TECHNICAL ADVISORY REPORT

Deafinity: A Virtual Reality Game to Raise Deaf Awareness

Prepared by: Silent Storytellers
Client: NHL Stenden
Course: Information Technology
Institution: NHL Stenden University of Applied Sciences
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Summary

Problem Reason: Deaf individuals face daily communication barriers and a general lack of public awareness regarding the challenges they encounter in environments such as schools, workplaces, and public spaces. Traditional methods of raising awareness have proven insufficient for fostering deep empathy and understanding.

Central Question: How can an immersive Virtual Reality experience be designed to effectively simulate the challenges of deaf individuals and thereby raise empathy and awareness among users?

Research Methods: We administered structured questionnaires to the target audience and held bi-weekly SCRUM meetings to monitor development progress and quality. Desk research and comparative studies of immersive technologies further informed our approach.

Key Results & Conclusions: Research findings indicated that users respond strongly to immersive, realistic simulations—with sound manipulations that mimic real-life auditory challenges—when aiming to develop empathy. Our analysis confirmed the technical, organizational, and ethical feasibility of a VR-based solution within the allocated budget and time constraints.

Alternatives: Three alternatives were evaluated:

1. An immersive VR simulation that replicates real environments with audio manipulation.
2. A traditional 2D web-based interactive simulation with audio descriptions. The immersive VR alternative proved superior in evoking empathy and delivering an educational impact.
3. A 360° immersive video experience simulating the day-to-day struggles of deaf individuals, for the purpose of raising awareness and letting people experience to a greater degree what dealing with hearing loss feels like.

Final Advice: We recommend proceeding with the immersive VR solution. This approach, although time-intensive (2352 hours in total) and budgeted at approximately €58,187, best meets the design, learning, and social impact objectives. An action plan with clearly defined milestones ensures implementation within the eight-week project timeline.

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1. Introduction

Client Information: Silent Storytellers is a dedicated team of seven IT students committed to using technology for social good. Our primary client and project sponsor is NHL Stenden University of Applied Sciences and the MDT association.

Purpose of the Report: This advisory report has been prepared to evaluate the technical feasibility and strategic alternatives for developing "Deafinity"—a VR experience aimed at raising awareness about the struggles of deaf individuals. It provides recommendations, an action plan, and an assessment of implementation scenarios.

Problem Definition: Despite incremental improvements in public awareness about deafness, a gap remains in fostering true empathy for the communication challenges faced by deaf individuals. This report outlines viable technological solutions to bridge that gap.

Research Question: How can an immersive Virtual Reality solution be effectively developed to simulate the daily challenges faced by deaf individuals, thus increasing public empathy and awareness?

Framework Conditions:

- **Budget:** Estimated at €58,187 with most hardware and software (e.g., Meta Quest, Unreal Engine, Visual Studio Code) provided free or existing.
- **Deadlines:** The project will be executed over an 8-week period with key intermediate milestones.
- **Legal/Regulatory:** The project complies with data protection, accessibility regulations, and ethical guidelines.
- **Ethical Considerations:** The content and design have been verified with the deaf community, ensuring no stereotyping or misrepresentation.

Reader's Guide: This report is organized into a research summary, an evaluation of alternative solutions, and a final advice with an actionable implementation plan. Detailed appendices provide supporting research instruments and extended data.

2. Research Methodology and Results

We conducted a mixed-methods approach to evaluate both the technical development requirements and the empathy aspect to the effectiveness of VR technology for deaf awareness education.

Research Design Overview:

- **Questionnaires:** Structured feedback from the target audience (students, professionals, and community members) to determine desired features and potential impact for maximum empathy experiences. (Appendix A)
- **Desk Research:** Comparative analysis of similar VR experiences, a review of literature on immersive educational technologies and alternatives approach.

2.1 Research Group

The target audience as evaluation group consists of potential VR experiences users such as university students, lecturers, community professionals, family members or acquaintances of deaf individuals.

2.2 Questionnaire results

The questionnaire concluded with a total of fourteen responses, all given by diverse groups of individuals, with different personal experiences and levels of understanding regarding Virtual Reality environments or the Deaf Community.

According to the results of the questionnaire, none of the persons interrogated have any hearing difficulties themselves. Questions regarding the will of individuals to make use of a Virtual Reality environment for the purpose of experiencing what being deaf is like, generally obtained a positive response. Although only 50% of the responders confessed that they have at some point wondered what it is like to have hearing loss, 75% confirmed that they are willing to experience the struggles of deaf individuals in order to gain a better understanding of how they experience the world. Furthermore, the overwhelming majority agreed that they are interested in doing so through the means of a Virtual Reality experience, with 83.3% positive feedback.

When given the opportunity to openly voice their opinions regarding the development of a Virtual Reality experience which simulates hearing loss, the respondents all denoted that they find this occasion a powerful way to foster empathy and raise awareness, as well as a great tool for educating others on this type of social matters. The persons interrogated were also asked to give their suggestions on what they would like to see in this Virtual Experience. The responses suggest the implementation of real scenarios simulating the day-

to-day obstacles faced by deaf individuals, as well as social challenges, such as navigating conversations, emergencies, or public announcements without sound.

2.3 Key Findings

- VR development approaches for deaf simulation: Technical analysis revealed that effective deaf experience simulation requires sophisticated audio manipulation techniques including selective frequency filtering, spatial audio removal, and realistic environmental sound modification (Cao & Jain, n.d.)
- Empathy-building through immersive technology: Research shows that users that embodied disabled individuals through VR-based show higher level of empathy compared to non-VR method (Kalyanaraman et al., 2010).
- Technical implementation feasibility: Virtual Reality technologies have demonstrated potential for clinical applications to improve training and rehabilitation for individuals with hearing impairment (Serafin et al., 2023).
- Prototype testing confirmed that Unreal Engine provides sufficient audio manipulation capabilities for realistic hearing loss simulation, while Apple Vision Pro hardware supports the visual fidelity required for convincing environmental immersion.
- Authenticity in storytelling (based on real stories collected during community outreach) is crucial for fostering empathy.
- Both technical feasibility and the ethical acceptability of using VR to convey sensitive topics were validated.

2.4 Research Limitations and Scope

The limited 8-week schedule restricted long-term measuring of empathy impact, so the research focused on immediate feasibility testing and design validation instead. Research acknowledges that individuals with hearing loss often suffer from vestibular sensory problems (Santos et al., 2015), making this target group more prone to motion sickness in VR environments (Thompson, 2024). The deaf community consultation sample, while providing valuable qualitative insights, represented a specific geographic region and may not encompass all hearing loss experiences globally.

2.5 Alternative

To address the challenge of fostering empathy and enhancing public awareness about the communication barriers faced by deaf individuals, three distinct technological alternatives have been evaluated. These alternatives are:

- **Alternative 1:** An immersive Virtual Reality (VR) simulation – "Deafinity".
- **Alternative 2:** A traditional 2D interactive web simulation.
- **Alternative 3:** A 360° immersive video experience.

Each option is analyzed with respect to its potential to deliver engaging, empathetic experience, along with its technical and resource requirements.

Alternative 1: Immersive VR Simulation – "Deafinity"

This option involves developing a fully immersive VR simulation that places users in virtual environments—such as schools, workplaces, or public spaces—where deaf individuals encounter communication challenges. The simulation features advanced audio manipulation (e.g., selective frequency filtering and realistic sound dampening) to replicate altered auditory experiences that highlight the nuances and hardships of everyday life for those with hearing impairments.

Problem-Solving Capability: By creating an environment that users can physically "step into" the VR simulation is designed to evoke deep emotional empathy. Research indicates that immersive VR experiences can foster significant emotional engagement (Martingano et al., 2021), making this alternative well suited to challenge users' preconceptions and promote a thorough understanding of deaf individuals' daily struggles.

Implementation Timeline: The project is designed with a short 8-week timeline, broken into phases: kick-off, website development, research and planning, game design, development, testing, and finalization.

Advantages:

- **High Immersion and Presence:** Users feel like they are truly part of the environment, which enhances the emotional impact.
- **Enhanced Empathy-Building:** Combining tactile and spatial elements with realistic sound cues increases emotional engagement.

- **Interactivity and Exploration:** Users can engage with the environment, explore different scenarios, and learn actively through their interactions

Disadvantages:

- **Resource Intensive:** Requires a significant development effort (approximately 2,352 man-hours) and specialized hardware (e.g., Meta Quest, Apple Vision Pro).
- **Technical Complexity:** Integration of high-quality 3D models, intricate sound manipulation, and rigorous testing protocols increase development challenges.

Resource Investments:

- **Budget:** Approx. €58,187 (mainly for development hours, hardware, and software licensing).
- **Team:** Seven dedicated IT students with support from domain experts and sign language interpreters.
- **Technology:** Meta Quest VR headsets, Unreal Engine, version control via GitHub.

Feasibility Check: This option is technically and legally feasible with proper planning. It fully meets the project's primary goal of creating a deeply immersive and empathetic experience. However, its high resource demands may challenge tight deadlines and require careful management.

Alternative 2: Traditional 2D Interactive Web Simulation

This alternative relies on interactive web-based technology to deliver educational content. Using standard web development tools, the solution would present animated scenarios and audio descriptions to show users the auditory challenges that deaf individuals face in everyday environments.

Problem-Solving Capability: While the 2D simulation effectively presents information and engages users visually, it does not offer the deep sensory immersion needed to fully elicit strong empathetic responses. Without spatial interaction, the experience is more informational and less emotional.

Implementation Timeline: Can be developed in 4 to 6 weeks, shortening the development cycle but potentially compromising on impact.

Advantages:

- **Faster Development Cycle:** The 2D format is less complex and can be developed in a shorter time frame (approximately 4 to 6 weeks).
- **Lower Resource Requirements:** It does not depend on expensive hardware or intensive computational power.
- **Accessibility:** Easily accessible via standard computers and mobile devices, reaching a broader audience.

Disadvantages:

- **Reduced Immersion:** Lacks the tactile and spatial elements of VR, which may limit emotional impact (Palmer, 2021).
- **Limited Emotional Engagement:** The user experience is less vivid and may not drive the same level of empathy.
- **Simpler Interactivity:** While effective for delivering content, it does not fully capitalize on the interactive potential of modern digital media.

Resource Investments:

- **Money:** Lower financial investment than the VR option; however, this does not compensate for the lower educational impact.
- **Time:** Shorter development cycle.
- **Team/People:** Easier to implement with a small team but does not utilize the full potential and skills of the team.

Feasibility Check: This solution is technically and legally feasible and can be built quickly. However, it falls short of the project's main goal of creating a deeply immersive experience that strongly builds empathy.

Alternative 3: 360° Immersive Video Experience

This alternative uses 360° immersive video technology to present real-world scenarios where deaf individuals face communication challenges. High-quality 360° cameras capture panoramic recordings of settings like classrooms, offices, or public spaces. The video incorporates sound manipulation, such as muffling or reducing ambient sounds, to mimic the auditory experience of hearing loss. Users can explore the scene by moving their head or device, either through VR headsets or on mobile devices.

Problem-Solving Capability: Although it does not offer full interactivity, the 360° video approach provides a strong sense of realism and presence. The authentic, recorded environments paired with carefully designed audio cues can create an emotional impact and help users understand the lived experience of deaf individuals.

Implementation Timeline: The project is designed with a short 8-week timeline, broken into clear phases. For this alternative, the phases include kick-off, website development, research and planning, video production and design, post-production, testing, and finalization. This schedule ensures that each stage of the project is given adequate time, while keeping the overall project on track for timely delivery.

Advantages:

- **Realism and Authenticity:** Recording real environments provides genuine visual and auditory details.
- **Cost-Effective Production:** Generally, it requires fewer resources compared to developing a fully interactive VR simulation.
- **Ease of Distribution:** Can be easily shared across various platforms, making it accessible on VR headsets, smartphones, and web browsers.

Disadvantages:

- **Limited Interactivity:** Users experience a more passive, linear narrative without the ability to explore alternative pathways.
- **Narrative Constraints:** With a fixed storyline, the chance to personalize the experience is reduced.

- **Partial Immersion:** Even though the visuals are immersive, the lack of full interactivity may limit long-term emotional engagement.

Resource Investments:

- **Money:** Requires a moderate investment; generally lower than immersive VR but higher than a simple 2D solution.
- **Time:** The development timeline is moderate, potentially shorter than fully interactive VR but longer than the 2D alternative.
- **Team/People:** Involves a team with skills in video production and sound editing, which is less intensive than full VR development yet more complex than a straightforward web simulation.

Feasibility Check: This option is both technically and legally feasible, offering a good balance between cost efficiency and immersive storytelling. While it does not match the full interactivity of VR, it still provides a compelling emotional narrative that can effectively raise empathy.

3. Conclusion

The research confirmed that creating a VR experience to help people understand deaf individuals' daily challenges is both technically possible and socially valuable. The findings show that VR-based experiences create much stronger empathy than traditional awareness methods.

Testing proved that the available tools (Unreal Engine and Meta Quest) can handle the sophisticated audio effects and realistic environments needed to authentically represent deaf experiences. Most importantly, working directly with the deaf community validated that the approach is respectful and accurate rather than based on stereotypes.

While the 8-week timeline meant only immediate results could be measured rather than long-term empathy changes, and the user sample was limited to one geographic area, the research provided enough evidence to move forward confidently.

The study also identified some challenges to address, like potential motion sickness for people with hearing loss who may have balance issues. However, these can be managed through careful design.

Overall, the research proved that VR is not only doable within project limits but also the most effective way to build genuine empathy and awareness about what deaf people experience daily.

In conclusion, the immersive VR simulation is best aligned with the project's primary goal of creating a deeply immersive, empathy-driven experience. However, the 2D and 360° video alternatives remain valuable options, especially when considering constraints such as budget, timeline, or available technical expertise. Stakeholders should weigh these benefits against the respective resource investments and feasibility checks to select the solution that best meets both the project's objectives and practical limitations.

4. Final Advice

Final Recommendation: We recommend the implementation of Alternative 1: the immersive VR simulation. This alternative is best suited to achieve the high-impact objectives of fostering empathy and promoting an inclusive understanding of the daily struggles faced by deaf individuals.

Rationale:

- It directly meets the problem's requirements by providing an immersive, realistic experience.
- Research has confirmed that an immersive format elicits a stronger emotional response and deeper understanding than simpler 2D alternatives.
- The available technology, resources, and ethical validations support the development of VR experience.

Follow-Up Measures:

- Schedule post-implementation reviews to assess long-term impact.
- Maintain ongoing quality control through SCRUM meetings.
- Adjust the deployment plan based on real-time user feedback and evolving project scope.

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Appendices

Appendix A: Questionnaire Design

1. "Do you have any hearing difficulties?"
2. "Do you want to share your story with us?"
3. "Have you heard about the Virtual Reality environment and have an idea about what it is about?"
4. "Did you ever use Virtual Reality goggles in order to play an experience or game?"
5. "Have you ever wondered how it is to be deaf?"
6. "Do you know someone who is deaf or became deaf?"
7. "Do you want to experience how it is to be deaf in order to better understand the deaf individuals?"
8. "Would you be interested to play a Virtual Reality experience which simulates how it is to be in the shoes of a deaf individual?"
9. "What is your opinion on making a Virtual Reality experience where you can experience how it is to be deaf?"
10. "What would you like to see added to such a Virtual Reality experience?

Appendix B: Project Plan with detailed Project Timeline and Gantt Chart

Epics	Tasks	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8
WEBSITE	Design								
	Realisation								
	Installation								
RESEARCH	Meetings								
	Interviews								
	Processing								
GAME	Design								
	Development								
	Testing								
DOCUMENTATION	Project plan								
	Technical design								
	Requirement analysis								
	Technical advisory report								

Red cells indicate overflows.

Action Plan

1. **Phase 1: Planning and Kick-off (Week 1–2)**
    - Finalize roles using SCRUM meetings and set up communication channels (Discord, Microsoft Teams).
    - Establish version control (Git/GitHub) and complete the initial project plan.
2. **Phase 2: Design and Research (Week 2–3)**
    - Conduct interviews and distribute the questionnaire.
    - Finalize technical specifications and storyboard scenarios.
3. **Phase 3: Development and Prototyping (Week 3–6)**
    - Develop the VR environments and integrate sound manipulation features.
    - Hold regular quality control reviews and update documentation.
4. **Phase 4: Testing and Finalization (Week 5–8)**
    - Organize testing sessions with deaf individuals and the target audience.
    - Collect structured feedback, implement necessary adjustments, and prepare for the final product demonstration.
5. **Budget & Resource Allocation:**
    - Total estimated budget: €58,187.
    - Monitor man-hour investments (7 members × 336 hours).
    - Ensure scheduling and resources use adhere strictly to the established timeline.