slater later expanded upon their definition, publishing a paper introducing Place Illusion [PI] & Plausibility Illusion [PsI] as contributing factors to presence in virtual environments [22].

PI, refers strictly to the strong illusion of "being there", with no external factors such as knowledge or experience. While PsI related to the plausibility of the illusion of realism that the virtual environment or experience present. Do the environment or happenings seem real? Are they plausible, or do dragons, and impossible high-tech factor into the experience of the user, defying reality? These are defined as important facets of presence, and the immersive experience [22].

Seeing as the focus of the thesis will be the MELab, which is a plausible and realistic setting and scenario, the focus will be achieving a high enough fidelity for the intial prototype of AAUverse and its first location, for users to achieve the illusion of being physically at the lab.

2.5 SOTA | State Of The Art

2.5.1 University Of Miami | UMVerse

The UMVerse, an XR initiative founded in 2018 by the Virtual Experiences Simulation Lab (VESL) at University of Miami, and the inspiration for this thesis, has a focus on integrating cutting-edge immersive technologies into MiamiU's curriculum and research [30].

The XR initiative led to the first class being held entirely in VR in 2020, with immersive content integrated into 40 courses by 2024. The UMVerse covering over student projects, XR courses such as Architecture, Art History, Interactive Media and various other courses, and Faculty Training [31]. The widespread usage of XR and integration of the UMverse being an impressive effort.

The current UMVerse applications vary between mobile and hololens AR and standalone HDM VR, but due to the future nature of the project being available to students off-site *while* retaining a sense of immersion using the most immersive XR technology, it would make sense to focus the thesis on VR as it is also the standard for MELab projects.

2.5.2 MIT Center For Advanced Virtuality

MITs Center for Advanced Virtuality is another great example of XR and VR incentives at Universities & in educational settings, facilitating the creation of student projects related to various studies the students wish to perform ranging from museum experience to xenophobia studies in immersive VR settings [16].

2.6 Target Group

As introduced in **Section 1**, and further discussed in **Section 2.5.1**, there is a clear focus on students and Aalborg University as a campus. Therefore, it is essential to target students from AAU, and more specifically those from AAU CPH due to the physical nature of testing the VR prototype.

It is also vital that participants have not been to or worked at the Multi-sensory Experience Lab, as it could potentially bias or impact their experience based on previous familiarity.
Testing will therefore require a prerequisite of participants being active AAU students, capable of being physically present for testing, and having never been to MELab before.

2.7 Hypotheses

Research into the field of XR, and all related facets, such as VR, Virtual Environments, Immersion and Presence, as well as a dive into UMverse and MITs Center for Advanced Virtuality, have all been presented and pave the way for the final research question to be defined and hyptheses.

2.7.1 FRQ | Final Research Question

With this, we can further define the research question, to a finalized version:

How can a VR application, including a virtual environment representative of the Multisensory Experience Lab at AAU CPH, help students get familiarized with campus and provide them an experience of being physically present at the real lab when in the virtual variant?

2.8 H0 & H1

As the final research question has been defined, we can present two hypotheses to state whether or not the VR experience and virtual environment provide users a sense of presence when they try the virtual variant of the Multisensory Experience Lab.

H0: The user experiences too slight, or no sense of presence in the virtual environment replica of MELab.

H1: The user experiences a large sense of presence in the virtual environment replica of MELab.

3 Design

The design of the AAUverse hub, and the virtual environment replica of the Multisensory Experience Lab, went through two iterations, based on feedback provided in the initial usability test as mentioned in **section 5.1**

3.1 Initial Design

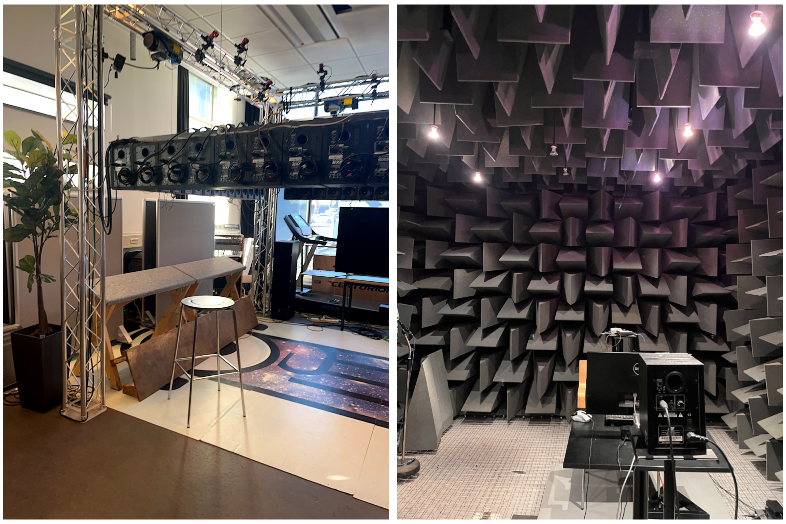
The initial design of the UX, or user experience, takes inspiration from Hillman's Object-Oriented UX framework and methodology towards design for XR [11]. Hillman's OOUX approach relies on a framework of four steps:

- **Object Discovery:** Identification of core components within the XR environment.
- **Object Definition:** Establishing behaviours and attributes to core components.
- **Relationship Establishment:** Establishing relationships for inter-object interaction.
- **Object Prioritization:** Determining hierachy and importance for each object to the UX.

3.1.1 OOUX

One of the first steps to the OOUX framework, is the identification of core components in the environment. The most important components in the Multisensory Experience Lab for visiting students, researchers and outsiders, are definitively the Razvan 360 sound installation for spatialized sound, and the Tinitus soundproof room.

Both of these play an important role in the MELab, as mediators of experiences and parts of semester projects, and are shown in **figure 4**, so the categorization of them core components of the environment within the VE is not unwarranted.



(a) The 'Razvan' installation. *(b) The 'Tinitus' soundproof room.*

Figure 4: The core components of the MELab.

The design of the behaviour and attributes of the two installations, if attempting to recreate the two in the VE, can be seen in **figure 5**. Due to the installations being stationary in nature, they do not interact, have any agency, or have any relation to each other which would need to be accommodated in the UX and VE. But there is a lot of nearby clutter, that is interactable in the MELab, that would require extensive collision design for the UX and meticulous 3D modelling, texturing and more to be realized in the virtual environment. With this in mind, the two installations and larger furniture are prioritized before any smaller details and any clutter.

Razvan	Tinitus
- 360 spatialized sound experience (Certain sound/audio such as flies flying around.) - Surrounded by speakers.	- Room covered in sound-proof foam - Completely silent/quiet.

Figure 5: The behaviours and attributes of the core components.

3.1.2 Initial UI Design

The initial UI design for the AAUverse hub, can also be seen in **figure 6**. The focus of the first UI iteration, was for it to be simple, with quick access to the first virtual environment for testers to evaluate MELab. Any UI was design with the AAU design guide in mind, using the AAU font and colours.

This included a small guide, or walkthrough, to system controls and how to use the controllers to interact with the environment. These controls were designed with the standardized controls usually used in VR in mind, as users with more VR experience would have an easier time interacting with the prototype.

Figure 6: Initial AAUverse Hub UI.

3.2 Second Iteration

The second iteration of both UX design and the hub UI, was rooted in the feedback given by testers in the initial usability test. The feedback results are displayed in **section 6.1.1**, but to reiterate the main points of the feedback collected, users had issues with the initial doors, unclear interactibles, as well as grabbable UI areas.

3.2.1 OOUX

The doors of the initial prototype were too sensitive, and opened too abruptly, impacting user experience. Therefore the sensitivity should be adjusted in the second iteration of the prototype. As for unclear interactibles, a key focus is exploring visual effects to draw attention to them either by outlining, surrounding them in a glow or using particle effects [27]. Therefore exploring a non-invasive outline surrounding doors and the core components might shift the focus of users towards interactable elements in the virtual environment.

3.2.2 Second Iteration UI

The UI of the second iteration, received a redesign to further categorize and allow for expansion of UI elements, should the AAUverse receive new experiences or projects in the future.

Figure 7: Expanded UI of the Second Iteration.

4 Implementation

The implementation of the AAUverse prototype, along with its first visitable location of MELab, were made using the Unity game engine, with a combination of other tools to support development such as Polycam and Blender, and technology such as 360 cameras for images that could be converted to HDRIs within Unity.

4.1 PolyCam

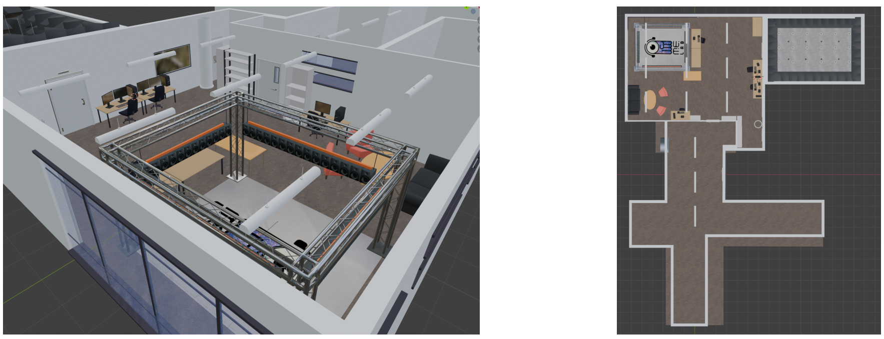
In an attempt to create a 3D scan of the MELab, with an acceptable fidelity, the initial step was to use photogrammetry or gaussian splatting to convert 2D images to an accurate-size 3D variant of the lab. An application that allows for this is PolyCam, a mobile app that is capable of doing both. The initial photogrammetric scan of MELab, is shown in **figure 8**.

Figure 8: The 3D scan of MELab.

The photogrammetric scan of the lab was unfortunately much too low of a fidelity, and incohesive, muddled and lacked proper geometry and texturing to perform well to provide a realistic experience with gaussian splatting not working on the application at all due to an inability to properly grab the room from needed angles in photos.

4.2 Blender

The failed approach of attempting low-fidelity photogrammetry, in turn led the thesis to the solution of 3D modelling the MELab instead. For this, the free open-source 3D modelling software called Blender was used to accurately model the lab, based on quick measurements of the real lab.



(a) The primary MELab Room. *(b) A floorplan overview of MELab.*

Figure 9: The 3D modelled MELab.

The 3D model can be seen in **figure 9** within the Blender platform. The 3D model included the core components, tinitus and razvan, and more esssential decor such as lights, keycard readers, doors, and bigger furniture such as tables, the MELab sofa, storage shelves, and computers found at the lab used for work. These models were then uv-unwrapped, textured based on real-life images of the items, and exported to FBXes that could be imported to Unity without technical issues.

4.3 Unity

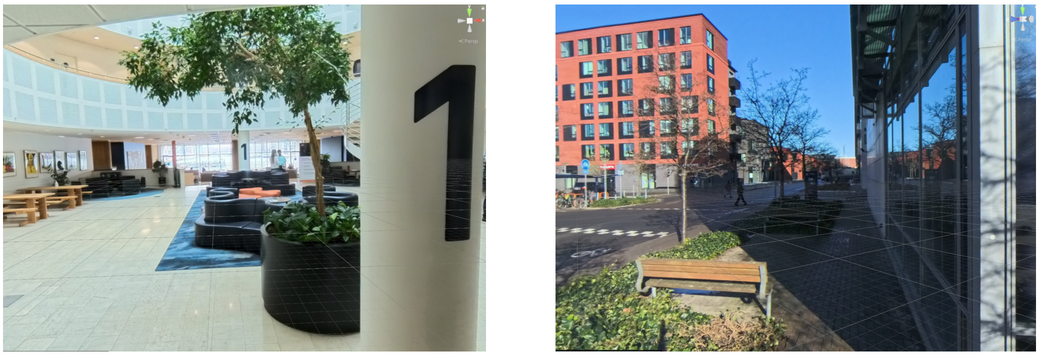
The Game Engine used for the thesis project has been mentioned previously, but the AAUVerse prototype was built using the Unity Game Engine, a free game engine based on C# scripting incorporating various functionality such as scenes, 2D and 3D sprites and models, as well as shaders, physics and particle systems. The platform is incredible versatile and capable of building applications for both desktop, ios, android, VR and more.

4.3.1 Unity VR Plugins and Packages

Unity has a variety of packages, also known as plugins, that expand upon functionality and development in the engine. The thesis project uses version **3.0.8** of the Unity XR Interaction Toolkit, and version **74.0.0** of the Meta XR Audio SDK to support VR development and spatialized sound in 3D environments. The interaction toolkit is meant for 3D and UI interaction for VR and AR, and provides the framework that the project uses to recognize controllers and hands that allows users to use the controller to actually engage with the environment and UI.

4.3.2 360 Camera

In an attempt to achieve a high fidelity, the two scenes included in the prototype used HDRIs taken using an Insta360 X4. The Insta360 X4, made by Aranshi Vision, is a small compact and waterproof camera capable of grabbing 360° images that can be later be converted to HDRIs and used as Skyboxes within the Unity Game Engine.



(a) A snippet of the Hub skybox in Unity, taken at the CPH Reception.

(b) A snippet of the MELab skybox in Unity, taken outside the lab.

Figure 10: The HDRI Skyboxes in Unity.

4.4 Scripts

C# scripts are an important part of ensuring that the components in the virtual environment are capable of performing certain behaviours needed to seem realistic. The thesis project needed scripts for Razvan and Tinitus behaviour, as well as UI events, with the Razvan being the more complex of the installations and covered in the thesis report.

4.4.1 Razvan

The Razvan installation, the more complex of the core components, was reliant on a script capable of randomly choosing an audio file at random intervals. Five to six audio files from the original installation were imported, with an IEnumerator function to randomly select one, with a random downtime between 0.5 and 2 seconds afterwards as seen in **listing 4.4.1**.

```
private IEnumerator PlayRandomSound()
{
    while (true)
    {
        int randomIndex = Random.Range(0, soundObjects.Length);
        GameObject selectedObject = soundObjects[randomIndex];

        if (selectedObject != null)
        {
            AudioSource audioSource = selectedObject.GetComponent<AudioSource>();

            if (audioSource != null && audioSource.clip != null)
            {
                selectedObject.SetActive(true);
                audioSource.Play();

                yield return new WaitForSeconds(audioSource.clip.length);

                selectedObject.SetActive(false);
            }
        }

        yield return new WaitForSeconds(Random.Range(0.5f, 2f));
    }
}
```

Listing 1: AudioRandomizer.cs Script.

4.4.2 Splines

Another important behaviour, was adding animated movement to certain audio within the Razvan experience. This was done using the Splines packages, allowing for 3D paths and curves that Unity gameobjects can move along and be looped on, giving a semblance of real-life moving sources. **Figure 11** shows the spline paths & audio sources.

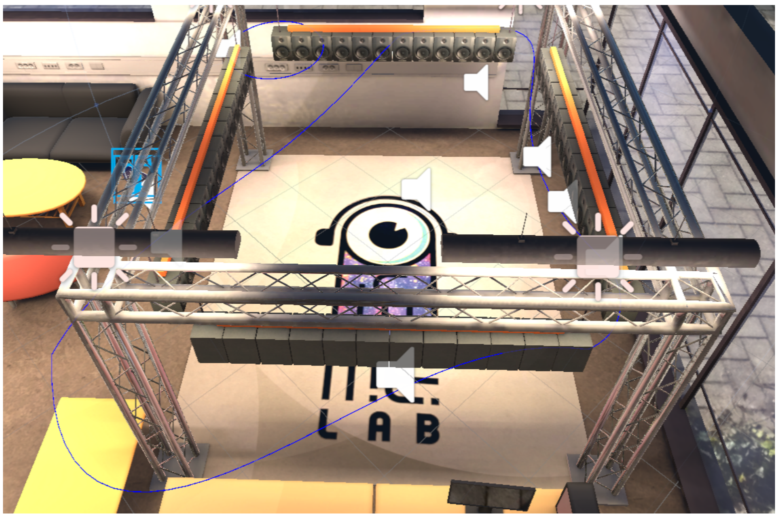


Figure 11: Static & Moving Audio Sources in Razvan, and blue Spline paths.

5 Evaluative Methodology & Procedure

This section will cover the important facets of the evaluative procedure. Methodologies and frameworks chosen for performing the testing of the AAUverse and the digital twin of the MELab, as well as covering the reasoning behind the choice of those specific frameworks & methodologies. The section then explains the details of the test procedure for using those specific methodologies for evaluating the prototype variant of AAUverse. Both questionnaires mentioned in the later part of this section can be found in detail in **appendix A**.

First part of the section delves into the methods and procedure of the initial usability test, the section then details the primary test meant to measure the presence of participants within the VR environment and methods of understanding participants immersive tendencies.

5.1 Initial Usability Test

The initial usability test was conducted during the last week of March and the first week of April in 2025. Testing spanned from the 27th of March to the 3rd of April, with test participants being scouted from various technological and design-related studies with a focus on UI & UX. The focus of the test was to pinpoint weak spots in the usability of the AAUverse prototype, through the use of a System Usability Scale questionnaire. In total 12 participants tested out the usability of the AAUverse.

5.1.1 SUS | System Usability Scale

The System Usability Scale, often shortened SUS, is a standardized quantitative Likert scale questionnaire tailored to measure the perceived usability of systems. The scale consists of 10 five-point items, switching between negative and positive tonality, and has become a popularized means of measuring usability both industrially and academically [14]. Grading SUS scores has been somewhat standardized for better understanding where various systems fall, but the thesis will use the Journal Of User Experience thresholds for grading [13].

The shortness of the System Usability Scale makes it a great contender for performing quick tests that provide an ample overview while not tiring out participants through rigid questionnaires of extreme length that cause fatigue. A fatigue that in turn can affect and bias participants towards negative mindsets, detrimental to conducting accurate tests and demanding of participants minds and well-being. Hence, the choice to use the SUS for the initial usability testing of the AAUverse prototype.

5.1.2 Feedback Textfield

The questionnaire, in addition to containing the SU scale, also had a small feedback field for participants to write down thoughts relevant to the usability of the application. This allowed them to write down and pinpoint more thorough observations in a few words, that the SUS could overlook due to its generalized items.

5.1.3 Initial Usability Test Procedure

Location
The initial testing of the AAUverse demo was conducted in the Multisensory Experience Laboratory at the Aalborg Copenhagen campus.

Participant Recruitment
Participants were recruited from tech-related studies on campus, primarily consisting of Medialogy

students from various semesters in both the master's and bachelor's program.

PlanWay
Participants & interested parties were able to book an individual 20-minute time through the booking platform PlanWay, a GDPR compliant time management and booking system usually used by appointment-based companies. These spanned from 10 AM to 3 PM during the two weeks the initial testing spanned.

Consent
Participants were, upon arrival, asked to provide their consent prior to the experience and were briefed on how to retract their consent in the event they wished to retract it. They were then given a short agenda of the fact that testing would start off with the experience, and then a short questionnaire.

Application Testing & Tasks
Participants were then guided to a ground marker, an "X" marked in tape, where they were given noise-cancelling Airpod pro earbuds. They were then given a Meta Quest 2 with the pre-loaded and prepared application to avoid having participants interact with the initial UI of the Meta Quest. Testers were then handed the Quest controllers, and then given two tasks:

- **Task 1 :** Find and interact with the Razvan installation.
- **Task 2 :** Find and enter the Tinitus room.

System Usability Scale
After having experienced both installations, testers were then taken out of VR and asked to fill out the System Usability Scale. The finishing of the questionnaire concluded test participation, and participants were thanked for their willingness to participate and given snacks as compensation.

5.2 Primary Presence Test

Primary presence testing was carried out in the start of May, for slightly longer than a week from the 5th of May to the 14th. Participants were scouted by having booths in the information of the A-building at Aalborg CPH, and having study-secretaries send out e-mails enticing students from various studies at Copenhagen to participate. The primary focus consisting of measuring participants presence in the virtual environment of MELab, and pinpointing immersive tendencies outside of virtual reality in correspondence with their presence response to the virtual environment. In total 9 people participated in the presence test of the AAUverse & MELab.

5.2.1 PQ | Slater-Usoh-Steed Presence Questionnaire

The Slater-Usoh-Steed Presence Questionnaire [**PQ**], published in 1994, is a suggested means of measuring presence in Virtual Environments. The framework of it being based on previous work by both Slater & Usoh with regards to the internal and external factors of presence, as well as Barfield & Weghorst's paper regarding presence indicators. The paper and framework have become referenced in a large amount of various contemporary papers afterwards, with roughly 2000 citations on scholar, both improving and acknowledging the foundation the questionnaire provided to understanding presence [23].

The original questionnaire condenses facets of both the internal and external aspects of VR, and the presence indicators into a three-question short survey, focusing on three facets:

- Virtual Environment Sensation Comparison
- Sense Of Reality
- Experience Memory Categorization

However, due to certain flaws, the questionnaire was expanded upon by an academic group including Slater & Usoh, in an attempt to improve validity and attempt a more in-depth exploration of presence and related cognitive & memory oriented facets that brought three new questions to the questionnaire.

These questions expanded upon the sensory experience of virtual environments, as well as the experienced memory structure of virtual environments compared to physical ones, and has since been cited and used in a wide variety of studies regarding VR [33]. The 6-item version of the **PQ** with a 1-7 scale for each item, was therefore chosen for measuring presence in participants in this thesis. In comparison, the revised PQ also provides more accurate presence measurements in real-life scenarios compared to other presence measuring tools such as Witmer & Singers presence questionnaire, in the same paper that proposed the revised PW including Slater and Usoh [33], with Slater publishing a response to Witmer & Singers variant as well [21]. Most research pointing to the Slater-Usoh-Steed Presence questionnaire as a more accurate presence measurer, and with a low amount of questions, makes the PQ the suitable choice for testing the MELab digital twin.

5.2.2 ITQ | Immersive Tendencies Questionnaire

The Immersive Tendencies Questionnaire [**ITQ**], was developed and published by Witmer & Singer in 1998 [35] alongside their own version of a presence measurement questionnaire for virtual experiences. An 18 item Likert-questionnaire with 4 sub-scales, The questionnaire focuses on understanding and measuring behavioural tendencies outside of virtual settings, with a focus on common activities, and how those affect individuals means of involving oneself in media and activities to varying degrees depending on person.
The Cyberpsychology Lab at University Of Quebec [**UQO**] later revised changed to the ITQ, while preserving all 18-items only making subtle changes validating its use for their own cyberpsychological research [32]. This thesis will use the UQO variant from 2004 for it's evaluative purposes.

5.2.3 Primary Presence Test Procedure

The test procedure for the primary presence test was carried out in the same way as the initial usability test, except for the location and means of recruiting participants.

- **Location |** The testing was conducted in room 2.1.042 at AAU CPH.
- **Participant Recruitment |** Participants were recruited via study-secretary e-mails & setting up a booth at the information/entrance of the A-building. Potential participants were also chosen on two conditions. **1)** Having never visited MELab before and **2)** being an active student at AAU.
- **Consent |** When participants showed up, they were asked to give their consent, along with marking their role at AAU. They were then prompted to go do the VR experience before continuing.
- **VR Application & Tasks |** The same two tasks were given to participants: **1)** Try out the Razvan 360 sound installation. **2)** Try the Tinitus soundproof room. After this they were taken out of VR and asked to continue the questionnaire.
- **PQ & ITQ |** Participants then filled out the PQ and ITQ parts of the survey at their own pace.

- **Real-Life Lab |** Testers were then shown the real-life MELab located right down below the test location, and asked if they thought the digital counterpart was reminiscent of the real-life counterpart.

The whole test flow took roughly 25 minutes per test participant, despite being given time to go through the VR experience at their own pace.

6 Findings

The findings section will present, analyse, and discuss the results received from both the initial usability test and the primary presence test.

6.1 Initial Usability Test

6.1.1 Results

System Usability Scores
As can be seen in **Figure 12**, the SUS score of the initial usability test amounted to a SUS Score of **67.5** when calculating the mean of combined scores. The median score however, would be **73.5**. The lower and upper bounds of the SUS Scores are also detailed, with the scores ranging from the highest SUS Score being 90 to the lowest being 27.5.

SUS Score Mean:	67.5
Lowest Score:	90
Highest Score:	27.5

Figure 12: SUS Mean Score & Score Boundaries.

Figure 13 shows a comprehensive overview of individual participant scores, including the mean & median values.

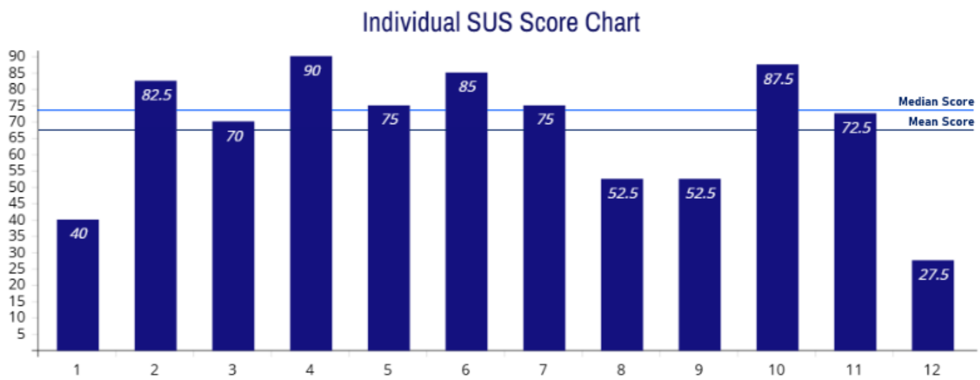


Figure 13: Individual Participant SUS Score Overview.

Figure 14 boxplots the individual scores, to provide a visualization of potential areas of interest or extremities.

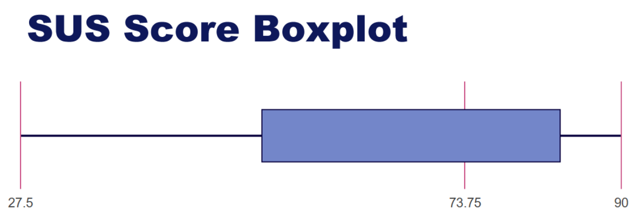


Figure 14: SUS Median Boxplot.

Qualitative Feedback Field
The comments from the qualitative feedback field can be seen in **Figure 15**

Any feedback or comments regarding your experience in VR? Feel free to elaborate below:
the doors were incionsistent. I was able to open the lab door as expected, but not the tinitus door.
the doors are inconsistent or lack proper collition, had a hard time opening them atleast and the lack of any sound outside of the experiences.
i was fun to walk around the space, it had some kinda uncanny areas like the hallways outside the multisensory lab.
Was slightly unsure of what was interactible, ie the doors, as well as not knowing if there was more to the tinitus room
The interaction with the doors was hard to open
Only very slight discomfort when the front door suddenly slammed open in my face. Also weird that the two doors behave so differently, but otherwise really cool! 👍
Make it possible to grab the UI text areas to make it easier to read and adjust. The doors was very unintuitive to use.
I had trouble opening the doors at first, since I'm not used to targeting with the raycast line thingy on the controllers while opening doors. Other than that everyhting was intuitive and made sense!
I got slightly dizzy when moving arond
I could not open the door to tinnitus. I went through it and opened it from behind. Do not know if i did something wrong. Got a bit of locomotion sickness from moving and teleporting around.

Figure 15: Usability Feedback Field.

The feedback participants provided generally centered around three primary points as listed below:

- Door Issues
- Unclear Interactibles
- Grabbable UI Areas

With feedback solely concerning certain interactive aspects of the prototype.

6.1.2 IUT Analysis

As mentioned in **section 5.1.1**, with the vast amount of existing System Usability tests performed, there are standardized means of grading a systems usability score and referencing them into percentile ranks. The prototype mean score of **67.5**, indicates a marginally passable system, albeit a bit flawed, ranking it somewhere between he 41st to 59th percentile with a C score. Basing the results on the median of **73.5**, however, slightly bumps this up, to somewhere between the 65th and 69th percentile, with a B- grading, indicating a system at the higher end of acceptability.

6.1.3 IUT Discussion

When discussing system usability, various factors can influence the outcome of test results, such as individual VR experience & sensitivity or system bugs that appear for some when interacting with the system but are unbeknownst by other testers.

To some, individual experience with VR plays a large factor, as the controllers and interface can be quite different from other existing technology. Despite using students from UX and UI majors at AAU, some might have much less experience, or perhaps none at all, interacting with VR interfaces. The inexperience, combined with a noticed pattern of some participants skipping the controller guide integrated right into the Hub UI, meant having to reexplain essential controls at times. A factor which could potentially affect experienced system usability for the individuals who participated in the initial usability test and account for some part of the huge fluctuation between the lowest and highest SUS scores recorded in the IUT. The skipping of the controller guide, was also noted as a point to bring up to the primary presence test, to make participants aware that there is a guide if you were new or unfamiliar with VR controls before they were placed into the experience.

As shown in the results of the feedback form in **Figure 15**, there were also a few initial bugs to fix that affected user experience for the AAUverse Hub and Multisensory Experience Lab. These comments were integrated as adjustments before the primary test, but due to constraints in regard to working on the thesis alone, as well as time constraints, it was not possible to perform another usability test, preferably with the same individuals who participated in the IUT. These constraints meant that it was not possible to measure the effect of bug fixes on usability, but the bugs are presumed to have had quite a large effect on the experience for those who scored around the 20-50 in the IUT.

6.2 Primary Presence Test

6.2.1 Results

An overview of the presence scores for each participant including ITQ combined scores as well as subscale scores, can be seen in **figure 16**. The presence scores where calculated by taking the amount of presence questions each participant had scored "6" or "7", and was then divided with the amount of questions on the scale. The ITQ subscales were also combined to a general tendency score for the subscales of "Focus", "Involvement", "Emotion" and "Game" in the IT questionnaire.

Participant Nr.	Presence Score	Presence Average (not excluding answers below 6 or 7)	ITQ Combined	ITQ Focus	ITQ Involvement	ITQ Emotions	ITQ Game	ITQ Percent
1	83	5,6	4,21	5,2	4,8	4,25	2,6	60,18
2	50	5,5	4,98	4,4	5,2	5	5,3	71,07
3	0	2,5	4,34	5,4	5,4	3,25	3,3	61,96
4	16	4,3	3,38	3,6	4,8	3,5	1,6	48,21
5	33	5	4,98	5	5,6	5	4,3	71,07
6	0	2,5	5,56	5,8	5,2	6,25	5	79,46
7	33	5,5	5,94	5,4	6,8	6,25	5,3	84,82
8	50	5,1	4,59	6	5,8	5,25	1,3	65,54
9	100	6,8	4,59	4,2	4,8	5,75	3,6	65,54

Figure 16: Presence Scores, as well as ITQ combined and subscale scores.

The table also includes averaged scores for the presence measurement without excluding answers below "6" or "7" on the measurement scale, as an opposing means of viewing presence by showing the average response value by participants.

A comparison between the presence score reported by participants, was then compared to the percentage score of the combined ITQ, in an attempt to notice patterns with real-life immersive tendencies as compared to the presence felt in the experience. This comparison is seen in the column diagram in **figure 17**.

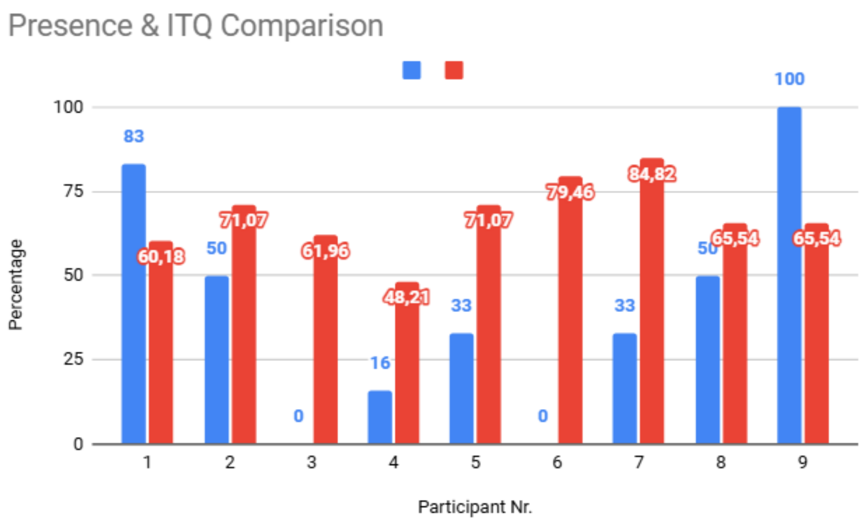


Figure 17: Presence and ITQ comparison.

Participants were also asked their opinion on the likeness of the MELab likeness to the real laboratory, on a scale from "No, fully." to "Yes, fully.", with 55% or 5 participants answering that the MELab had a certain degree of likeness as seen in **figure 18**.

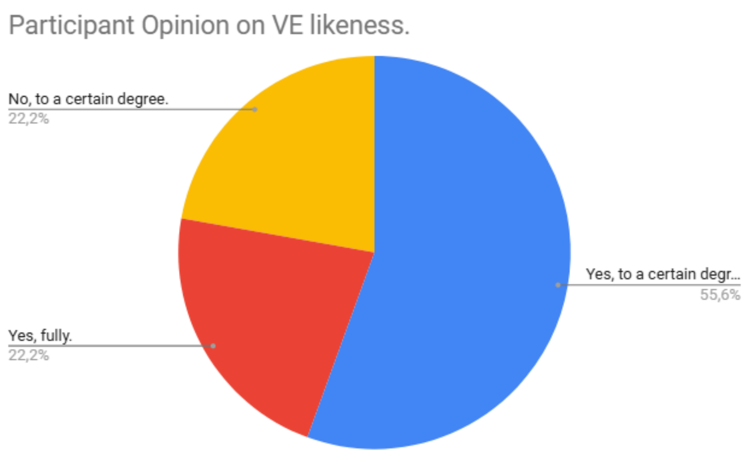


Figure 18: PPT VE Likeness Pie Chart.

6.2.2 PPT Analysis

The data gathered by test participants points towards a lacking amount of presence found in users, with 5 out of 9 participants reporting a complete sense of presence below 50%. The score for the sense of presence measured in participants, representative of a percentage of the amount of questions participants marked "6" or "7" out of the six questions, indicates that only four out of the 9 answered more than half of the questions as being in a state of "very present". The two interesting "0" cases, where neither participant reported any sense of heightened presence in the environment, also correlated with an average of 2.5 *even* when taking the averaged and inclusive score into account.

Now these two cases were interesting, seeing as their low self-reported sense of presence prevailed even when examining the inclusive averaged presence, while the other low scoring participants still showed a nice middle-centered average such as participant 4 and 5. This, in contrast to the high response of test participants who indicated a positive resemblance, creates a dichotomy since the fidelity of the prototype should be assumed to good enough for most participants to recognize if the VE reportedly has a certain degree of likeness. Now, both of these special "zero presence" cases responded that they, to a certain degree, felt that the MELab virtual environment was not alike the real-life counterpart, indicating that it is perhaps likeness or graphical fidelity that is most detrimental to the sense of presence and PI of the experience of these two "outliers".

When comparing this however, to the ITQ scores there could be signs of a pattern of individuals with less immersive tendency being less critical of fidelity, graphics and PI while those with higher immersive tendencies tend to have a more critical response towards the MELab environment.

6.2.3 PPT Discussion

These quite varying presence scores in participants, especially the responses reporting a complete lack of presence, can arguably be linked to a somewhat shattered PI and fidelity of the MELab virtual environment. The interesting question to inquire is what made these participants have a more negative response? What could help improve fidelity to the point that participants such as those would feel present in an *actual* and realistic environment rather than an environment that drives attention towards the fact that it is a virtual one?

It is indefinite to presume what aspects of fidelity affected test participants, and it would require more qualitative data to pinpoint what points of weakness caused presence to weaken for the experience. Despite most participants stating it was still enjoyable, and had potential, as they thought the concept and implementation were still well done.

7 Conclusion

With a test sample size of 9 participants, it is extremely difficult, if not impossible, to conclusively state anything with regards to the hypotheses presented in **section 2.7**. Despite this, if one attempts to conclude on hyptheses the with the current gathered data and results, the tests did not prove a high enough presence in participants, as only four out of nine participants reported a presence score above 50%. Effectively not enabling us to reject the null-hypothesis, and notice a large enough perceived effect of the prototype and MELab virtual environment.

8 Future Works

Should one attempt to do future work on the thesis, there are a few points of major improvement, most notably the evaluative test setup as well as factors from the implementation made obvious during the presence testing.

8.1 Evaluative Methodology

The evaluative methodology of the thesis is lacking in some parts, and if one should do a larger-scale test, it would also be necessary to have a control group or measure for the physical lab instead of merely measuring presence within the VE itself, this would allow for a more conclusive overview of test-participants tendencies in real-life environments and provide a more insightful means of concluding whether the VE provided an ample experience of presence to participants.

8.2 Within-Group Design

The control group, or measure, would optimally be done using a within-group design, with some participants testing the real-life condition first and the VE second, and other participants testing the VE first and the real environment second, of equally large amounts as a means of minimizing bias. The within-group design would also ensure that the target participants would not need to be scouted to fulfill the same demographic description as a participant of the other group, as is typically the desire for between-group test designs. The real-life control measure would also act as a means to suggest a threshold or standard presence response to the real-life environment, which can act as a guide to setting non-functional test requirements for the AAUverse prototype. This would later be checked for normal distribution to determine the appropriate parametric or non-parametric statistical tests to use during evaluation.

8.2.1 Integrated Presence Questionnaire

An important aspect of testing presence is also the minimizing of subject-removal from the experience when they should answer the questionnaire. An important bias that is usually avoided by integrating the questionnaire directly into the VR environment when the experience is done. Due to both technical and time-related constraints, the survey following the experience was not implemented into the VR prototype, but participants were taken out of the headset before filling out the presence and ITQ questions. Largely the case due to the new Unity 6 not having any supported questionnaire packages as of this thesis, and the setup of a VE-questionnaire would not be viable at this scope. In the future, this is an extremely important factor to bias and evaluating the prototype, and would need to be integrated.

8.3 Implementation

The implementation of the VE itself could also be improved to seem even more like the real environment and provide a smoother UX for the protoype. There are a few factors that could help this along:

8.3.1 Optimization

Optimization is a large part of a good UX, and especially between scene switches and when entering Razvan, there are a few loading seconds. The small drop in FPS might be due to the hardware specifications of the Meta Quest 2 headset, as newer models could perhaps handle the functionality more smoothly, but this would need to be tested. The 3D models were created with optimization in mind, and are at a low-polygon count as to not affect efficiency, but perhaps some improvements could be made to certain models.

8.3.2 Clutter & VE Fidelity

As mentioned, and as some of the data pinpoints, there is still some way to go for the realism fidelity of the MELab VE. This, should the project and prototype be improved in future work, would most likely consist of some more clutter to the scene that can be found in MELab. There werent included due to the focus of core-components and larger furniture found in MELab, as they outweighed smaller details, that might give the scene that small push of realism and usage. Whether those assets should be made or found on asset stores, is debatable, as using asset store models could save time while new models would add more to realism fidelity if they were design to be exactly like items found in the MELab.

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A Appendix: Questionnaires

APPENDIX A : SUS IUT

Thank you for your interest in participating in the initial System Usabiity test of the ME Lab digital twin, and the upcoming AAUVerse! This is a current master thesis project in development.

By continuing and providing your consent below, you agree to participate in a 5-10 minute test of the digital twin and conset to the usage of the collected data to perform various UX adjustments. You will of course remain anonymous, and should you wish to withdraw your data at any point, please reach out to dinacelm@hotmail.com.
You can at any time let the test conductor know of any discomfort, and stop the experience should you wish.

We thank you for your cooperation, and hope for a good VR experience!

I hereby give consent to participation in this survey & test, and allow for the use of my data.

Yes ☐ No ☐

PREVIOUS NEXT 33%

Please start the AAUVerse VR Experience
And proceed after finishing the experience.

PREVIOUS NEXT 50%

I think that I would like to use this system frequently.

1 [Strongly Disagree] ○ 2 ○ 3 ○ 4 ○ 5 [Strongly Agree] ○

I found the system unnecessarily complex.

1 [Strongly Disagree] ○ 2 ○ 3 ○ 4 ○ 5 [Strongly Agree] ○

I thought the system was easy to use.

1 [Strongly Disagree] ○ 2 ○ 3 ○ 4 ○ 5 [Strongly Agree] ○

I think that I would need the support of a technical person to be able to use this system.

1 [Strongly Disagree] ○ 2 ○ 3 ○ 4 ○ 5 [Strongly Agree] ○

I found the various functions in this system were well integrated.

1 [Strongly Disagree] ○ 2 ○ 3 ○ 4 ○ 5 [Strongly Agree] ○

I thought there was too much inconsistency in this system.

1 [Strongly Disagree] ○ 2 ○ 3 ○ 4 ○ 5 [Strongly Agree] ○

I would imagine that most people would learn to use this system very quickly.

1 [Strongly Disagree] ○ 2 ○ 3 ○ 4 ○ 5 [Strongly Agree] ○

I found the system very cumbersome to use.

1 [Strongly Disagree] ○ 2 ○ 3 ○ 4 ○ 5 [Strongly Agree] ○

I felt very confident using the system.

1 [Strongly Disagree] ○ 2 ○ 3 ○ 4 ○ 5 [Strongly Agree] ○

I needed to learn a lot of things before I could get going with this system.

1 [Strongly Disagree] ○ 2 ○ 3 ○ 4 ○ 5 [Strongly Agree] ○

PREVIOUS NEXT 66%

Did you feel any type of discomfort during the experience?

Yes, a lot of discomfort. ☐ Yes, slight discomfort. ☐ No, no discomfort at all. ☐

Any feedback or comments regarding your experience in VR? Feel free to elaborate below:

PREVIOUS NEXT 83%

Thank you for participating!

PREVIOUS FINISH 100%

APPENDIX A : Presence & ITQ Questionnaire

Thank you for your interest in participating in the testing of the upcoming AAUVerse!

By continuing and providing your consent below, you agree to participate in a 20-30 minute test of the AAUverse prototype and consent to the usage of the collected data for evaluating the Master Thesis product. You will of course remain anonymous, and should you wish to withdraw your data at any point, please reach out to delmaz20@student.aau.dk.
You can at any time let the test-conductor know of any discomfort, and stop the experience should you wish to do so.

We thank you for your cooperation, and hope for a good VR experience!

I hereby give consent to participation in this survey & test, and allow for the use of my data.

Yes ☐ No ☐

What is your gender?

-- Vælg --

What is your age?

-- Vælg --

What is your role at Aalborg University CPH

-- Vælg --

FORRIGE NÆSTE 28%

Start the AAUVerse VR Experience.
Proceed <u>after</u> finishing the experience.

I have gone through the AAUVerse experience.

☐ Yes

FORRIGE NÆSTE 42%

Presence Questions

Please rate your sense of being in the virtual environment, on the following scale from 1 to 7, where 7 represents your normal experience of being in a place.

Did Not Feel Like Visiting A Place At All — Normal Experience of Visiting A Place

To what extent were there times during the experience when the virtual environment was the reality for you?

No Times At All — All The Time

When you think back to the experience, do you think of the virtual environment more as images that you saw or more as somewhere that you visited?

Images I Saw — A Place Visited

During the time of the experience, which was the strongest on the whole, your sense of being in the virtual environment or of being elsewhere?

Elsewhere — Virtual Environment

Consider your memory of being in the virtual environment. How similar in terms of the structure of the memory is this to the structure of the memory of other places you have been today?

By 'structure of the memory' consider things like the extent to which you have a visual memory of the virtual environment, whether that memory is in colour, the extent to which the memory seems vivid or realistic, its size, location in your imagination, the extent to which it is panoramic in your imagination, and other such structural elements.

Not At All — Very Much

During the time of your experience, did you often think to yourself that you were actually in the virtual environment?

Not At All — Very Much

FORRIGE NÆSTE 57%

Immersive Tendencies

How mentally alert do you feel at the present time?

Not Alert — Moderately — Fully Alert

How physically fit do you feel today?

Not Fit — Moderately Fit — Extremely Fit

How good are you at blocking out external distractions when you are involved in something?

Not Good — Somewhat good — Very Good

How well do you concentrate on enjoyable activities?

Not At All — Moderately Well — Very Well

Do you ever become so involved in a television program or book that people have problems getting your attention?

Never — Occasionally — Often

Do you ever become so involved in a movie that you are not aware of things happening around you?

Never — Occasionally — Often

Do you ever become so involved in a video game that it is as if you are inside the game rather than moving a joystick and watching the screen?

Never — Occasionally — Often

Do you easily become deeply involved in movies or tv dramas?

Never — Occasionally — Often

When watching sports, do you ever become so involved in the game that you react as if you were one of the players?

Never — Occasionally — Often

How frequently do you find yourself closely identifying with the characters in a story line?

Never — Occasionally — Often

Do you ever become so involved in a daydream that you are not aware of things happening around you?

Never — Occasionally — Often

Do you ever have dreams that are so real that you feel disoriented when you awake?

Never — Occasionally — Often

When playing sports, do you become so involved in the game that you lose track of time?

Never — Occasionally — Often

How often do you play arcade or video games? (OFTEN being every day or every two days, on average.)

Never — Occasionally — Often

Have you ever gotten excited during a chase or fight scene on TV or in the movies?

Never — Occasionally — Often

Have you ever gotten scared by something happening on a TV show or in a movie?

Never — Occasionally — Often

Have you ever remained apprehensive or fearful long after watching a scary movie?

Never — Occasionally — Often

Do you ever become so involved in doing something that you lose all track of time?

Never — Occasionally — Often

FORRIGE NÆSTE 71%

Please follow the test conductor.
You will now be shown the real-life Multisensory Experience laboratory.

When done, continue.

Did you feel the digital twin of the Multisensory Experience lab was similar to its real life counterpart?

Yes, fully. ○ Yes, to a certain degree. ○ No, to a certain degree. ○ No, not at all. ○

FORRIGE NÆSTE 85%

Thank you for testing out the AAUverse and the first experience within it!

You are free to take some snacks, and please remember to send in your reply properly by finishing the survey below..

FORRIGE AFSLUT 100%