



Faculty of Computer Science and Information Technology

## **PathoSphere – Exploring UNIMAS Anatomy & Pathology Museum in VR**

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Bachelor of Computer Science with Honors (Multimedia Computing)

UNIVERSITI MALAYSIA SARAWAK

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# **PathoSphere – Exploring UNIMAS Anatomy & Pathology Museum in VR**

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requirements for the degree of  
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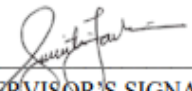
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## DECLARATION

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## ABSTRACT

This project focuses on enhancing educational engagement through the development of a Virtual Reality (VR) experience designed for the UNIMAS Anatomy and Pathology Museum. The VR system provides users with an immersive and interactive platform to explore anatomical and pathological specimens in detail. By integrating interactive 3D models, supplementary materials such as videos and diagrams, and an intuitive user interface, the system aims to improve accessibility and comprehension for learners. Using an Agile methodology, the project progressed through iterative phases, including planning, design, development, testing, and refinement. The design focuses on user-friendly navigation, clear explanations tailored to a lay audience, and accessible features to accommodate diverse learners. Tools such as Unity and Blender were employed to create a visually realistic and interactive VR environment, optimized for use with Meta Quest hardware. This VR system addresses the limitations of the physical museum, such as restricted access, time constraints, and the inability to photograph specimens, by offering an on-demand, virtual alternative. By leveraging emerging technologies, this project contributes to the field of educational innovation, providing a scalable and effective solution for anatomy and pathology education that enhances understanding and broadens accessibility for learners.

## ABSTRAK

Projek ini memfokuskan kepada peningkatan penglibatan pendidikan melalui pembangunan pengalaman *Virtual Reality* (VR) yang direka untuk Muzium Anatomi dan Patologi UNIMAS. Sistem VR ini menyediakan pengguna dengan platform yang imersif dan interaktif untuk meneroka spesimen anatomi dan patologi dengan lebih mendalam. Dengan mengintegrasikan model 3D interaktif, bahan tambahan seperti video dan diagram, serta antara muka pengguna yang intuitif, sistem ini bertujuan untuk meningkatkan aksesibiliti dan pemahaman bagi pelajar. Menggunakan metodologi Agile, projek ini berkembang melalui fasa-fasa berulang, termasuk perancangan, reka bentuk, pembangunan, ujian, dan penambahbaikan. Reka bentuk memberi tumpuan kepada navigasi mesra pengguna, penerangan yang jelas yang disesuaikan untuk khalayak awam, dan ciri-ciri yang mudah diakses untuk memenuhi keperluan pelajar yang pelbagai. Alat seperti Unity dan Blender digunakan untuk mencipta persekitaran VR yang realistik dan interaktif, yang dioptimumkan untuk digunakan dengan perkakasan Meta Quest. Sistem VR ini mengatasi kekangan muzium fizikal, seperti akses terhad, had masa, dan ketidakupayaan untuk merakam gambar spesimen, dengan menawarkan alternatif maya yang boleh diakses pada bila-bila masa. Dengan memanfaatkan teknologi terkini, projek ini menyumbang kepada bidang inovasi pendidikan, menyediakan penyelesaian yang boleh diperluas dan berkesan untuk pendidikan anatomi dan patologi yang meningkatkan pemahaman dan memperluaskan aksesibiliti untuk pelajar.

# Chapter 1 : Introduction

## 1.1 Introduction

Virtual reality (VR) refers to a computer-generated, three-dimensional environment that allows user interaction. It is typically accessed via a computer capable of presenting 3D information through a display, either on separate screens or on a wearable device like a head-mounted display (HMD), often accompanied by user recognition sensors (Riva et al., 2015).

VR can be categorized into two types: immersive and non-immersive VR. Immersive VR typically uses devices like head-mounted displays (HMDs) to track users' movements and present visuals based on their positions, offering a 360-degree experience within the virtual environment. In contrast, non-immersive VR involves multiple screens or a confined digital space that surrounds the user without fully immersing them (Riva et al., 2015). Between these types lies augmented reality (AR), which overlays computer-generated visuals onto the physical world, and mixed reality (XR), a hybrid that blends AR and VR for interactions that are both digitally immersive and grounded in the real world (Wohlgenannt, Simons, & Stieglitz, 2020).

In addition to these definitions, VR is characterized by five essential features that distinguish it from other digital interfaces:

**Immersion:** The user becomes deeply involved in the virtual environment, which can lead to a heightened sense of presence within the virtual world.

**Simulation:** The VR environment is computer-generated, mimicking real-world experiences and creating a realistic interaction space.

**Interaction:** Users can interact with the virtual environment in real time, manipulating objects or navigating the space.

**Presence:** VR creates a strong sense of being physically present in a virtual world, often making the user feel as if they are truly "inside" the environment.

**Environment:** The virtual world is a multi-sensory space that engages users through visual, auditory, and sometimes haptic feedback, enhancing the overall experience.

These characteristics make VR a powerful tool in fields such as education, where it can simulate complex environments, enabling more engaging and effective learning experiences. VR was initially developed for gaming, providing immersive experiences that changed the way players engage with digital worlds. However, its possibilities go well beyond gaming, with uses now being investigated in areas like education, training, healthcare, and beyond. This project leverages VR's capabilities to create a VR Museum focused on anatomy and pathology, establishing an interactive and immersive learning platform for medical students, professionals, and a wider audience. Expanding its accessibility, the VR Museum becomes a valuable resource for both specialised education and public knowledge. This project, which focuses on the design of a VR Museum for anatomy and pathology, leverages these key features of VR to create an immersive and interactive educational platform for medical students and professionals.

## **1.2 Problem Statement**

The Anatomy and Pathology Museum at Universiti Malaysia Sarawak (UNIMAS) faces several challenges that limit its effectiveness as an educational resource. Firstly, the museum operates with limited access due to time constraints and capacity restrictions, reducing opportunities for students and educators to fully utilize the museum for learning purposes. This limited access is especially problematic for students who require extended time for in-depth study and exploration of the specimens.

Secondly, there are strict restrictions on photographing the objects in the museum, such as organs, bones, and other pathological specimens. The inability to visually document these materials makes it difficult for students to review them outside of the museum setting, limiting opportunities for further study and revision. This reliance on in-person visits exacerbates the impact of restricted access.

Additionally, most of the objects in the museum are static, meaning students can only observe the specimens without interacting with them. This lack of interactivity limits the depth of understanding, as students cannot manipulate or explore the structures in detail. Virtual Reality (VR) offers a unique solution to this problem, as it allows users to explore these objects much deeper in an interactive environment. With VR, students can virtually manipulate and inspect

anatomical and pathological specimens from multiple perspectives, enhancing their comprehension and engagement.

These constraints present significant barriers to effective learning. The development of a VR Museum offers a solution by providing an immersive, interactive, and accessible platform where students can explore anatomical and pathological specimens without the limitations of time, space, or restricted interaction.

### **1.3 Aim and Project Objectives**

#### **1.3.1 Aim**

The aim of this project is to design and develop a Virtual Reality (VR) Museum for the Anatomy and Pathology Department at Universiti Malaysia Sarawak (UNIMAS). This VR Museum will provide an immersive, interactive, and accessible learning platform that addresses the limitations of the physical museum, enhancing students' ability to study and explore anatomical and pathological specimens in detail.

#### **1.3.2 Project Objectives**

- To simulate a virtual museum experience that overcomes the time and capacity constraints of the physical museum, allowing students to access the content remotely and at any time.
- To develop interactive features for the virtual specimens, allowing users to manipulate, inspect, and explore organs and other anatomical structures in detail, thereby improving their understanding of complex biological systems.

- To validate the functionality and usability of the virtual museum through User Acceptance Testing (UAT).

## 1.4 Brief Methodology

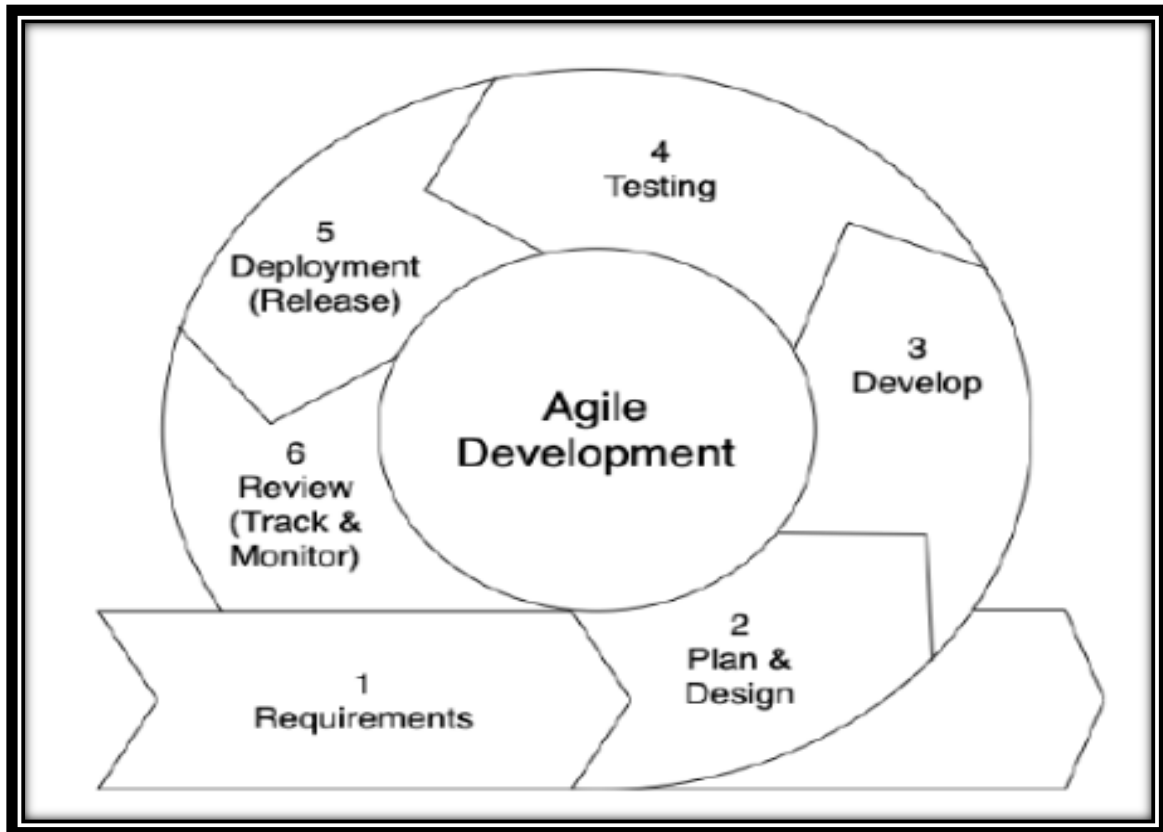


Figure 0.1 : Agile Methodology (Omonije, 2024).

The project follows the Agile Methodology to design the Virtual Reality (VR) Museum for the Anatomy and Pathology Department at Universiti Malaysia Sarawak (UNIMAS). This project uses Agile Methodology because it provides flexibility, fast delivery, and the ability to quickly adapt to changing client needs, making it ideal for the ever-changing nature of software projects (Altameem, 2015; Gupta et al., 2022).

### 1. Requirements Gathering:

Define the project's scope and gather requirements, including from medical students, educators, and public users. Identify key features such as interactive 3D anatomical models, user navigation controls, and the integration of educational content.

## 2. **Planning & Design:**

Develop a comprehensive plan outlining the project's timeline, resources, and key milestones. Design the VR Museum's interface, user experience (UX), and user journey within the virtual space. Create wireframes and prototypes for the 3D models and educational features.

## 3. **Development:**

Implement the core functionalities of the VR Museum using suitable VR development tools and frameworks, such as Unity or Unreal Engine. Build and integrate 3D anatomical models, interactive features, and educational content, ensuring compatibility with Meta Quest VR hardware.

## 4. **Testing:**

Conduct testing using Meta Quest VR gear. This phase will focus on assessing the functionality, user experience, and overall performance of the VR Museum. Gather feedback from a select group of testers, including medical professionals and students, to identify any issues or areas for improvement.

## 5. **Deployment (Release):**

Prepare for the release by finalising the VR content and optimising the application for Meta Quest VR. Deploy the VR Museum application in a controlled environment, such as a university lab or a closed beta testing group.

## 6. **Review (Track & Monitor):**

Monitor user feedback and performance metrics. Conduct regular reviews and gather data on user engagement and educational impact. Use this feedback to refine the application, making iterative improvements to enhance the VR experience.

## **1.5 Scope**

This project aims to create a Virtual Reality (VR) Museum for the Anatomy and Pathology Department at Universiti Malaysia Sarawak (UNIMAS) to help medical students learn better. The VR Museum will look like a real museum and will include 3D models of important anatomical and pathological specimens.

In addition, these models will be accurate and detailed, using data from the UNIMAS museum and other resources since photographing the real specimens is not allowed. The project will make the models interactive, letting students explore the specimens by rotating them, zooming in, and learning more about each part.

## **1.6 Significance Of Project**

- Solves Photography Restrictions:

Since the physical museum does not allow photos of specimens, the VR Museum provides 3D models that students can study outside the museum.

- Enhances Learning Through Interaction:

Students can interact with 3D models of organs and bones in the VR Museum, helping them understand complex structures better by manipulating and exploring them in ways not possible in the real museum.

- Flexible Learning Environment:

The VR Museum gives students more flexibility to study outside of regular classroom hours, making it easier to review materials when needed.

## 1.7 Project Schedule

For this project, the timeline of 1-year (6-months on FYP1 and another 6-months on FYP2) is given. The Gantt Chart for showing the schedule for the whole FYP is attached on the appendix.

## 1.8 Expected Outcome

The expected outcomes of the PathoSphere project are as follows:

### 1. **Functional VR Museum Prototype**

A fully functional and immersive Virtual Reality Museum developed using Unity and deployed on Meta Quest 3, replicating the experience of the UNIMAS Anatomy & Pathology Museum.

### 2. **Improved Accessibility to Learning Content**

Students and users will be able to access anatomical and pathological content remotely and at any time, overcoming the time and capacity limitations of the physical museum.

### 3. **Interactive Learning Features**

The system will include interactive 3D models with features such as object rotation, zoom, labels, audio guides, and quizzes to support in-depth exploration and better understanding of biological structures.

### 4. **Enhanced User Engagement and Learning**

The immersive and interactive nature of the VR museum is expected to increase user engagement, comprehension, and retention of anatomical and pathological concepts.

### 5. **Validated Usability and Educational Value**

Through User Acceptance Testing (UAT), the system will be validated for its usability, performance, and effectiveness in supporting anatomy education, with positive feedback from users.

## 1.9 Project Outlines

This project is organised into six main chapters, each detailing a specific phase of the PathoSphere development process:

- **Chapter 1: Introduction**

Introduces the concept of Virtual Reality (VR) and its relevance in medical education. This chapter outlines the problem statement, project aim and objectives, methodology, scope, and significance of the project.

- **Chapter 2: Literature Review**

Provides an overview of existing VR applications in education and museum experiences. It compares similar systems and identifies gaps that PathoSphere aims to address.

- **Chapter 3: Requirement Analysis and Design**

Discusses the requirements gathered from stakeholders, including functional and non-functional specifications. It also covers the design phase, including use case diagrams, UI wireframes, and interaction flows.

- **Chapter 4: Development and Implementation**

Describes the tools, software, and processes used to build the PathoSphere VR museum. This includes the creation of 3D models, VR scenes, user interfaces, and interactive components using Unity and Meta Quest 3.

- **Chapter 5: Testing and Evaluation**

Presents the testing strategies used to validate the system, including functional, non-functional, and usability testing. It also evaluates user feedback on comfort, learning effectiveness, and overall experience.

- **Chapter 6: Future Work and Conclusion**

Summarises the achievements and limitations of the project, and proposes future enhancements such as content expansion, AI chatbot integration, and multilingual support.

# Chapter 2 : Literature Review

## 2.1 Introduction

This chapter looks at research and studies about using Virtual Reality (VR) in education, especially in medical learning and museums. Virtual Reality (VR) creates entirely immersive, computer-generated environments that replace our perception of the real world, making learning more engaging (Eisenberg, 2022). Virtual Reality, Augmented Reality, Mixed Reality, and Extended Reality represent a rapidly evolving landscape of immersive technologies that are transforming various aspects of our lives. While each technology presents a distinct approach to interacting with reality, they are interconnected, forming a continuum of increasingly immersive experiences. Understanding the unique capabilities and limitations of each technology is crucial for their effective application in diverse fields, from education and healthcare to entertainment and industry. Addressing the challenges related to cost, standardization, ethics, and accessibility will be essential to unlocking the full potential of these transformative technologies. In anatomy and pathology, VR allows students to explore complex structures in a virtual space, which helps overcome the limitations of physical museums and traditional teaching methods.

This chapter reviews existing systems and apps that use VR in education, discussing their strengths, weaknesses, and how they improve learning. By studying these examples, we can identify useful features and technologies that can be applied to the development of the VR Museum for the Anatomy and Pathology Department at Universiti Malaysia Sarawak (UNIMAS). It will also compare the proposed VR Museum with other similar VR systems and applications that already exist, highlighting how they are used in education and what can be learned from them.

## 2.2 Review on Existing Systems/Applications

### 2.2.1 Gamified Immersive Museum Experience for Engineering and Design Heritage



Figure 0.1: *Gamified Immersive Museum Experience for Engineering and Design Heritage* (Alatrash, 2023)

*Gamified Immersive Museum Experience for Engineering and Design Heritage* (Figure 2.1) was created as part of a collaborative research project led by Saif Alatrash, Sylvester Arnab, and Kaja Antlej from institutions including Coventry University in the UK and Deakin University in Australia. This research used virtual reality to enhance the interpretation and engagement of museum visitors with engineering heritage through storytelling and gamification strategies (Alatrash et al., 2023).

The project aimed to use virtual reality (VR) to improve how visitors understand and engage with engineering heritage in a museum context. Its objectives included:

- Preserving and presenting engineering artefacts digitally.
- Enhancing visitor experiences through immersive storytelling and gamification.
- Bridging the gap between traditional museum exhibits and modern interactive technology to make heritage accessible to a broader audience.

The VR application features three distinct scenarios:

- The "Immersive" scenario, which provides an immersive virtual environment representing the Lanchester workshop.
- The "Narrated" scenario, which enhances the VR experience with narratives and storytelling to guide the user's exploration.
- The "Gamified" scenario, which incorporates gamification strategies on top of the narrated version to encourage more interactive engagement with the heritage artifacts and context.

The software used to design and develop the project:

- 3D Modelling and Texturing:
  1. Blender: For creating detailed 3D models of artefacts and environments.
- Game Development:
  1. Unreal Engine: Built the VR experience and incorporated real-time interactions.
  2. Meta Quest 3: Used as the primary VR headset for testing and deployment.
- Design Framework:
  1. Followed the Mechanics, Dynamics, and Aesthetics (MDA) framework to align interactive elements with storytelling goals.

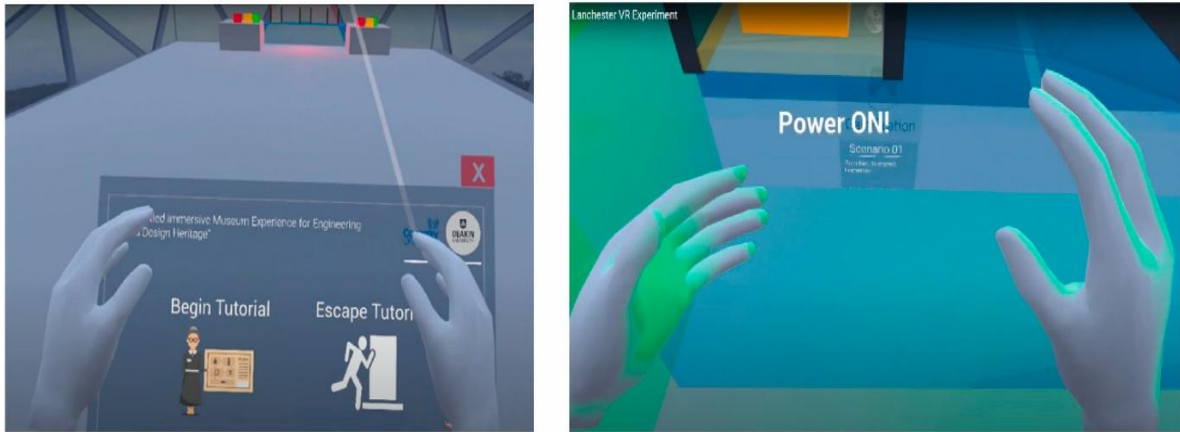


Figure 0.2 : The Tutorial inside Gamified Immersive Museum Experience for Engineering and Design Heritage

Based on figure above (Figure 2.2), the interface appears user-friendly, with intuitive buttons like "Begin Tutorial" and "Escape Tutorial," which simplify navigation for first-time users. Icons and text are clear and easy to understand, which is essential in VR to avoid cognitive overload. The inclusion of visible hands enhances immersion, allowing users to feel more connected to the virtual environment and interact naturally with the surroundings. The background and interface appear uncluttered, which helps users focus on tasks or exhibits without unnecessary distractions.

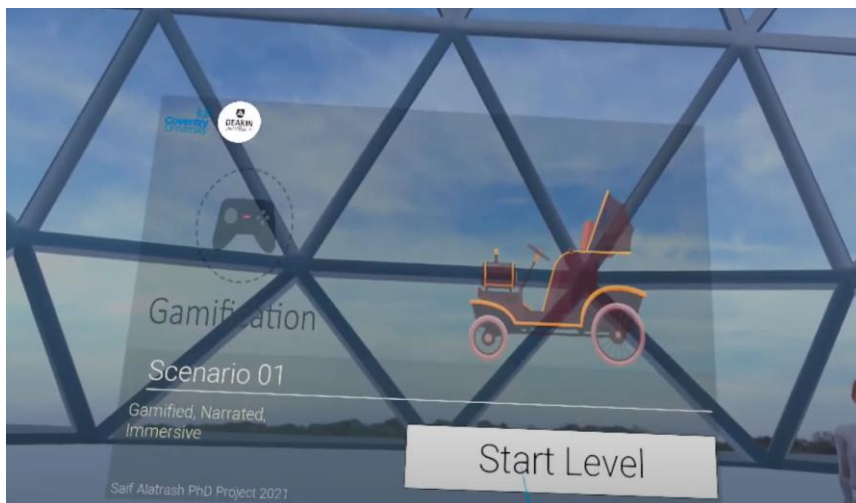


Figure 0.3 : Level Select Option interface

One of the downsides of the Gamified Immersive Museum Experience for Engineering and Design Heritage is that users must pick a level or stage before they can access the main content. This can be a problem for some users who might prefer to explore the museum freely

and discover things on their own. Having to choose a stage first might stop them from interacting with the content naturally or stumbling upon interesting stuff by chance.

### 2.2.2 UNIMAS Anatomy & Pathology Museum (Physical Museum)

The Anatomy & Pathology Museum at Universiti Malaysia Sarawak (UNIMAS) is a place where medical and health sciences students learn about the human body and diseases. It is designed to help them study human anatomy and understand different medical conditions using real specimens, giving them a more hands-on way to learn.



*Figure 0.4 : Artificial Human Anatomy being showcased inside the museum.*



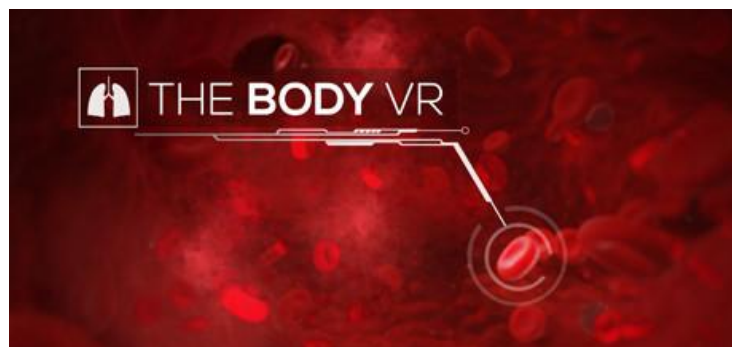
*Figure 0.5 : Different type of artificial specimen being showcased*

Based on Figure 2.4 and Figure 2.5, this is how currently the museum displays the models or specimens. Most of the specimens are kept inside a protected casing, to prevent people from touching or interacting with them.

**The objectives of this museum are:**

- Allow students and visitors to interact with real and artificial anatomical and pathological specimens to deepen understanding.
- Document and classify all exhibits with detailed descriptions, including their medical and scientific significance.
- Maintain and safeguard anatomical and pathological specimens to ensure their longevity for future educational use.

**2.2.3 The Body VR :Journey Inside a Cell**



*Figure 0.6 : The Body VR : Journey Inside a Cell*

*The Body VR: Journey Inside a Cell*, developed by The Body VR LLC, is a VR educational application that allows users to explore the human body at a microscopic level. It takes users on a virtual journey inside the human body, providing an immersive experience of the body's systems, including the cardiovascular system and individual cells. In this VR environment,

users can interact with various biological structures, gaining a deeper understanding of how cells function and how diseases affect the body.

The app uses detailed 3D models and simulations to educate users about anatomy and physiology, allowing them to explore cells, organs, and biological processes in ways that are impossible with traditional methods. The ability to interact with and visually explore complex biological systems makes this app a powerful educational tool for students and medical professionals.

The scope of *The Body VR: Journey Inside a Cell* is to create a fun and immersive way for people to learn about human cells. Using virtual reality, it lets users explore 3D models of cell structures like the nucleus and mitochondria and see how processes like protein-making and energy production happen. The game is designed for VR platforms, so it's easy for students, teachers, and anyone curious about biology to use. It makes learning interactive and exciting by guiding users through the cell with helpful explanations and activities. The goal is to make understanding biology easier and more enjoyable, especially for students who find traditional methods boring or hard to follow.

The objectives of *The Body VR: Journey Inside a Cell* are:

- **Enhance Understanding:**

To provide a deeper understanding of cellular biology through interactive, immersive learning experiences that are difficult to achieve using traditional methods like textbooks or static visuals.

- **Foster Engagement:**

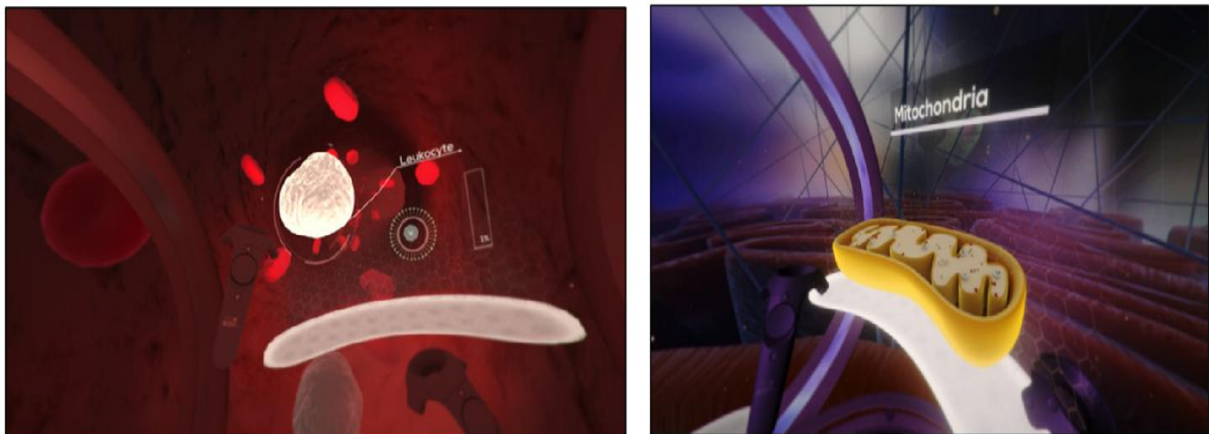
To make learning more appealing by using gamified VR environments that stimulate curiosity and interest in biology.

- **Bridge Knowledge Gaps:**

To offer a practical visualisation tool that bridges the gap between theoretical concepts and real-life biological processes.

- **Promote Educational Innovation:**

To showcase how VR can revolutionise the teaching of complex subjects such as cellular biology.



*Figure 0.7: The Body VR: Journey Inside a Cell Gameplay*

#### **2.2.4 3D Virtual Reality Game For Google Cardboard (Flying Kite)**



*Figure 0.8: Preloader Scene (Payendenick, 2024)*

*3D virtual reality (VR) game for Google Cardboard (Flying Kite) by Muhammad Payendenick, inspired by local traditional games, simulates the experience of flying a kite. The primary goal is to make these traditional games accessible to a wider*

audience through modern technology, while simultaneously preserving cultural heritage (Payendenick, 2017). The use of Google Cardboard as the target platform is strategic, given its affordability and accessibility, enabling a wider reach. The choice of Unity3D, with its native integration with Google VR, simplifies the development process for Android applications.



Figure 0.9: Menu to choose game levels (Payendenick, 2017).

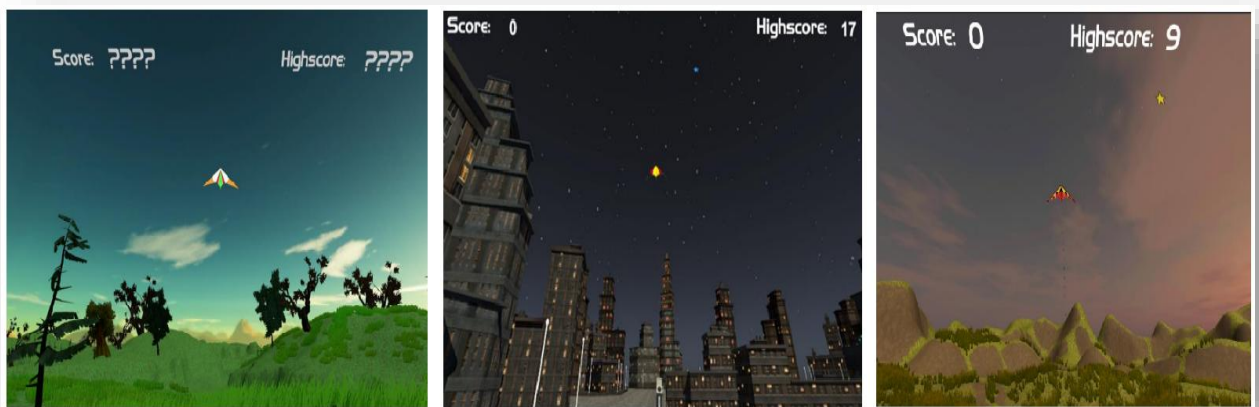


Figure 0.10: Different environments for different levels (Payendenick, 2017).

The game is a virtual reality kite-flying experience that allows users to interactively fly a kite. Based on Figure 2.9 and Figure 2.10, players can explore three distinct environments: **Urban**, **Wasteland**, and **Grassland**, designed to replicate features of real-world settings (Payendenick, 2017).

The limitations of this project are:

*Table 0.1: Flying Kite Limitations*

Limitations	Description
Hardware Limitation	The project depends on users having access to VR-capable devices such as smartphones compatible with Google Cardboard. Users without these devices are unable to experience the game, which limits accessibility, especially for those with lower-end hardware.
Basic User Interaction	User interaction is mainly limited to head movements for navigation and selection. More advanced controls such as hand gestures, voice commands, or external controllers were not supported, which could affect user engagement and immersion.
Scalability Issues	The game is designed specifically for Google Cardboard and may not perform well on other VR platforms without significant adjustments. Porting to more advanced headsets or platforms would require further development work.

## 2.3 Comparison on Existing Applications and the proposed Application

Table 0.2: Comparison of Existing Project and Application with the Proposed Project

Features	Gamified Immersive Museum Experience for Engineering and Design Heritage	UNIMAS Anatomy & Pathology Museum (Physical Museum)	The Body VR :Journey Inside a Cell	3D Virtual Reality Game For Google Cardboard (Flying Kite)	PathoSphere
Virtual Reality	✓	✗	✓	✓	✓
Interactable 3D Models	✓	✗	✓	✓	✓
Accessibility	Anytime	Accessible only when the museum is open.	Anytime	Anytime	Anytime
Navigation	✓	✓	✓	✗	✓
Head Tracking	VR Gear	None (Physical Museum)	VR Gear	Google Cardboard	VR Gear
Environment	Immersive	Fully-Immersive	Immersive	Semi-Immersive	Immersive

## **2.4 Brief Overview of the Proposed Project**

The proposed VR Museum for Anatomy and Pathology aims to create an immersive and interactive educational environment where users can explore human anatomy and pathology in depth. Utilizing advanced virtual reality technology, the museum will feature realistic 3D models of various organs, systems, and pathological specimens, allowing users to study them from multiple angles and perspectives.

### **Summary**

In summary, the proposed VR Museum for Anatomy and Pathology at University Malaysia Sarawak (UNIMAS) represents a modern approach to learning about the human body and diseases. By using virtual reality technology, the museum offers an engaging and interactive experience that enhances traditional education methods.

Key features include interactive 3D models of organs and systems, helpful educational content, support for multiple users, and realistic simulations of diseases. These elements work together to create a better learning experience for medical students, teachers, and researchers.

The museum will be accessible on various devices, allowing users to explore its resources from anywhere. As it continues to grow and update, the museum will provide the latest information and keep the experience fresh. Overall, the VR Museum at UNIMAS aims to improve understanding of anatomy and pathology, sparking curiosity and promoting deeper learning in these important areas.

# Chapter 3 : Requirement Analysis and Design

## 3.1 Introduction

In the field of computer science, **requirements analysis and design** play pivotal roles in the development of software systems (Sommerville, 2011). These phases ensure that a project is well-grounded in user needs and technical feasibility while providing a solid framework for implementation.

**Requirements analysis** focuses on gathering, understanding, and documenting the needs and expectations of stakeholders, including end-users, educators, and institutional administrators. For the PathoSphere VR project, this phase involves defining the functional and non-functional requirements of a virtual reality-based Anatomy and Pathology Museum, ensuring it addresses existing challenges such as limited physical access, time constraints, and restricted interaction with the exhibits.

The **design phase** builds upon these requirements by outlining the structure, components, and interactions of the proposed system. This involves designing the VR environment, user interactions, data integration for organ models, and an intuitive interface that promotes immersive and educational experiences. Key objectives include ensuring usability, scalability, and efficient system performance while aligning with the educational goals of the University Malaysia Sarawak (UNIMAS).

To achieve these goals, this project adopts the **Agile methodology**, a flexible and iterative approach to software development that emphasises collaboration, adaptability, and continuous improvement. Agile divides the workflow into multiple phases: **planning, designing, developing, testing, and refining**. This structured yet dynamic approach enables the team to respond to evolving requirements, integrate user feedback at each stage, and ensure the delivery of a high-quality VR system that aligns with user needs and educational objectives.

This chapter details the analysis of system requirements, including technical and user-based specifications, and outlines the design strategies used to bring the PathoSphere VR project to life.

## 3.2 Agile Methodology

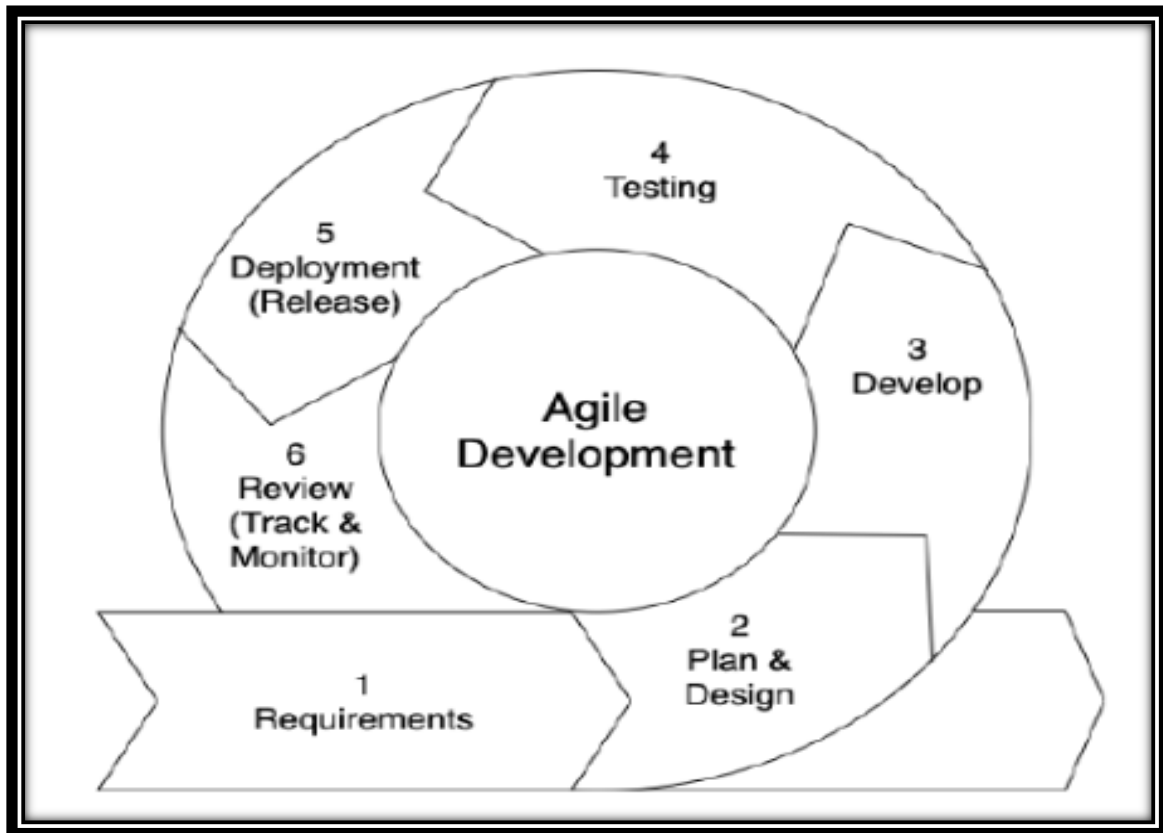


Figure 0.1: Agile Methodology (Omonije, 2024)

The Agile methodology is adopted in this project due to its iterative and adaptable approach, ensuring the development of the PathoSphere VR system remains user-centric and responsive to feedback. The process is divided into several phases: planning, designing, developing, testing, and refining, enabling continuous improvement throughout the development lifecycle.

### 3.2.1 Planning

The planning phase involved collaborating is to identify the objectives of the VR-based Anatomy and Pathology Museum. Surveys and interviews were conducted to understand their expectations and points with the current learning environment. Key project goals were defined, including creating an immersive and interactive VR experience that overcomes physical and time-based limitations of the traditional museum.

### 3.2.1.1 Survey

A survey was conducted to better understand the users, which are publicly targeted. The survey consisted of four sections that the respondents were required to answer. The first section focused on the participant's Demographic, the second section addressed Preferences for VR Features, and the third section explored the Accessibility and Technical Requirements of the Virtual Reality Museum, and lastly their General Feedback. A total of 29 participants accepted and agreed to the terms and conditions of the survey.

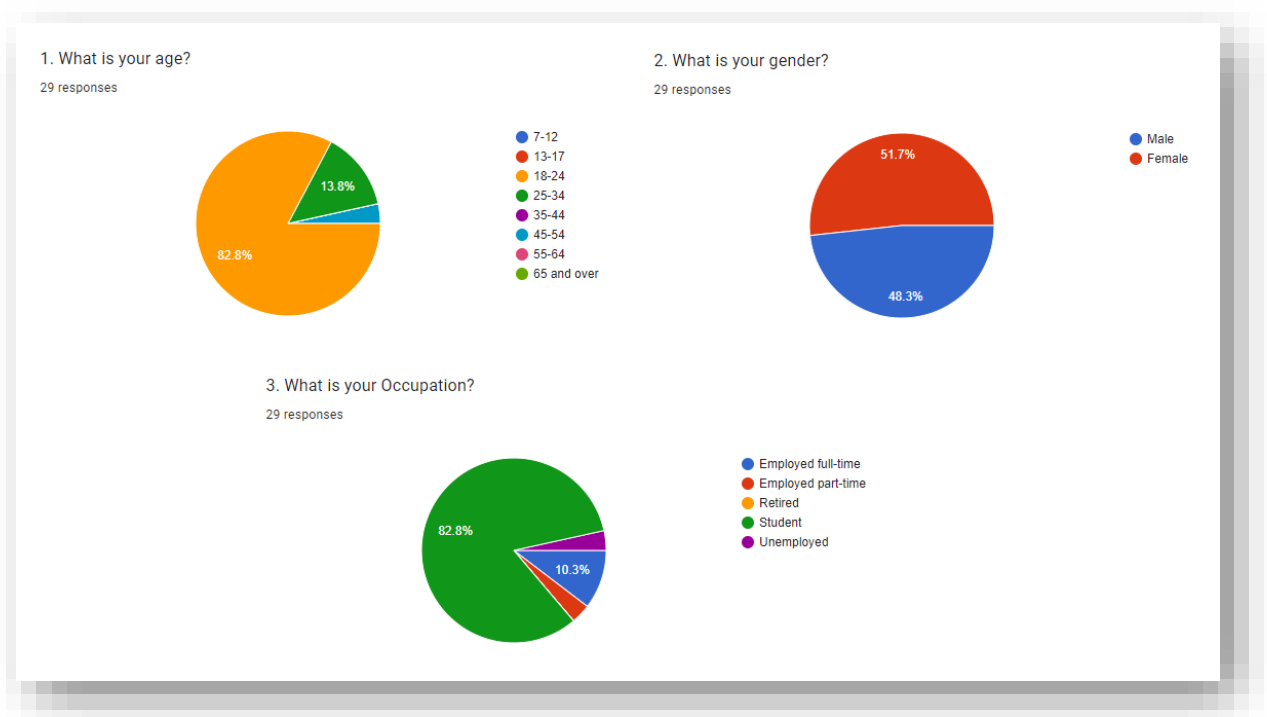


Figure 0.2 : Participants demographic taken from survey

Figure above shows a majority of participants are 18 to 24 years old (82.7%), and also majority of them are students (82.8%). This aligns well with the target audience for the VR museum, as it is likely to serve students who are studying anatomy, pathology, or related fields. The small percentage of participants in other age groups suggests limited interest or relevance to older demographics.

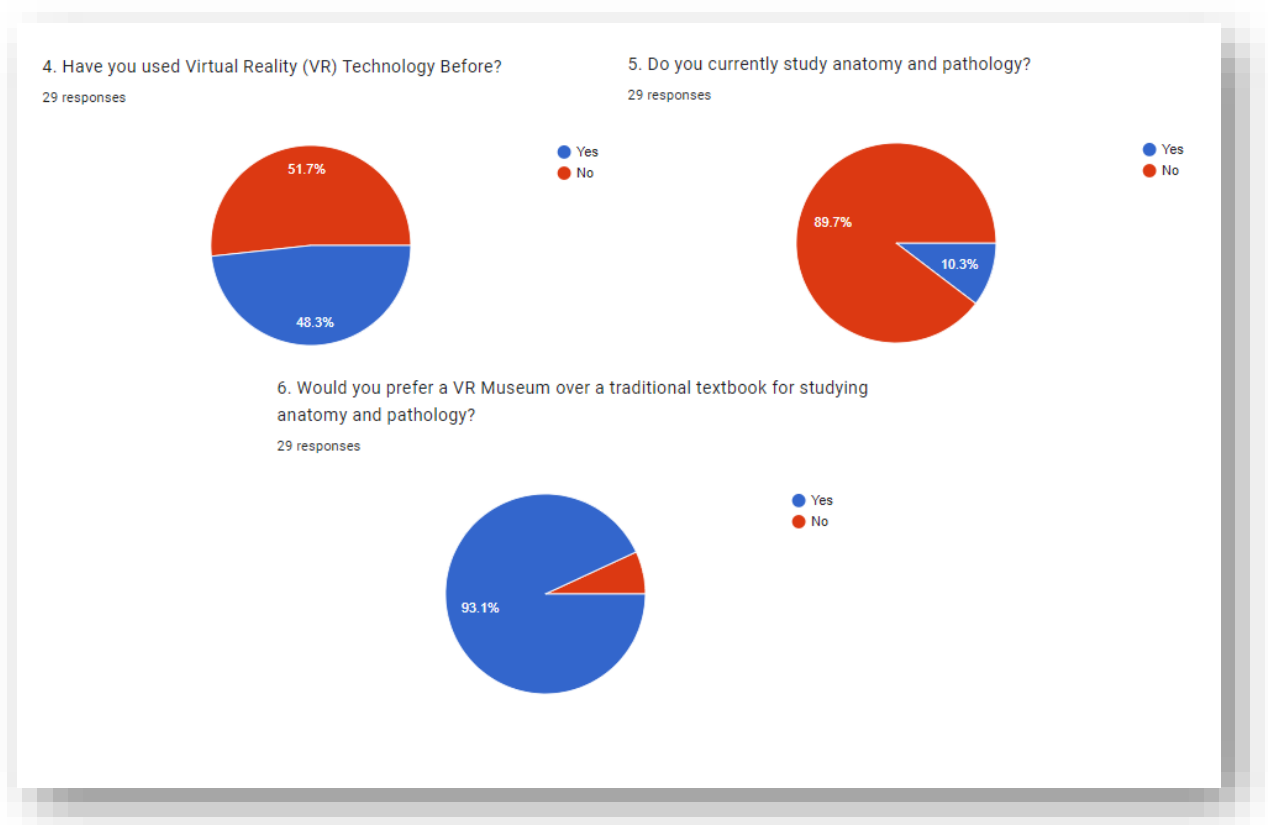
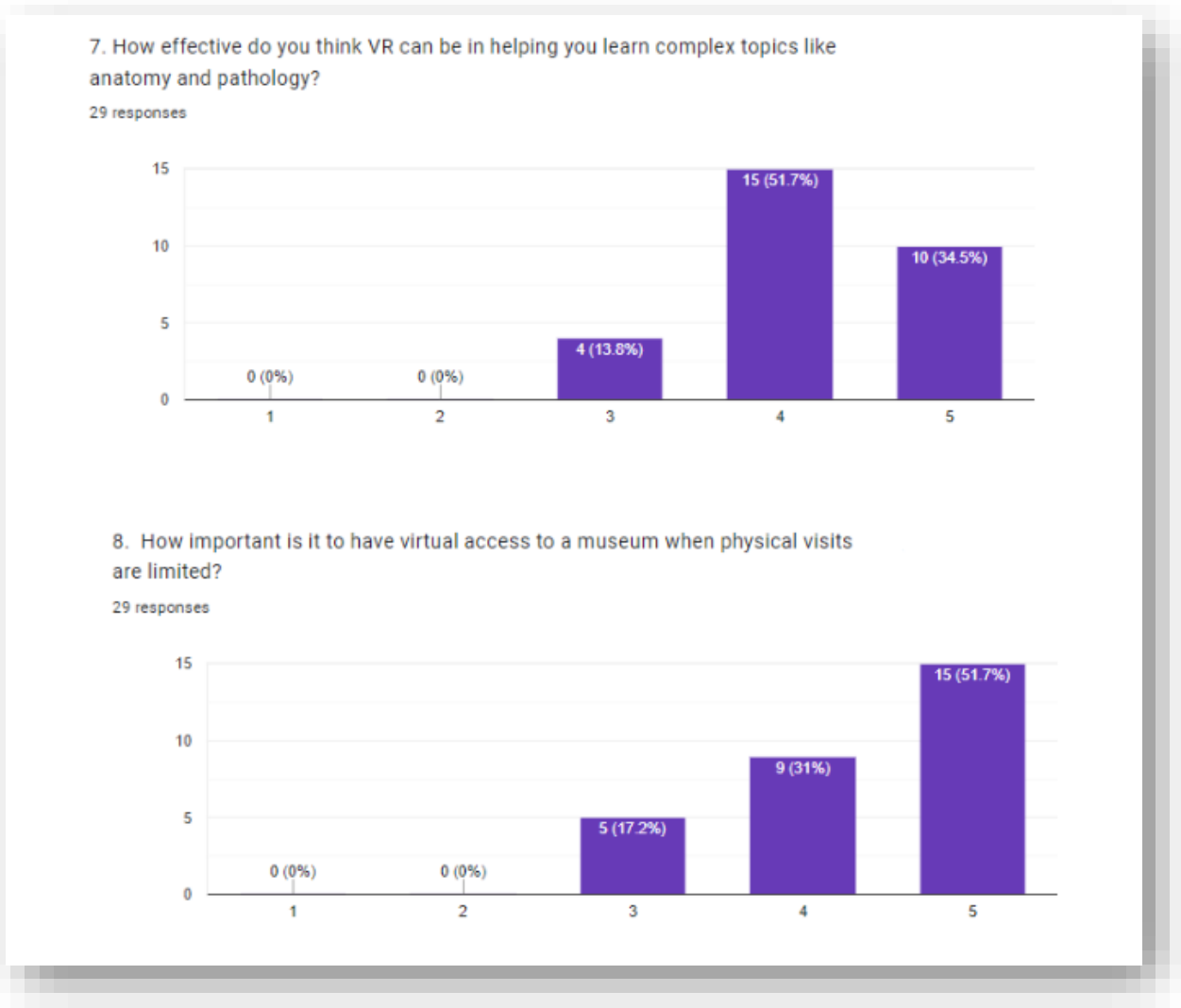


Figure 0.3 : Participants' familiarity with Virtual Reality (VR)

The responses indicate that 51.7% of participants have not used VR technology before, while 48.3% have. This highlights the need to design a user-friendly and accessible interface for first-time VR users. Only 10.3% of respondents are currently studying anatomy and pathology, while 89.7% are not. This suggests that the VR museum should cater to both anatomy students and a broader audience, possibly as an educational tool for those curious about the subject. An overwhelming 93.1% of respondents indicated they would prefer a VR museum over a traditional textbook. This result strongly validates the importance of this project, as it confirms that users see significant value in an interactive and immersive learning experience. The VR museum has the potential to revolutionise the way students engage with anatomy and pathology concepts.

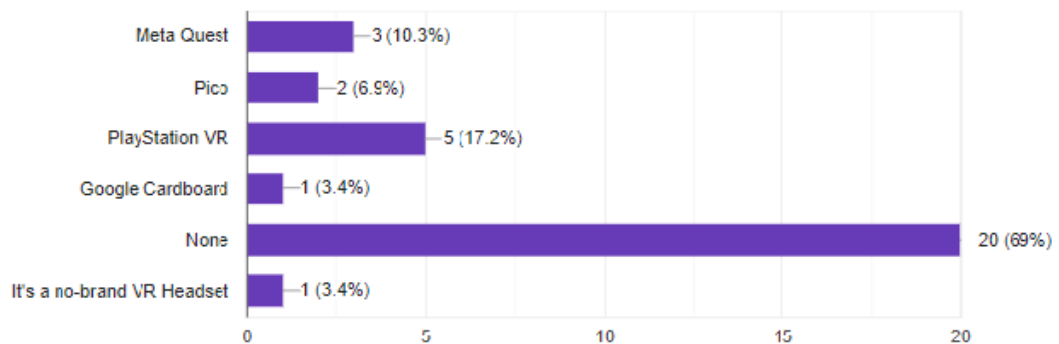


*Figure 0.4 : Participants' response on the learning needs for the VR Museum*

A significant majority of respondents rated the effectiveness of VR as either **4 (51.7%)** or **5 (34.5%)** on the scale. This indicates that most participants believe VR has strong potential as a tool for learning complex subjects like anatomy and pathology. It reinforces the idea that interactive and immersive VR technology can simplify challenging concepts and improve comprehension for students. Virtual access to museums is seen as a crucial alternative when physical visits are not feasible as the majority of participants rated the importance as **5 (51.7%)** and **4 (31%)**. This feedback highlights the relevance of your project in addressing challenges such as geographical barriers, limited museum access, or restrictions on physical attendance. A virtual museum provides an inclusive and flexible solution for users.

14. Do you have access to a VR headset or compatible device?

29 responses



15. Would you consider using the VR Museum on a non-VR device like a laptop or tablet? (Multiple Choice Answers)

29 responses

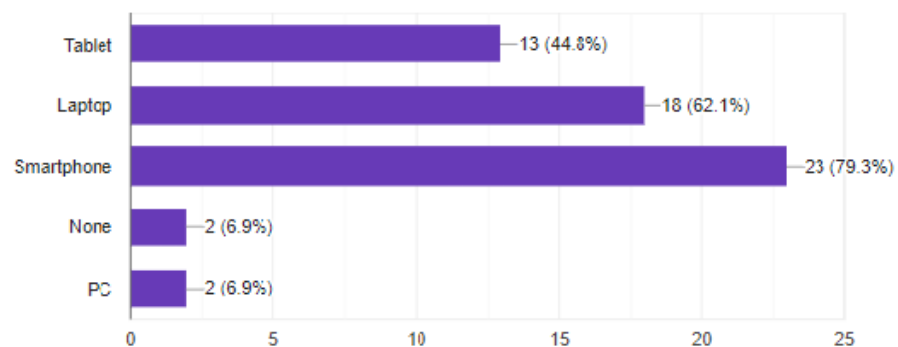
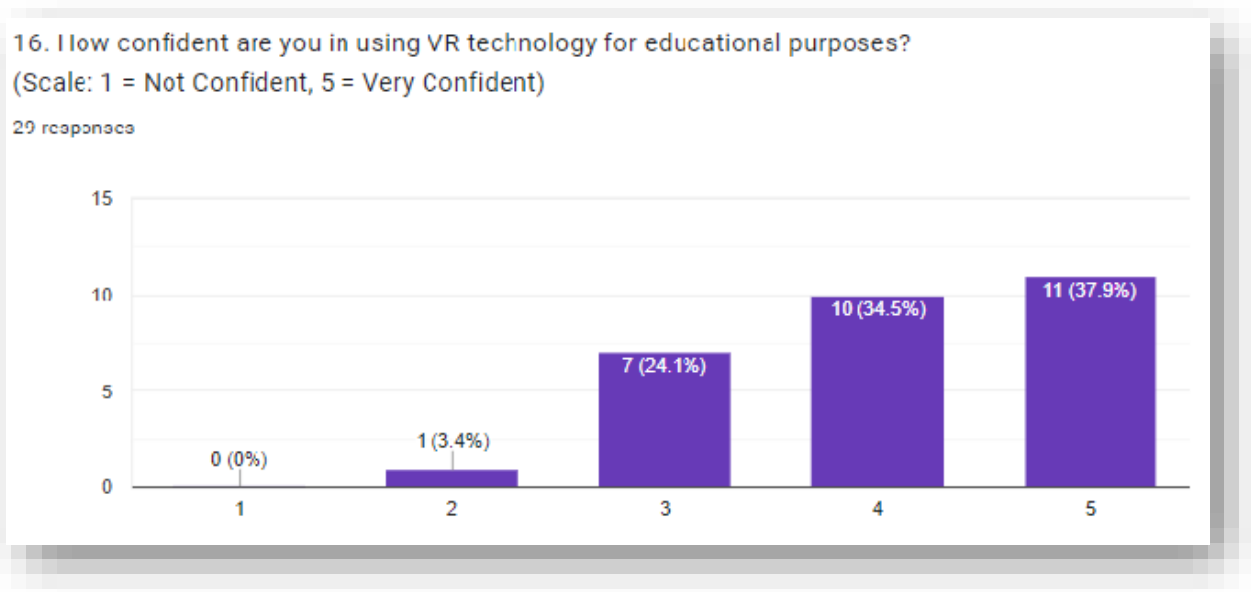


Figure 0.5: Participants' accessibility to VR device

Survey shows that most of the participants does not own any VR gear (69%) but also majority of them would consider using smartphone as the alternative (79.3%). This response suggests that smartphones could serve as a practical and cost-effective solution to increase accessibility to VR experiences. By leveraging smartphones, users could access VR content through apps or basic VR setups, such as Google Cardboard or similar smartphone-compatible VR devices. This approach eliminates the need for expensive VR equipment while still providing users with an engaging and immersive experience.

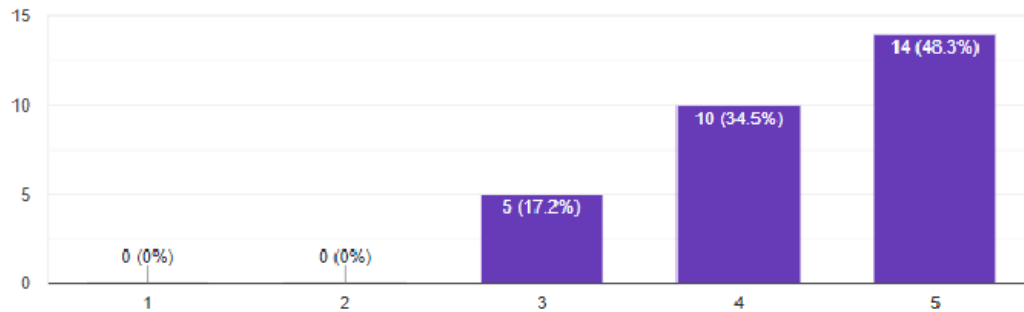


*Figure 0.6: Participants' confidence on using VR technology*

According to the figure above shows that majority of participants are **very confident (37.9%)** and **confident (34.5%)** on using VR technology. The high confidence levels suggest that most participants are not intimidated by VR technology and are willing to engage with it. This is a positive indicator for your project, as it implies a smoother adoption process for the VR museum.

21. How important is it to include supplementary materials like videos or diagrams alongside the 3D models? (Scale: 1 = Not Important, 5 = Very Important)

29 responses



22. How engaging do you think the VR Museum would be compared to traditional learning methods? (Scale: 1 = Not Engaging, 5 = Very Engaging)

28 responses

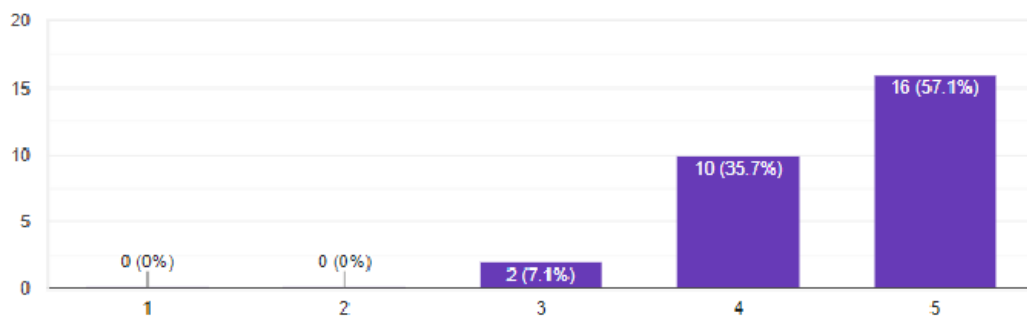


Figure 0.7: Participants' opinions about 3D Models and its effectiveness.

Figure above shows a significant **82.8%** of the respondents rated the importance of supplementary materials as either **4 or 5**. This indicates that most participants strongly value additional resources, such as videos and diagrams, to enhance their learning experience and deepen their understanding of the 3D models. To cater to this preference, the VR museum should include integrated videos, annotated diagrams, and additional textual content within the environment. These features could be placed interactively, allowing users to access them alongside the 3D models.

Do you have any suggestion you want to add for this project? (Leave blank if there is none.)

5 responses

No

Use easier term/vocab to explain the model so everyone can understand it.

All is great specially if you can freely explore the area and interact with.

Instead of text maybe can use audio to explain 3D model. Use a lay audience vocabulary for explanation so that everyone can understand.

*Figure 0.8: Participants' suggestions*

Most of the respondents suggested using simpler terms or explanations to cater to a lay audience. This feedback underscores the importance of accessibility in the VR museum, ensuring that users with varying levels of anatomical knowledge can effectively engage with the content.

### 3.2.1.2 Functional Requirements

- User should be able to interact with the User Interface (UI).
- User should be able to move around inside the PathoSphere.
- User should be able to exit the VR Museum application.
- User should be able to enable and mute the sounds.
- User should be able to interact with the 3D Models.
- User should be able to view the tutorial.
- User should be able to reset the tour.
- User should be able to interact with the AI Chatbot.

### 3.2.1.3 Non-Functional Requirements

- User should be able to install PathoSphere.
- User should be able to enter PathoSphere using VR Headset.
- User should be able to recognize controls easily.
- The system should be available all the time.
- The system should be able to load the 3D Models fast.

### 3.2.1.4 Software Specifications

#### 3.2.1.2.1 Tools and Technologies

Table 0.1 : Software Specifications

Software Tools	Description
Unity3D	For VR environment development that support 3D game development.
Blender	For creating, editing and animating 3D anatomical models.
Audacity	For audio editing and voice narration.

### 3.2.1.4.2 Programming Language

Table 0.2: Programming Language

Programming Language	Description
C#	C# is a versatile, object-oriented programming language developed by Microsoft. It is commonly used in Unity3D.

### 3.2.1.5 Hardware Specifications

#### 3.2.1.5.1 Virtual Reality Hardware (Meta Quest Headsets)

Table 0.3: Virtual Reality Hardware

Category	Hardware
Processor	Snapdragon XR2+
RAM	6GB+
Storage	64GB or above
Tracking	Inside-out tracking with six degrees of freedom (6DoF)
Battery Life	Approximately 2–3 hours of continuous usage.

#### 3.2.1.5.2 PC/Workstation (for PC VR Streaming or Testing)

Table 0.4: PC/Workstation (for PC VR Streaming or Testing)

Category	Hardware
Processor	Minimum: Intel Core i5-4590 / AMD Ryzen 5 1500X
GPU (Graphics Card)	Minimum: NVIDIA GTX 970 or AMD RX 480
RAM	8GB+ DDR4
Storage	256GB SSD or above
USB Ports	At least one USB 3.0 port for Oculus Link connection with Meta Quest (if using PC VR mode)
Operating System	Windows 10 or later (for VR development compatibility with Unity/Unreal Engine and Oculus SDK)

### **3.2.2 Designing**

In the design phase, comprehensive planning for the VR environment was carried out. This included creating wireframes, storyboards, and 3D models for anatomical specimens and pathological exhibits. Design priorities focused on accurate representation of organs, engaging user interactions, and intuitive navigation within the virtual space. Collaboration with the health department ensured the content adhered to educational standards.

#### **3.2.2.1 Activity Diagram**

A UML activity diagram shows the dynamic aspects of a system and helps to illustrate the activities involved in a process. As Sommerville (2011) explains, "Activity diagrams are meant to show the tasks that make up a system's process and how control flows from one task to another." The activity diagram in Figure 3.9 shows the steps a user needs to take in order to interact with the user interface.

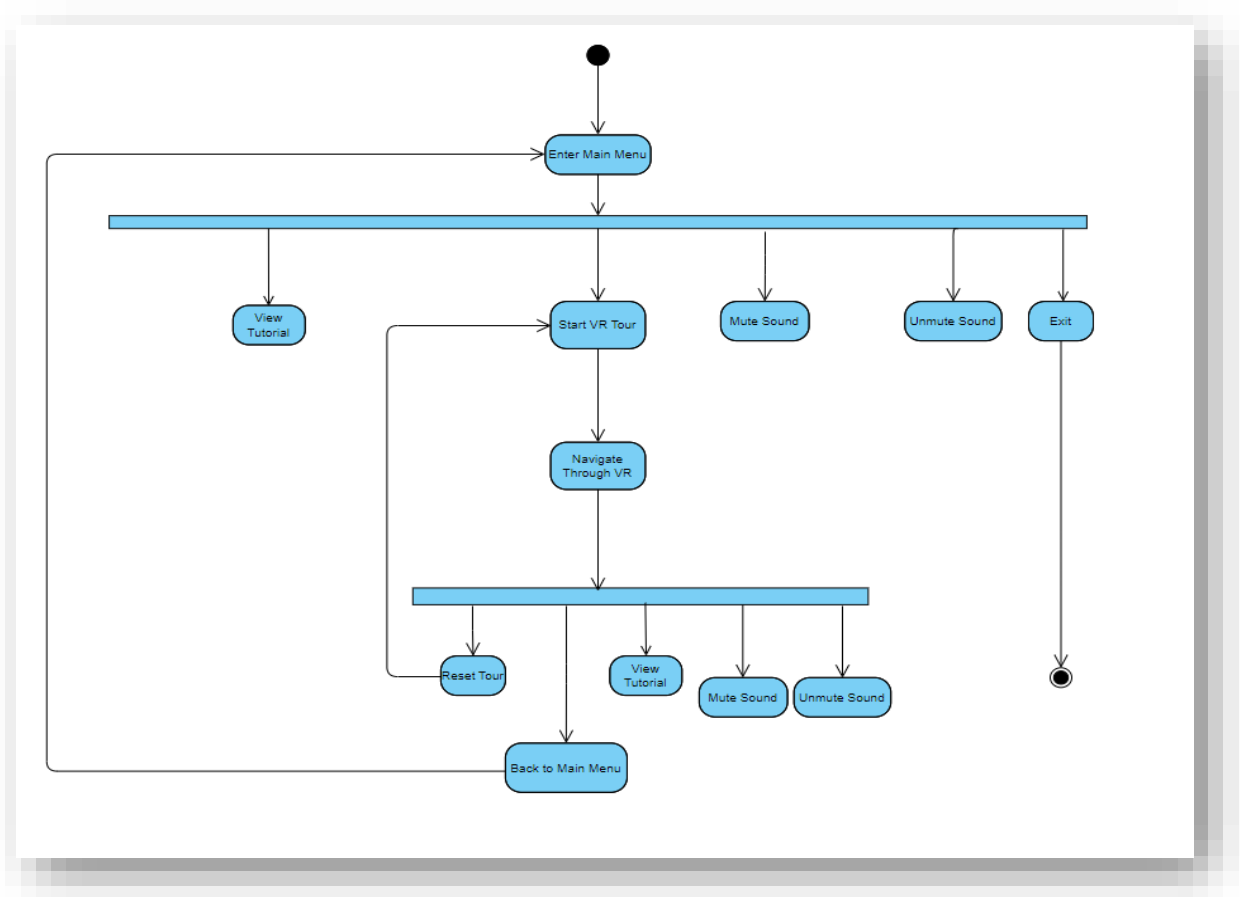


Figure 0.9 : Activity Diagram

### 3.2.2.2 Use Case Diagram

A use case diagram visually represents the interactions between users (actors) and the system. It helps identify system requirements and showcases how users will engage with various features of the application. The use case diagram illustrates key user interactions, including exploring 3D models, accessing detailed descriptions of anatomical specimens, and performing guided tours. Figure 3.2 shows the Use Case diagram for using the VR and describes how the user interacts with the system.

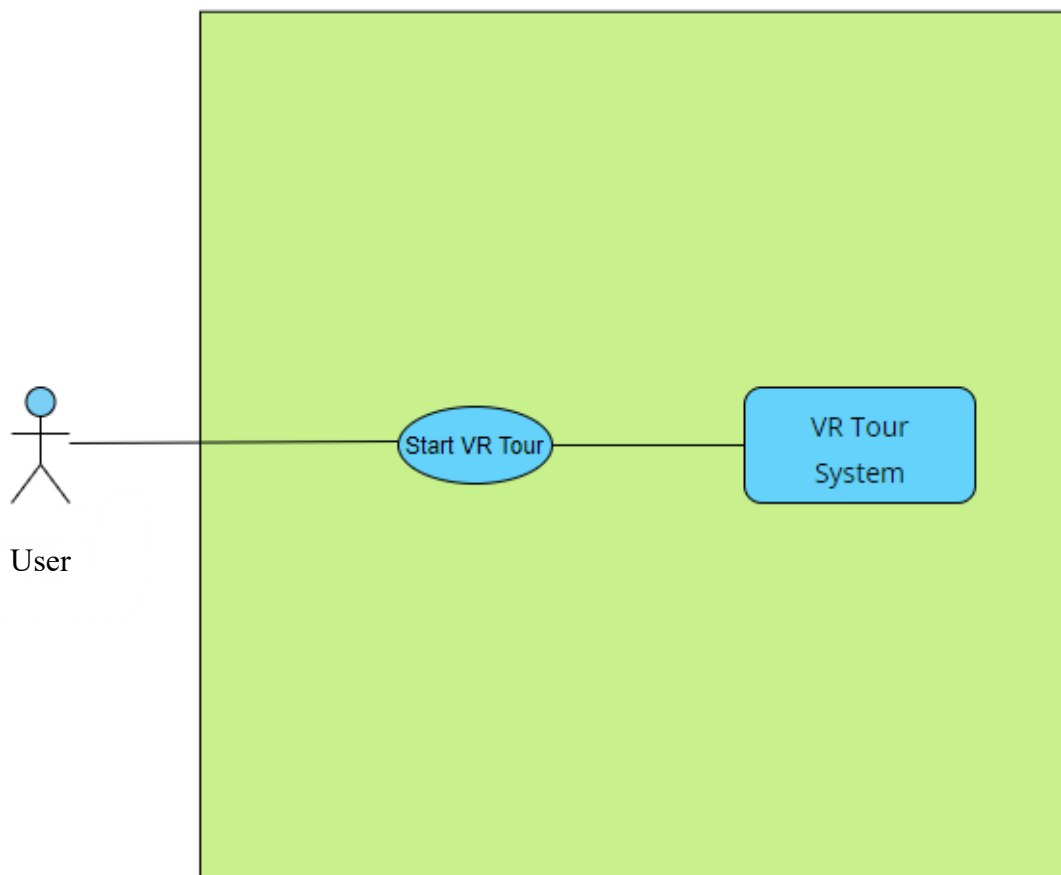


Figure 0.10: Use Case Diagram to Start the VR Tour

Table 0.5 : Use Case: Start VR Tour

Use Case Name	Start VR Tour
Main Actor	User
Goal	Start the VR Museum Tour
Precondition	<ul style="list-style-type: none"> <li>• The user is using a VR Headset</li> <li>• The user has installed the application.</li> </ul>
Trigger	User starts the application.
Main Course of Action	<ol style="list-style-type: none"> <li>1. User starts the application.</li> <li>2. User starts the VR Tour.</li> <li>3. The application loads all the 3D Models, Assets and Scenes.</li> <li>4. The audio is enabled by default.</li> </ol>

	5. The animated objects loads the animations.
Exceptional Course of Action	1. Application is closed/exited by the user. 2. The device is switched off.

The second use case (Figure 3.4) is about how the user interacts with the main components of the VR Tour.

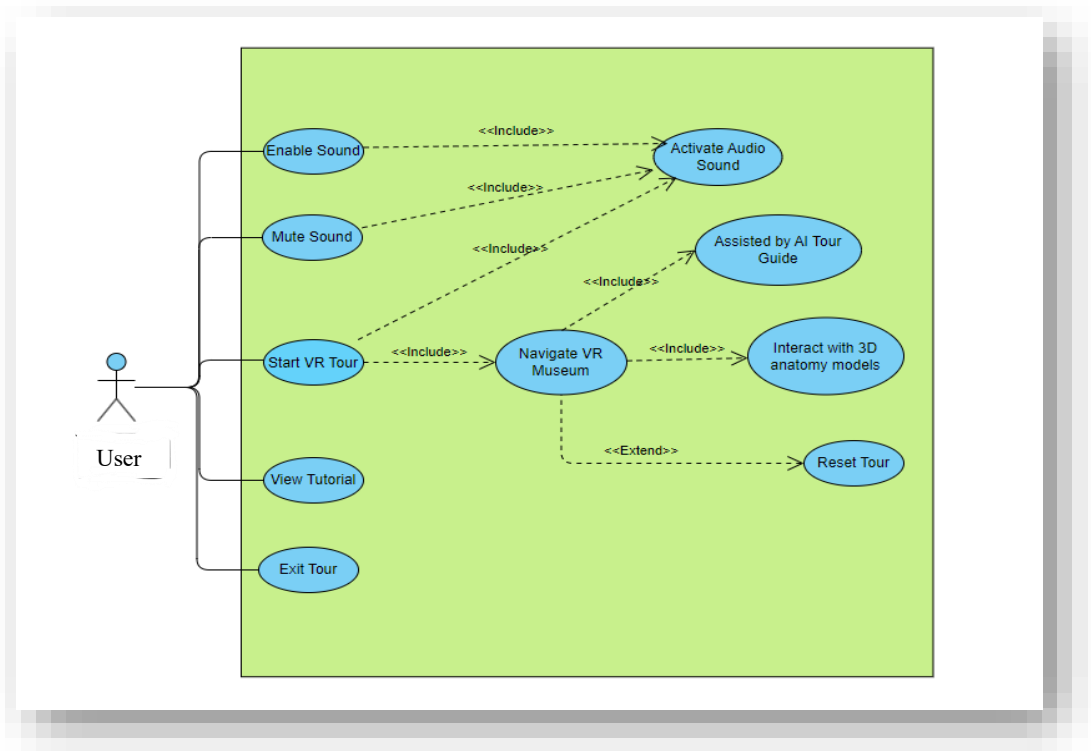


Figure 0.11: Use Case Diagram for VR Tour Main Component

Table 0.6 : Use Case : Enable Sound

Use Case Name	Enable Sound
Main Actor	User
Goal	To play the audio, mute or unmute the audio.
Precondition	The application is fully loaded.
Trigger	User choose the mute/unmute button.
Main Course of Action	1. The audio is activated once the application is fully loaded. 2. User points and press on the mute/unmute audio button. 3. The audio mutes or unmutes based on the user action.

Exceptional Course of Action	<ol style="list-style-type: none"> <li>1. Application is closed/exited by the user.</li> <li>2. The device is switched off.</li> <li>3. Possible errors that occurred on the device's audio system.</li> </ol>
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Table 0.7 : Use Case : Mute Sound

Use Case Name	Mute Sound
Main Actor	User
Goal	To play the audio, mute or unmute the audio.
Precondition	The application is fully loaded.
Trigger	User choose the mute/unmute button.
Main Course of Action	<ol style="list-style-type: none"> <li>1. The audio is activated once the application is fully loaded.</li> <li>2. User points and press on the mute/unmute audio button.</li> <li>3. The audio mutes or unmutes based on the user action.</li> </ol>
Exceptional Course of Action	<ol style="list-style-type: none"> <li>1. Application is closed/exited by the user.</li> <li>2. The device is switched off.</li> <li>3. Possible errors that occurred on the device's audio system.</li> </ol>

Table 0.8 : Use Case : View Tutorial

Use Case Name	View Tutorial
Main Actor	User
Goal	To display the Tutorial.
Precondition	The application is fully loaded.
Trigger	User choose the View Tutorial button.
Main Course of Action	<ol style="list-style-type: none"> <li>1. User press the View Tutorial Button.</li> <li>2. System display a window containing guidelines for the movement and how to interact with 3D Models.</li> </ol>

Table 0.9: Use Case : Exit Tour

Use Case Name	Exit Tour
Main Actor	User
Goal	Exit the application.
Precondition	The application is fully loaded.
Trigger	User choose the Exit button.
Main Course of Action	<ol style="list-style-type: none"> <li>1. User press the Exit Tour Button.</li> <li>2. The application is closed/exited by the user.</li> </ol>

### 3.2.2.3 Sequence Diagram

Sequence diagrams detail workflows such as selecting and examining anatomical models, navigating the VR museum, and interacting with AI-guided tutorials for deeper understanding.

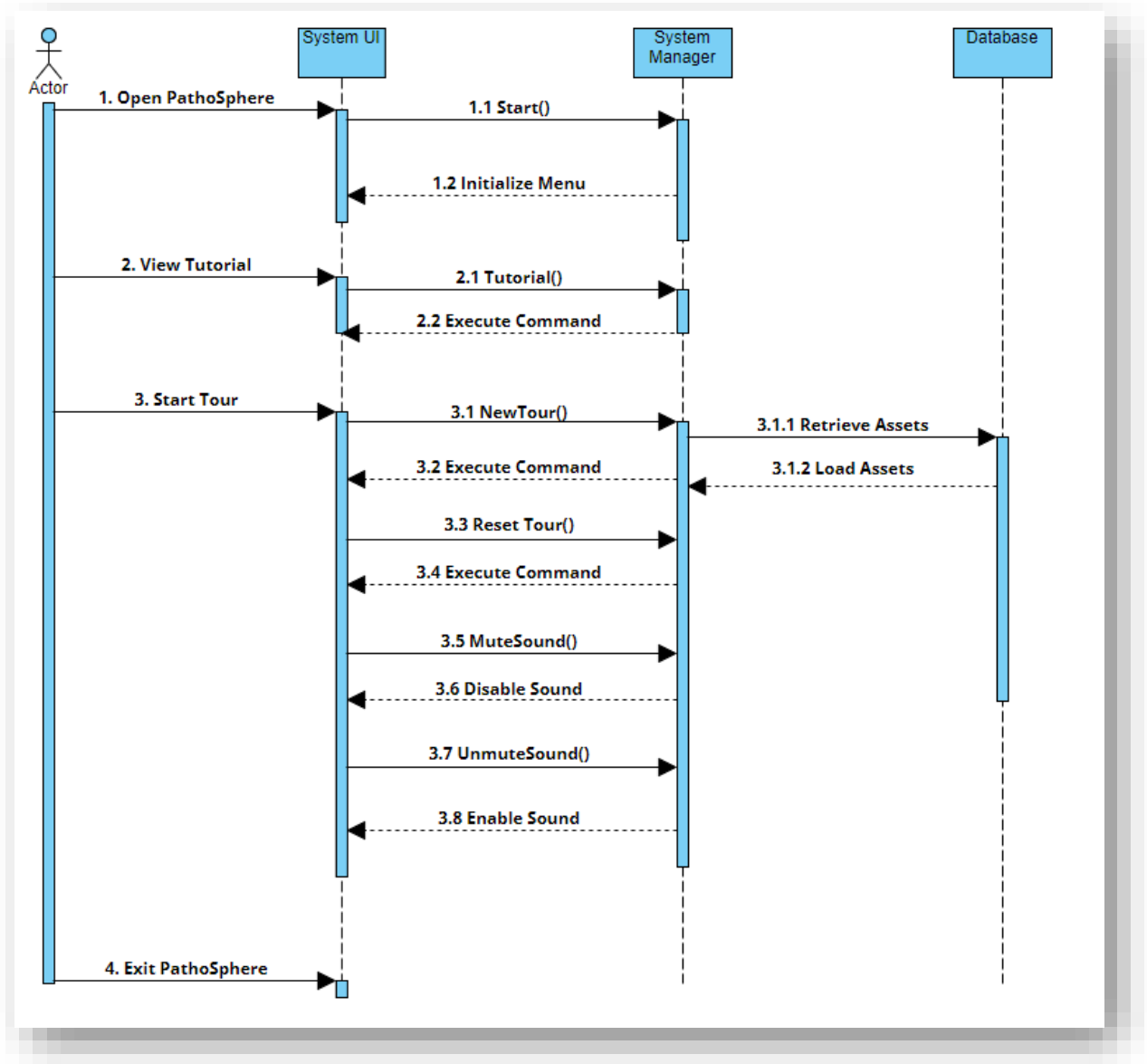


Figure 0.12: Sequence Diagram for PathoSphere

### 3.2.2.4 Class Diagram

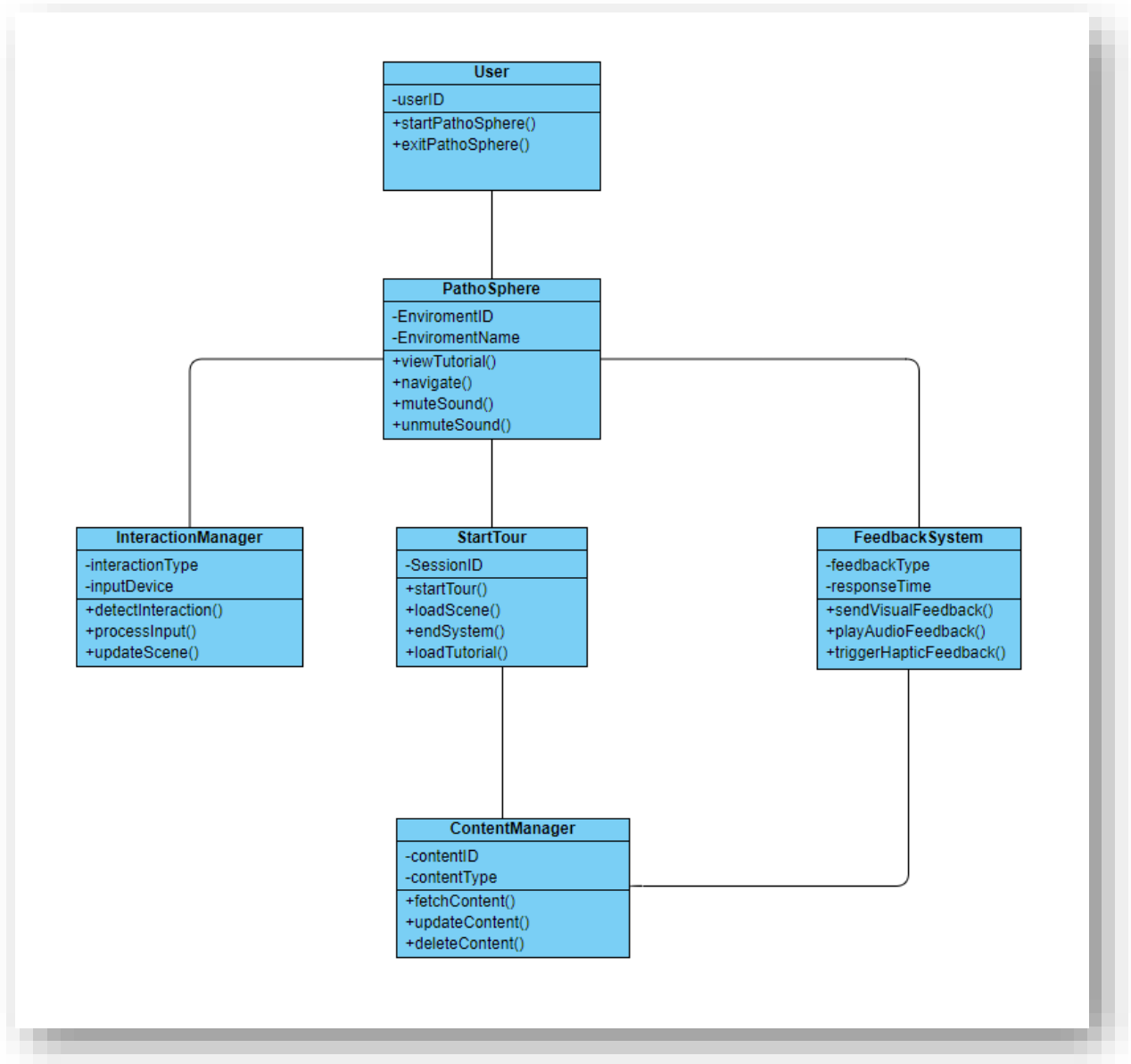
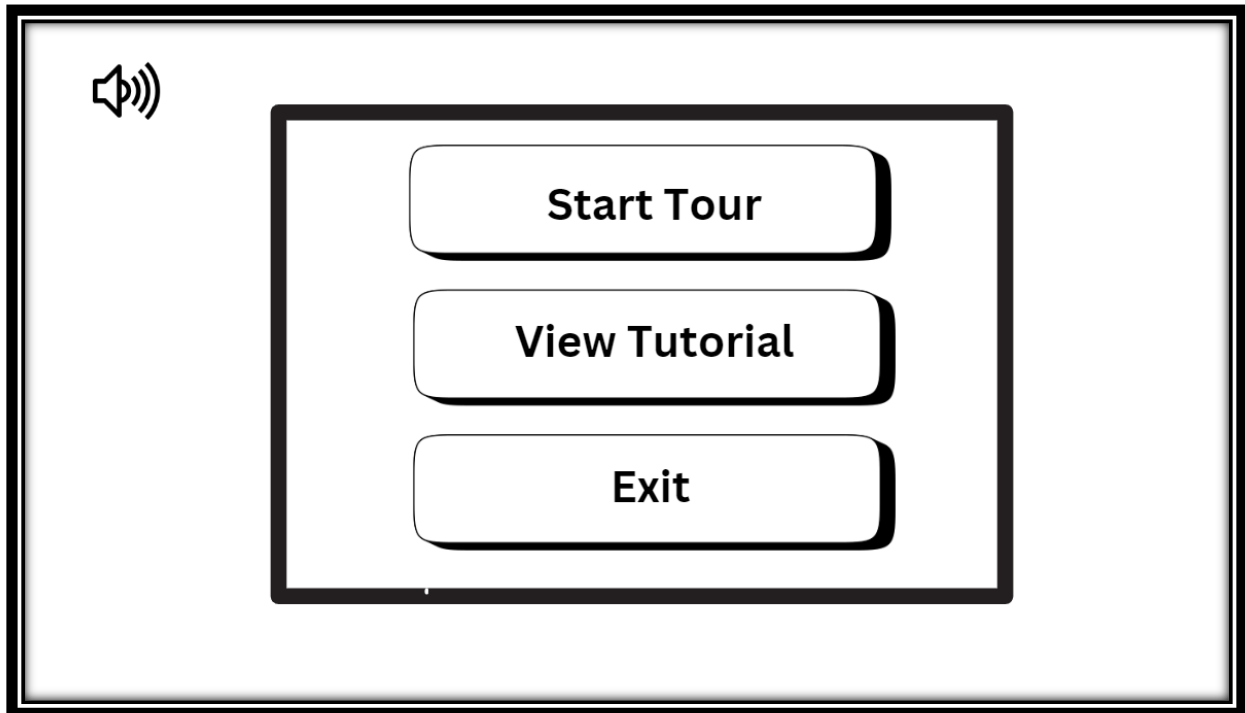


Figure 0.13: Class Diagram

### 3.2.2.4 Interface Design

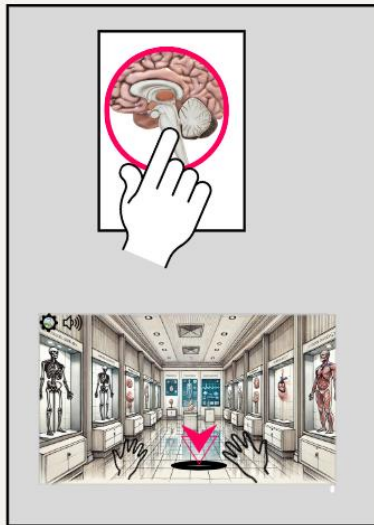
Wireframes were created to represent the VR user interface, including menus, tooltips, and interactive markers on specimens. The interface design emphasised usability and clear, accessible pathways for exploring the museum content.



*Figure 0.14: Main Menu Screen*

When starting the PathoSphere application, the user will enter the **Main Menu** screen as shown on Figure 3.14 where they can Start Tour, View Tutorials, Mute or Unmute the sound and Exit the application.

## Tutorial



Use VR Controller to Point, Move and interact with 3D Models.



BACK

Figure 0.15: Tutorial Screen

When users press the View Tutorial button at the Main Menu screen, the screen shown in the Figure 3.15 above will pop up giving the users on how to navigate and interact with the 3D Models inside the museum.

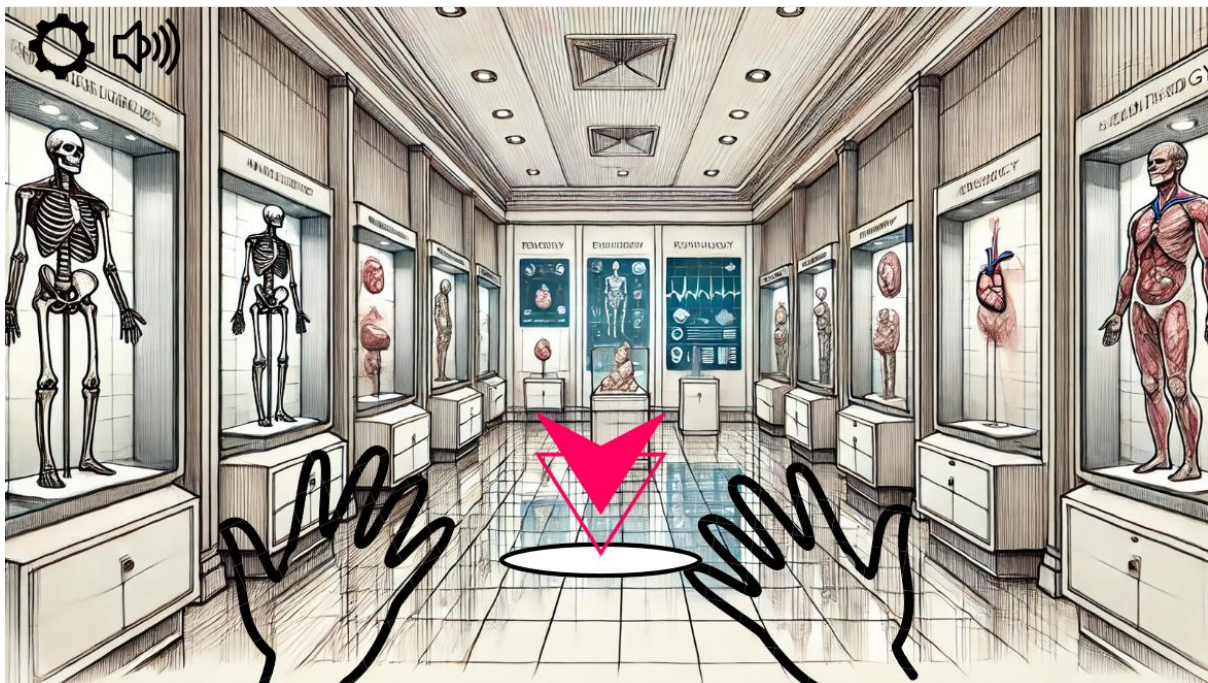
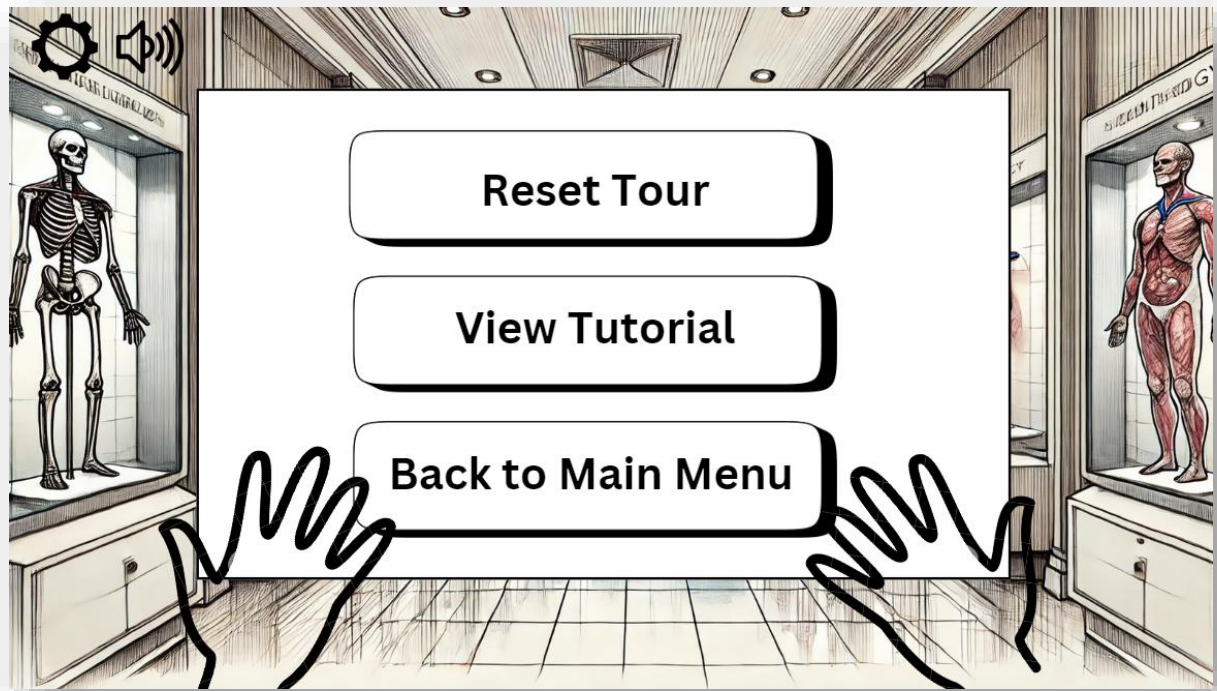


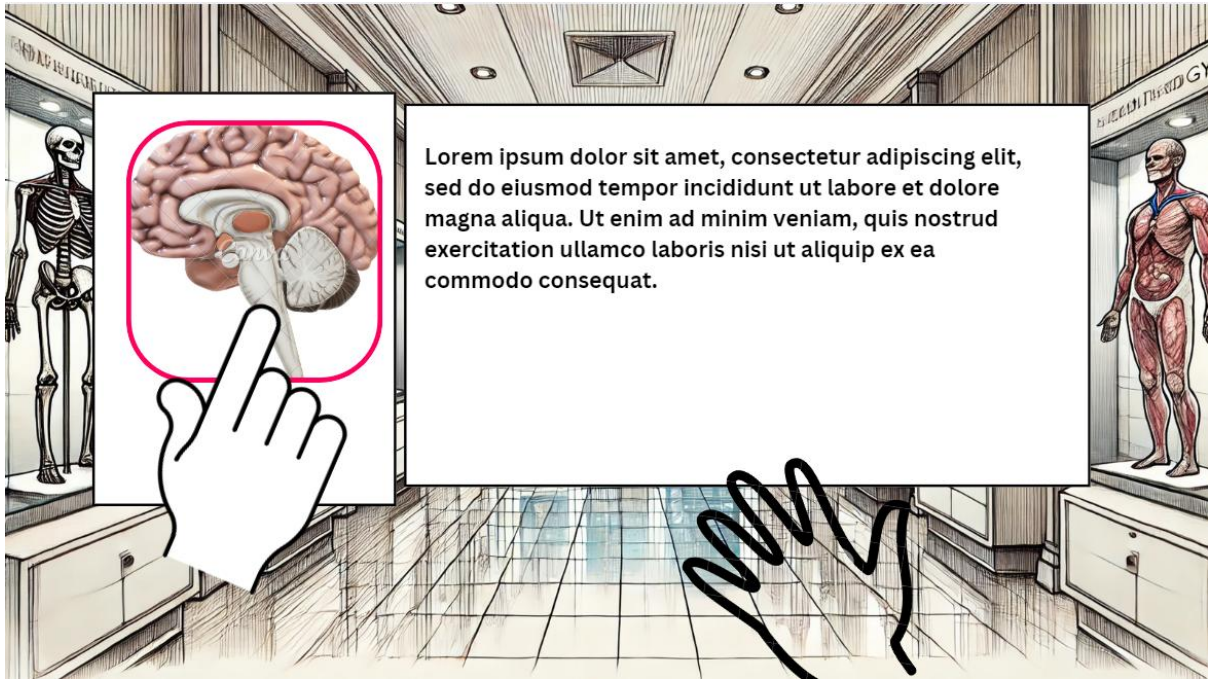
Figure 0.16 : PathoSphere VR Museum Lobby

Figure 3.16 above shows the PathoSphere main lobby interface. The users may choose either the point-and-click movement or the free movement using the VR Joystick. Users can move around the museum and interact with any of the 3D Models.



*Figure 0.17: Options Screen*

When users pressed the **Gear Icon** on top left, the Options Screen will pop up as shown in Figure 3.17 above. In this screen, users can choose the Reset Tour to bring them back to the main lobby where they initially started. Users can also choose to View Tutorial here in case they would forget certain functions of the system. Lastly, users can also choose to go back to Main Menu and end the tour.



*Figure 0.18: Interacting with the 3D Models*

Figure 3.18 above shows when the users interacted with the 3D Model. A screen with pop up and shows the details of the organ or specimen. Users can also rotate, zoom in, zoom out and move the 3D models. In the final design, users could interact with the 3D Model more for example, splitting the 3D Models in two, listen to the audio guide, watching educational video and more.

### **3.2.3 Developing**

The development phase focused on constructing the VR environment using Unity and optimising it for Meta Quest 3. The virtual space was modelled to replicate the physical museum at UNIMAS, incorporating interactable 3D models of organs and bones. Features such as object zoom, rotation, and layered views (e.g., organ cross-sections) were developed to enhance the educational experience. AI-assisted tools were integrated for real-time Q&A support and guided tours.

### 3.2.4 Testing

Testing will involve a pilot study with a sample group of UNIMAS students and lecturers. Feedback will be collected on the system's usability, content clarity, and immersion. Functional testing ensuring all interactions, such as model manipulation and navigation, works as intended. Identifying issues, including performance lags and UI clarity, will be addressed promptly.

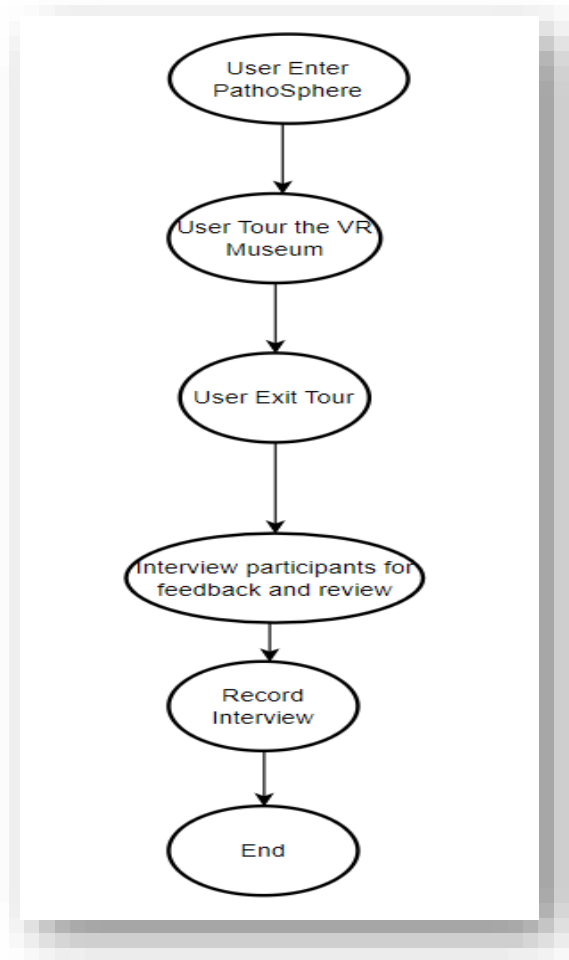


Figure 0.19: Testing Flow Diagram

### **3.2.5 Refining**

Based on testing feedback, refinements were made to improve system stability, performance, and accessibility. Additional features, such as multi-language support and enhanced visual effects for anatomical models, were implemented. The final system was optimised for deployment, ensuring it met the project's educational objectives and provided an immersive and effective learning tool for users.

### **Summary**

In summary, Chapter 3 focused on the requirement analysis and design process for the PathoSphere VR Anatomy and Pathology Museum, employing a structured and iterative methodology. This chapter covered the phases of planning, design, development, testing, and feedback. During the planning phase, key objectives were established, user needs were studied, and both functional and non-functional requirements were defined. The design phase concentrated on crafting user-friendly interfaces, interactive 3D models, and supplementary multimedia features, ensuring the VR system supported educational objectives. The development phase utilised software tools like Unity and Blender to build and implement the system's main components, such as the interactive 3D models and additional resources like diagrams and videos. Testing was conducted to assess the system's usability and ensure it met the outlined requirements. Feedback gathered throughout earlier stages informed improvements, leading to a polished final product. This chapter highlights a systematic approach that prioritised user engagement and educational effectiveness, resulting in a fully functional VR platform for anatomy and pathology learning.

# Chapter 4 : Development and Implementation

## 4.1 Introduction

This chapter discusses the development and implementation process of *PathoSphere*, a Virtual Reality (VR) museum designed to simulate the Anatomy and Pathology Museum at Universiti Malaysia Sarawak (UNIMAS). The project aims to address the limitations of the physical museum, including restricted access, limited time slots, and the prohibition of photography. Through the use of immersive VR technology, *PathoSphere* provides an alternative educational platform where users can explore detailed 3D anatomical and pathological specimens in an interactive, self-paced environment.

The development was carried out using the Unity game engine with XR support for Meta Quest 3. It involved constructing VR-ready 3D environments, integrating interactive medical models, designing user-friendly interfaces, and implementing navigation systems suitable for standalone VR headsets. This chapter outlines the software tools used, asset creation, user interface design, and the implementation of educational interactions that enhance user engagement and knowledge retention.

The primary objective of this phase was to build a stable, immersive system that could replicate the learning experience of a real anatomy museum while leveraging the benefits of VR, such as interactivity, accessibility, and visual clarity.

## 4.2 Software Installation and Configuration

To develop the *PathoSphere* Virtual Reality (VR) museum, several software tools and development environments were installed and configured to support the creation, deployment, and testing of a fully immersive VR experience. The main development platform chosen was **Unity**, due to its robust support for VR development, compatibility with the **Meta Quest 3** headset, and ease of use for rapid prototyping and scene management.

The following software components were installed and configured:

### 4.2.1 Unity Game Engine

- **Version:** Unity 2022 LTS (Long Term Support)
- Unity was installed via **Unity Hub**, with Android Build Support and XR Plug-in Management enabled during setup.
- **XR Interaction Toolkit** was added through the Unity Package Manager to enable VR input and interaction functionalities.
- **OpenXR Plugin** was enabled to allow compatibility with the Meta Quest 3 headset through Unity's XR plugin system.

### 4.2.2 Meta Quest 3 Integration

- **Meta Horizon** mobile app was installed to manage headset pairing, app deployment, and debugging.
- The Meta Quest 3 was set to **Developer Mode** via the **Meta Horizon** mobile app.
- ADB (Android Debug Bridge) was configured to enable communication between Unity and the headset during playtesting and builds.

### 4.2.3 Android SDK & NDK Configuration

- Required SDK, NDK, and JDK components were downloaded and linked through **Unity Preferences > External Tools**.

### 4.2.4 Other Supporting Tools

- **Blender** was used to model, optimise, and export 3D anatomical and pathological specimens in FBX format for Unity.
- **Visual Studio** (installed alongside Unity) served as the default IDE for writing C# scripts to handle user interaction, scene management, and logic.

## 4.3 Assets

This section explains the different types of digital materials (assets) used to build the *PathoSphere* VR museum. These assets include 3D models, images, sounds, menus, and scripts that make the VR experience interactive and educational.

### 4.3.1 3D Models

For the *PathoSphere* project, 3D models of human organs and pathological specimens played a central role in delivering an educational and immersive experience. These models are the core of the virtual museum, allowing users to visually study the structure of each organ in a way that feels lifelike and interactive.

- The organs and body parts were gathered from Unity Asset Store and were edited using a 3D software called **Blender**, then saved in **FBX** or **GLB** format for Unity.
- Models were made less detailed (low-poly) to make sure the VR app runs smoothly on **Meta Quest 3**.
- Some models can move or rotate when the user interacts with them.

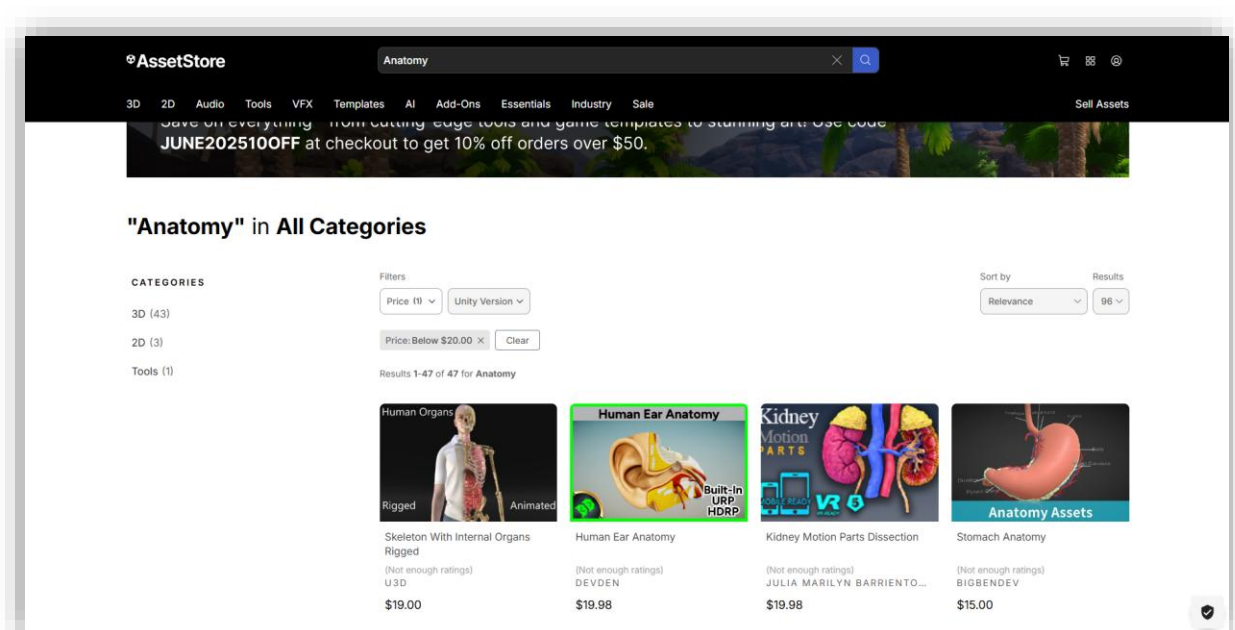


Figure 0.1: 3D Models from Unity Asset Store (<https://assetstore.unity.com>)

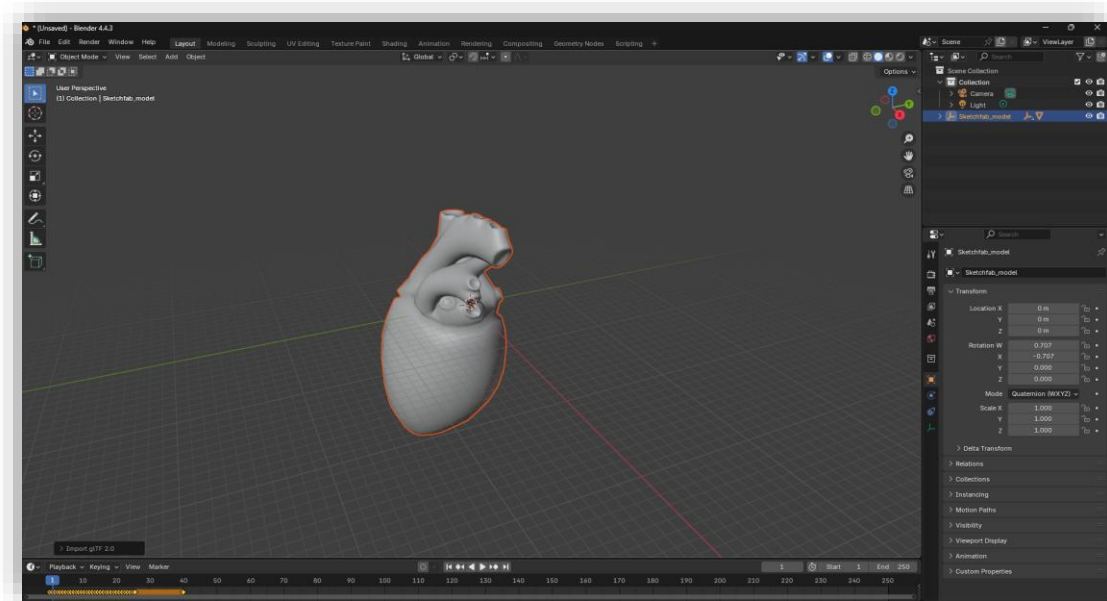


Figure 0.2: Blender Application for editing 3D Models

### 4.3.2 Textures and Materials

Each downloaded model was imported into **Blender**, a free and open-source 3D modelling software. In Blender, the models were **cleaned up, resized, re-textured, and simplified** to better suit the needs of the project. For instance, unnecessary details like internal bones, nerves, or extremely high-polygon features were removed or reduced to make the model lighter and more efficient for performance in VR. Once edited, the models were exported in **FBX** or **GLB** format, which are both compatible with Unity and ideal for VR deployment.

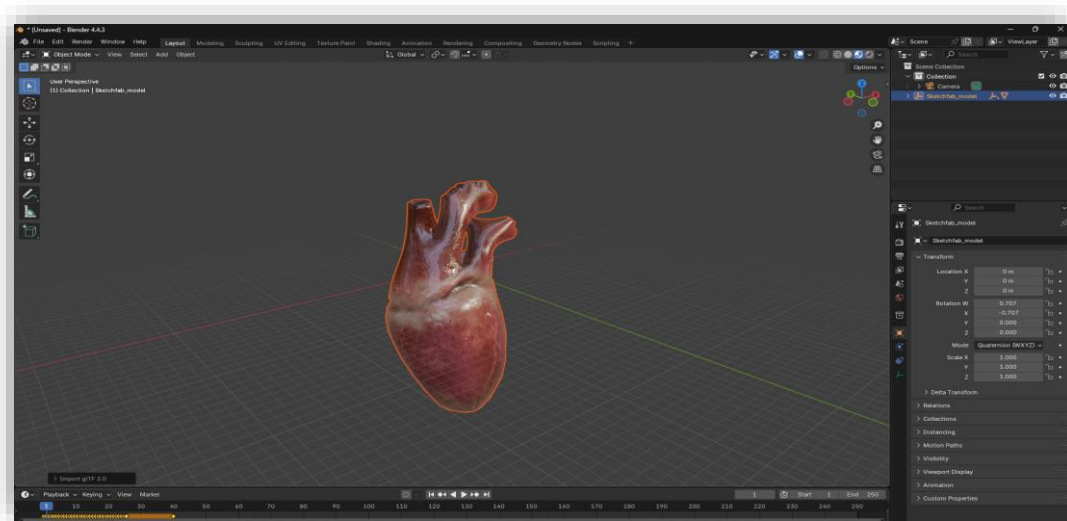


Figure 0.3: 3D Model of a Heart with Textures

### 4.3.3 User Interface

The user interface (UI) for *PathoSphere* was carefully designed to ensure accessibility, readability, and ease of interaction within a Virtual Reality environment. Since VR places users inside a 3D world, traditional flat-screen UI elements must be adapted to appear within the space in a way that is intuitive and comfortable to interact with.

- Simple menus and buttons were made using Unity's UI system.
- The UI appears inside the VR space, so users can see and press them easily with the controller.
- Text is large and easy to read in VR. Icons are clear and simple.

To achieve this, **Unity's built-in UI system** was used, with all canvases set to **World Space** mode. This mode allows UI panels such as buttons, text labels, and icons to appear as part of the virtual scene, rather than being locked to the player's screen like in 2D games. Each UI element was carefully positioned within the VR environment so that users could see them naturally from their point of view without needing to turn excessively or strain their neck.



Figure 0.4: PathoSphere's Main Menu User Interface

Simple and clean **menu designs** were implemented to avoid overwhelming the user. Each button was made large enough to be clearly visible and easily clickable using the Meta Quest 3 controllers. The buttons react to hovering and clicking actions with visual feedback,

such as colour changes or light animations, to help the user confirm that their interaction was registered.

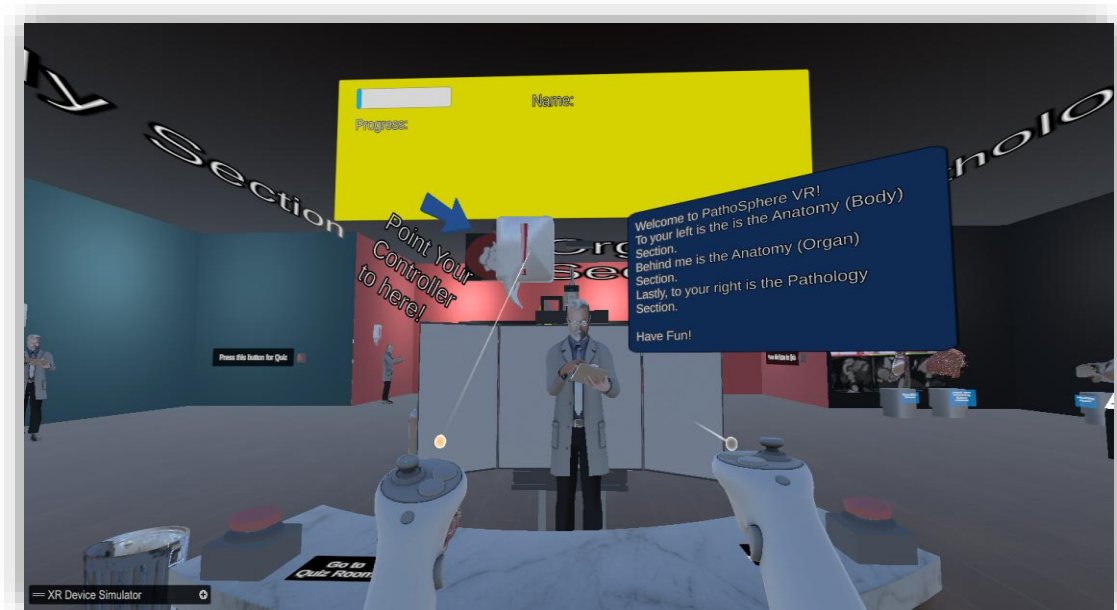


Figure 0.5: Museum Lobby Screen

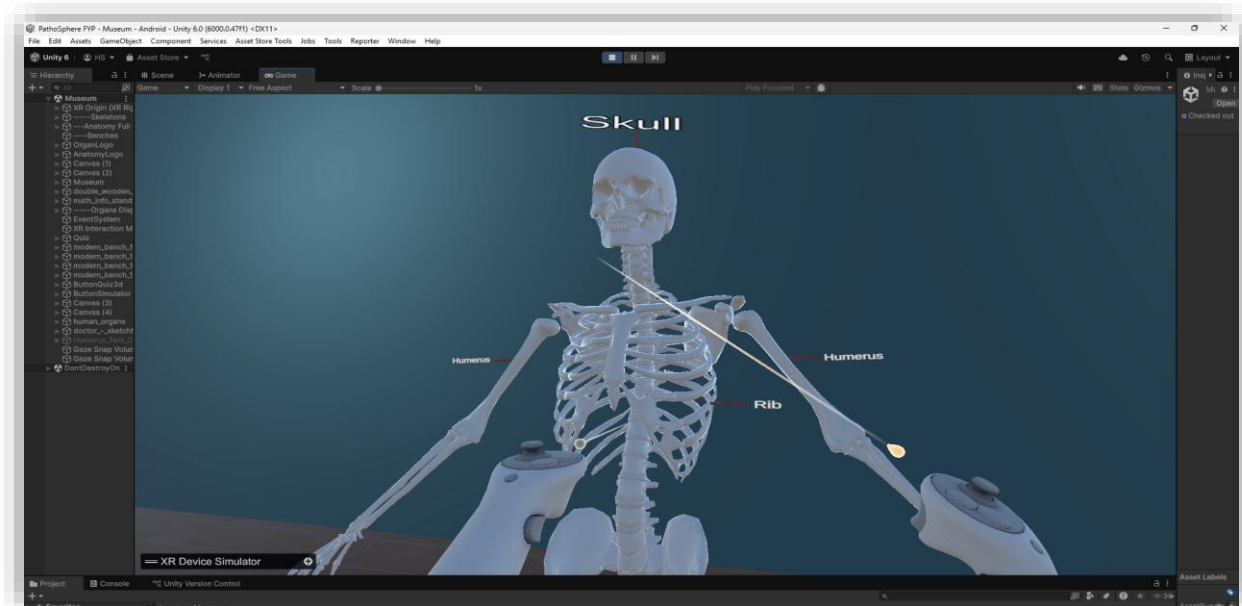


Figure 0.6: User Interface for details pops up on 3D Models

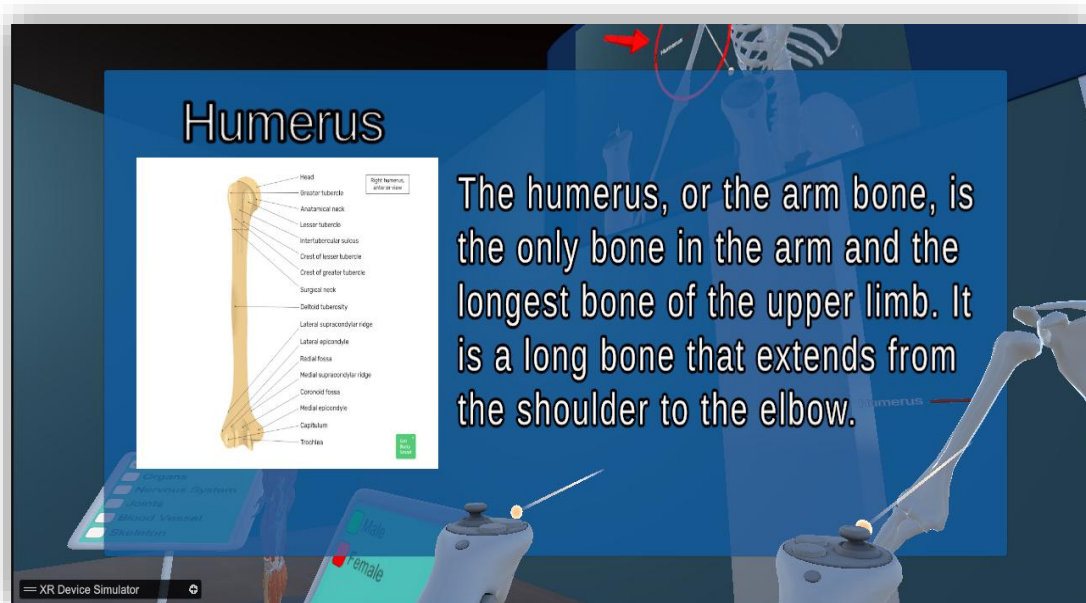


Figure 0.7: User interface for detailed explanation for the 3D object.

To ensure maximum **readability**, all text elements were created using **TextMeshPro**, a Unity plugin that allows for high-quality fonts and text rendering. The font sizes were increased to ensure they are legible from a typical VR viewing distance.

In summary, the UI in *PathoSphere* was designed to be:

- **Simple and readable**, with large fonts and clear icons.
- **Intuitive**, by using familiar layout patterns and interactive feedback.
- **Comfortable**, with in-space positioning that avoids strain.
- **VR-optimised**, ensuring smooth controller-based interaction.

#### 4.3.5 Animation and Interaction

Additionally, some of the 3D models were made **interactive** using Unity's scripting system. Certain organs, such as the heart or brain, were given simple animations or behaviours to make the experience more engaging. For example, users can **click or hover on a model to rotate it**, giving them the ability to inspect the object from multiple angles. In some cases, hovering over the model also triggers **audio explanations or pop-up panels** containing medical information.

This interaction was created using a combination of **C# scripts**, Unity's **XR Interaction Toolkit**, and **animation controllers**.

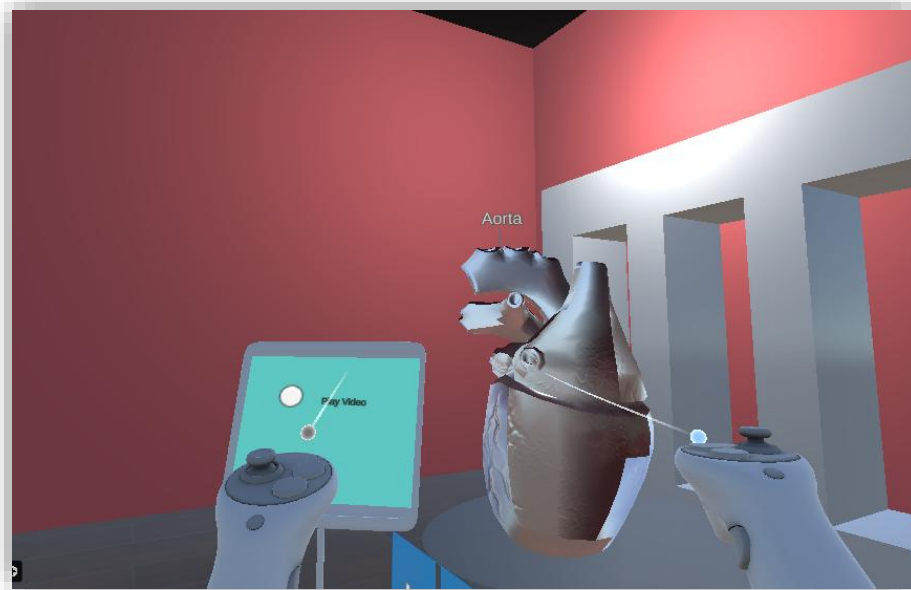


Figure 0.8: 3D Heart Model being grabbed.

```
using UnityEngine;

public class SpinObjectWithAxis : MonoBehaviour
{
    public enum Axis { X, Y, Z }
    public Axis spinAxis = Axis.Y;
    public float spinSpeed = 30f;

    void Update()
    {
        Vector3 axisVector = Vector3.zero;

        switch (spinAxis)
        {
            case Axis.X:
                axisVector = Vector3.right;
                break;
            case Axis.Y:
                axisVector = Vector3.up;
                break;
            case Axis.Z:
                axisVector = Vector3.forward;
                break;
        }

        transform.Rotate(axisVector * spinSpeed * Time.deltaTime);
    }
}
```

Figure 0.9: C# Script for spinning 3D Models.

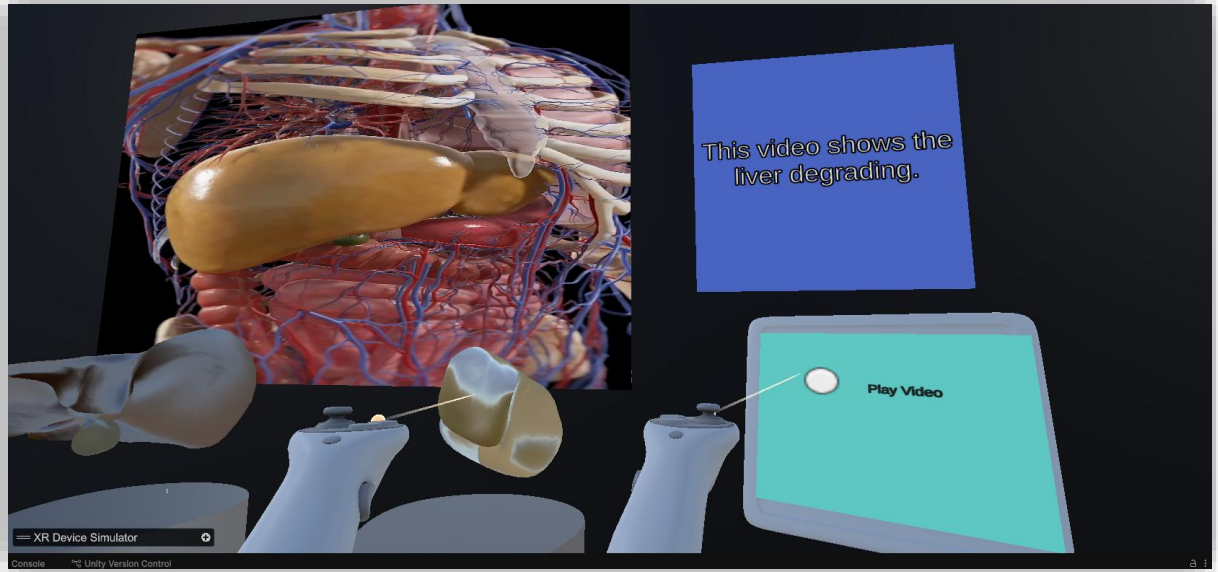


Figure 0.10 : Interaction of playing a Video after pressing the button.

```

using UnityEngine;
using UnityEngine.UI;

Unity Script (1 asset reference) | 0 references
public class TogglePanelDisplay : MonoBehaviour
{
    public Toggle toggle; // The toggle to listen to
    public GameObject panelToShow; // The panel to animate
    public float duration = 0.4f;
    public Vector3 showScale = Vector3.one;
    public Vector3 hideScale = Vector3.zero;

    private bool isTweening = false;

    Unity Message | 0 references
    void Start()
    {
        if (toggle != null)
            toggle.onValueChanged.AddListener(OnToggleChanged);

        if (panelToShow != null)
        {
            panelToShow.transform.localScale = toggle != null && toggle.isOn ? showScale : hideScale;
            panelToShow.SetActive(toggle != null && toggle.isOn);
        }
    }

    1 reference
    void OnToggleChanged(bool isOn)
    {
        if (panelToShow == null || isTweening) return;

        panelToShow.SetActive(true); // Must be active to tween
        isTweening = true;

        Vector3 targetScale = isOn ? showScale : hideScale;

        LeanTween.cancel(panelToShow);
        LeanTween.scale(panelToShow, targetScale, duration)
            .setEase(isOn ? LeanTweenType.easeOutBack : LeanTweenType.easeInBack)
            .setOnComplete(() =>
            {
                if (!isOn)
                    panelToShow.SetActive(false); // Hide after shrinking
                isTweening = false;
            });
    }
}

```

Figure 0.11: C# Script of toggling the panel after certain interactions.

```
using UnityEngine;
using UnityEngine.UI;
using UnityEngine.Video;

Unity Script (2 asset references) | 0 references
public class VideoPanelController : MonoBehaviour
{
    public GameObject videoPanel;
    public VideoPlayer videoPlayer;

    0 references
    public void ShowPanelAndPlayVideo()
    {
        videoPanel.SetActive(true);
        if (videoPlayer != null)
        {
            videoPlayer.Play();
        }
    }
}
```

Figure 0.12: C# Script of the Video Controller.

Figures 4.11 and 4.12 show the code that handles the interaction shown in Figure 4.10.

## Summary

This chapter explained the development process of *PathoSphere*, including software setup, asset creation, UI design, and interaction features. Unity and Blender were used to build and optimise the VR experience for the Meta Quest 3 headset. 3D models were edited and simplified to ensure smooth performance, and key models were made interactive with rotating and info panel features.

The UI was designed using Unity’s World Space canvas with large text and clear icons to suit VR use. Interactive elements like audio, quizzes, and animations were implemented to enhance learning. Overall, this phase successfully built a functional VR museum, ready for testing in the next chapter.

# Chapter 5 : Testing and Evaluation

## 5.1 Introduction

This chapter presents the testing and evaluation processes conducted to ensure the quality and performance of the *PathoSphere* VR system. The system was evaluated through both functional and non-functional testing, followed by user testing to assess its usability, interactivity, and educational value. The tests aimed to confirm that all implemented features worked as intended and that the system provided a positive user experience, especially in learning anatomy and pathology through a gamified VR environment.

## 5.2 Functional Testing

Functional testing was performed to ensure all the features of *PathoSphere* were working as expected. This included checking the navigation, interactions, quiz system, and user interface in the VR environment.

### 5.2.1 Test Plan 1: Splash Screen

Table 0.1: Test Case for Splash Screen

Test Case	Input Data	Expected Results	Results
SS01	Launching the application on Meta Quest 3	App launches successfully	Success

### 5.2.2 Test Plan 2: Main Menu Scene

Table 0.2: Test Case for Main Menu scene

Test Case	Input Data	Expected Results	Results
MM01	Tap the <b>Start</b> button	User will be navigated to the Museum scene.	Success
MM02	Tap the <b>Quit</b> button	The app will be terminated.	Success

### 5.3.3 Test Plan 3: Museum Scene

Test Case	Input Data	Expected Results	Results
MS01	Load in all the assets and 3D models inside the Museum Scene.	All assets and 3D models load successfully.	Success
MS02	Use the controllers' joystick to move around.	User able to move around using the joystick.	Success
MS03	Use the controller to hover on interactable 3D objects.	Trigger an event when hovering on interactable 3D objects.	Success
MS04	Interact with a button inside the Museum using the controller.	An event will trigger after user interact with a button.	Success
MS05	Look on certain 3D Object to show labels.	A label will pop up when user look or gaze onto a certain 3D object (e.g., skeleton anatomy).	Success
MS06	Grabbing 3D Objects using the controller's trigger button.	3D Object will be grabbed.	Success
MS07	Interact with the <b>'Quit'</b> button.	The app will be terminated after interacting with the button.	Success

## 5.3 Non-Functional Testing

Non-functional testing evaluated the performance, compatibility, and stability of the system across devices and under normal usage conditions.

### 5.3.1 Compatibility Testing

The application was tested across different VR platforms to ensure compatibility.

Table 0.3: Compatibility Testing Table

Device	Results
Meta Quest 3	Fully compatible
Pico 4	Minor performance issue

### 5.3.2 Performance Testing

Performance testing focused on frame rate, load time, and memory usage.

Table 0.4: Performance Metrics on Meta Quest 3

Metric	Results
Frame Rate	Average 30-60 FPS
Scene Load Time	1-2 Seconds
Memory Usage	~800MB during runtime
Battery Usage	Lasted up to 1 hour per session

## 5.4 Usability Testing

User testing was conducted to evaluate the system's usability, level of user engagement, and overall educational effectiveness. A total of 32 participants, consisting of students, lecturers and staff from various academic backgrounds, were selected to test *PathoSphere*. These users were asked to explore the VR museum and provide feedback based on their experience, which was used to assess how well the system supported learning and interaction in a virtual environment.

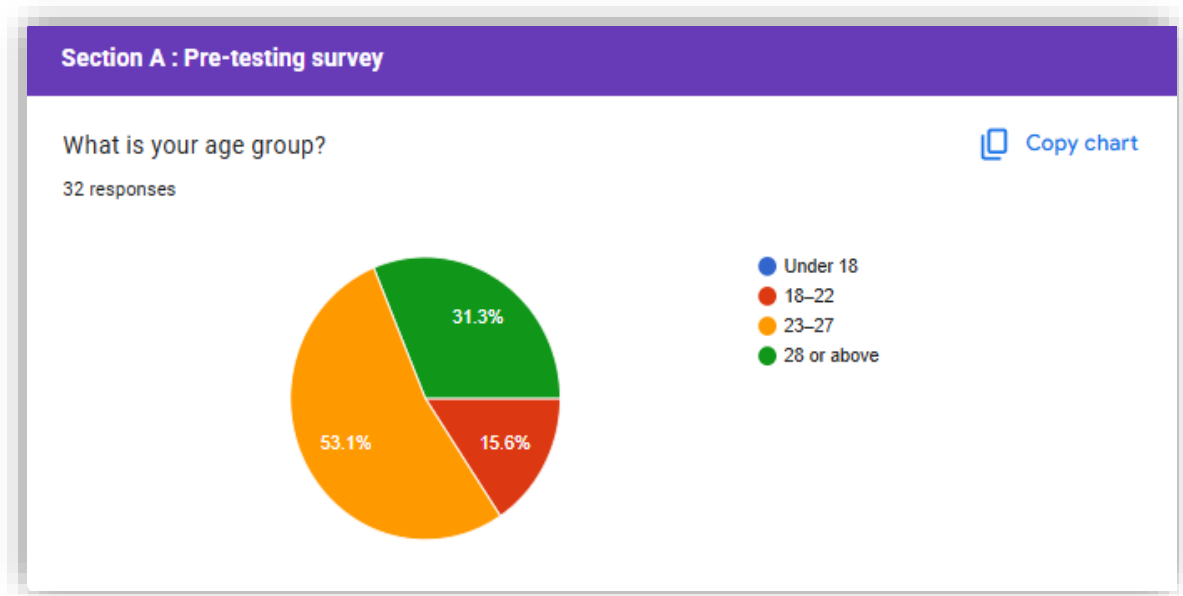


Figure 0.1 Respondents's Age Group Pie Chart

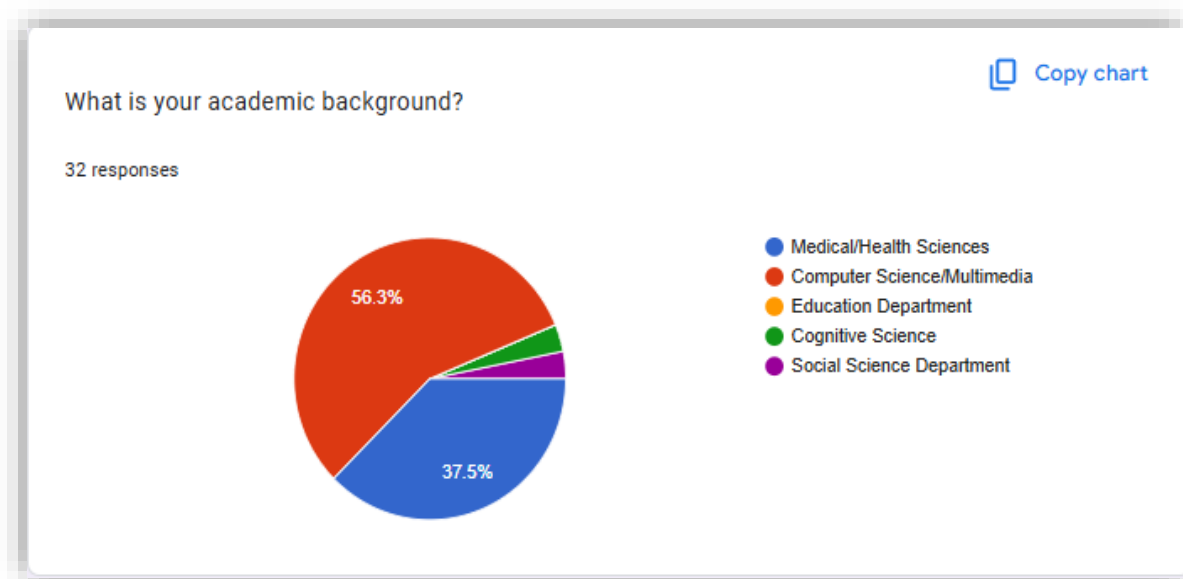


Figure 0.2: Respondent's Academic Background Pie Chart

As illustrated in Figures 5.1 and 5.2, most respondents were students, followed by lecturers and staffs, as shown in Figure 5.1. Regarding academic background, most participants were from the field of Computer Science, while the second largest group had a background in Medicine.

### 5.4.1 User Interface

This part evaluates the respondents' understanding of using VR to navigate through the museum. Results are shown as figure 5.1 below:

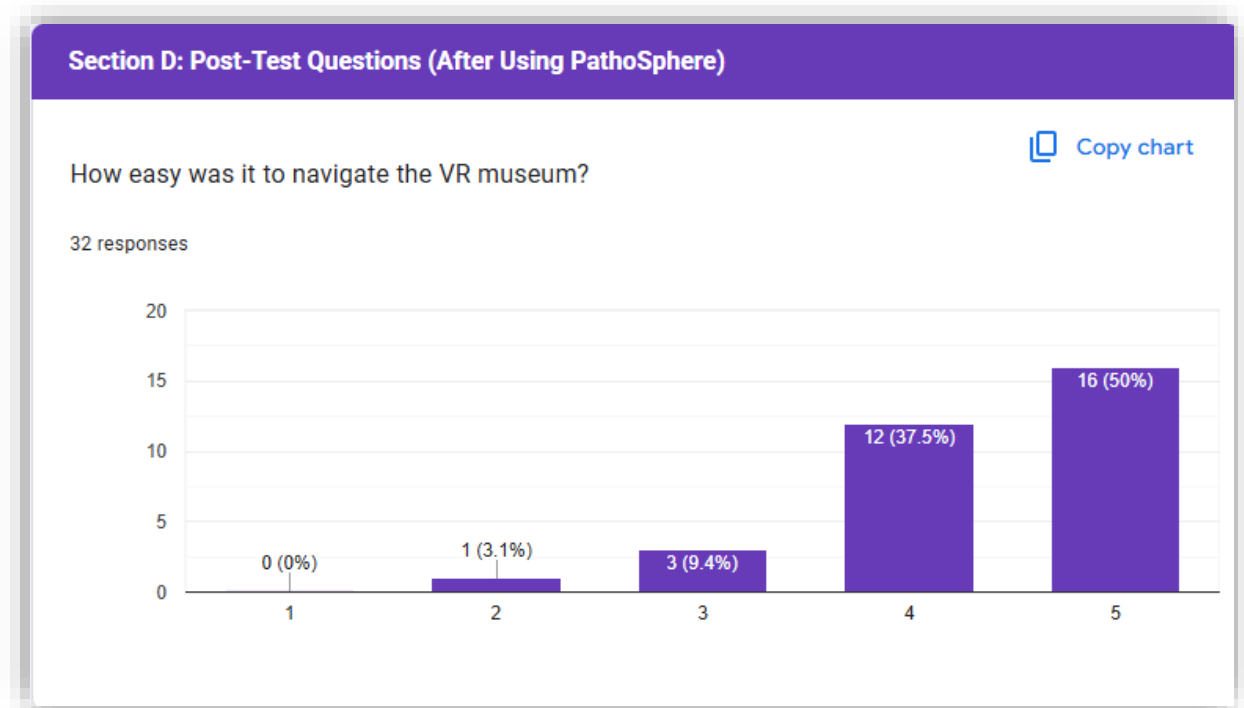


Figure 0.3: Respondent's understanding towards VR environment.

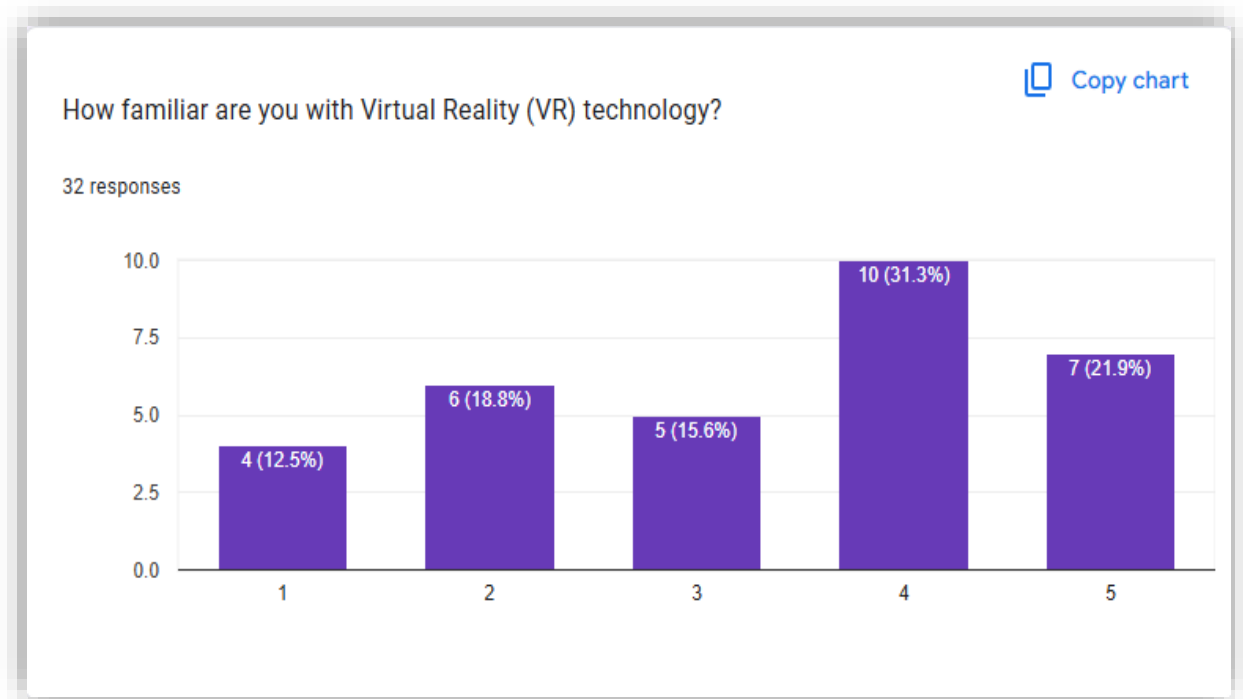


Figure 0.4: Respondent's familiarity towards VR technology.

Based on feedback from the 11 respondents, approximately **50%** of participants reported that navigating through the *PathoSphere* VR Museum was **very easy**, considering their respective experience with VR based on figure 5.2. This indicates that the user interface and movement controls within the VR environment were intuitive and well-designed, allowing users to explore the museum smoothly and with minimal confusion. The high percentage reflects the system's effectiveness in supporting first-time users and confirms that the navigation mechanics did not pose a barrier to learning or engagement.

## 5.4.2 Perception towards PathoSphere

This part evaluates the respondents' perception towards PathoSphere.

### 5.4.2.1 Comfortability

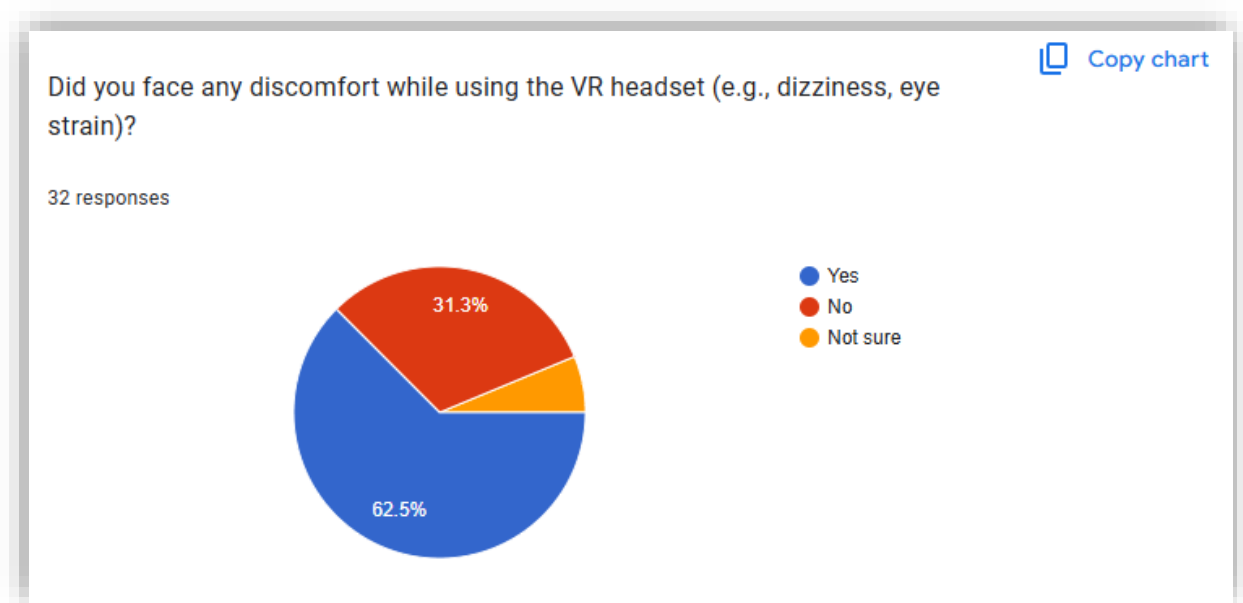


Figure 0.5: Respondent's feedback on comfortability.

Based on the results shown in Figure 5.3, 31.3% of participants said they felt no discomfort while using the VR museum. However, 62.5% mentioned feeling dizzy or experiencing eye strain, which could be due to long usage or personal sensitivity to VR. The remaining were unsure about how they felt. These results show that most users were comfortable using *PathoSphere*, but some improvements can still be made to make the experience easier for everyone.

### 5.4.2.2 Learning and Engagement

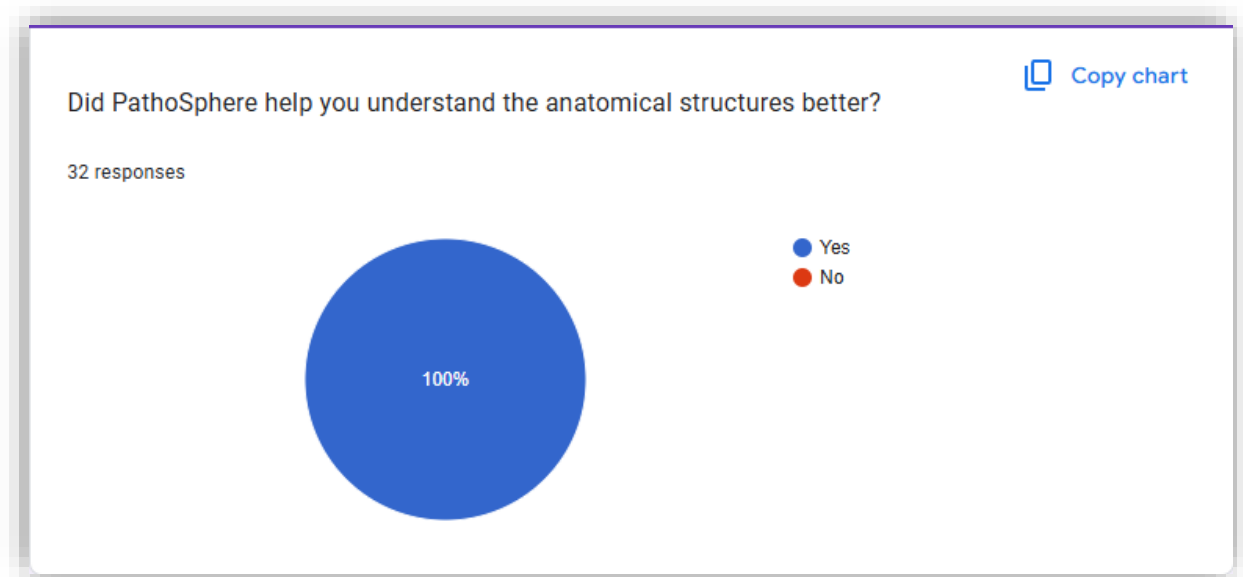


Figure 0.6: Respondent's feedback on Learning and Engagement.

The results shown in Figure 5.4 demonstrate that 100% of respondents agreed that PathoSphere helped them understand anatomical structures better. This strongly supports the educational purpose of the project, showing that the combination of 3D models, interactive elements, and immersive VR design successfully enhanced learning. The positive response also suggests that users were able to engage more deeply with the content compared to traditional learning methods, making *PathoSphere* an effective tool for visual and self-paced anatomy education.

### 5.4.2.3 System Usability Scale

The System Usability Scale (SUS) was used to measure how easy and user-friendly the PathoSphere system is. SUS is a simple and reliable method that includes ten statements rated on a five-point scale, from "Strongly Disagree" to "Strongly Agree".

In this project, users tried the PathoSphere VR museum using the Meta Quest headset and then answered the SUS questions. Their responses helped determine how usable and comfortable the system felt to them.

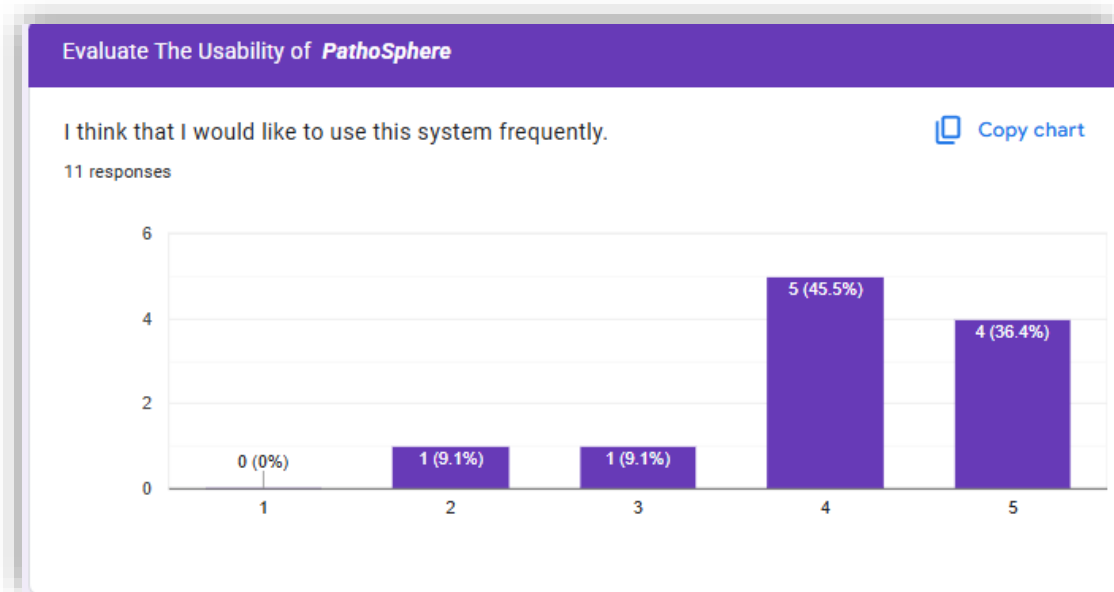


Figure 0.7: SUS Question No. 1

Based on the results shown in Figure 5.7 above, the majority of respondents expressed a positive willingness to use the PathoSphere system frequently. Out of 11 participants, 45.5% selected a rating of 4, and 36.4% selected a rating of 5, indicating strong agreement with the statement. This suggests that approximately 82% of users had a favourable experience and would likely continue using the system. Only two respondents (9.1% each) provided lower ratings of 2 and 3, and none selected the lowest option (1). These findings reflect positively on the overall usability and appeal of the PathoSphere system, demonstrating that most users found it engaging and easy to use.

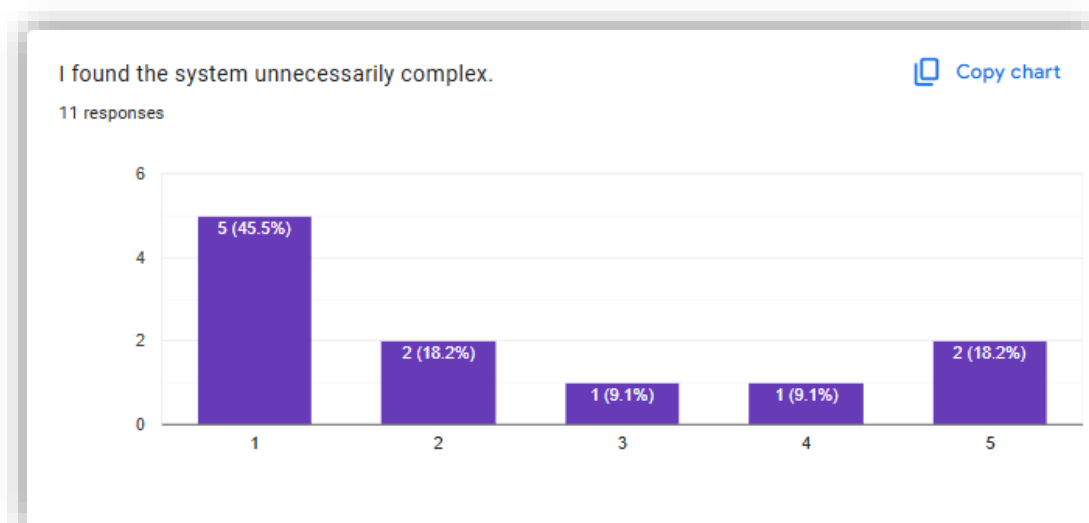


Figure 0.8: SUS Question No. 2

Based on the results shown in Figure 5.8, 45.5% selected a rating of 1, and 18.2% selected a rating of 2, indicating that the majority of users did not find the system complex. However, 18.2% of respondents gave a rating of 5, suggesting that a smaller portion of users perceived the system as unnecessarily complex. Additionally, ratings of 3 and 4 were each selected by 9.1% of participants, reflecting neutral to slightly agreeing views. These findings suggest that while most users found the system easy to use, a notable minority experienced some level of complexity, highlighting the potential for further refinement to enhance overall usability.

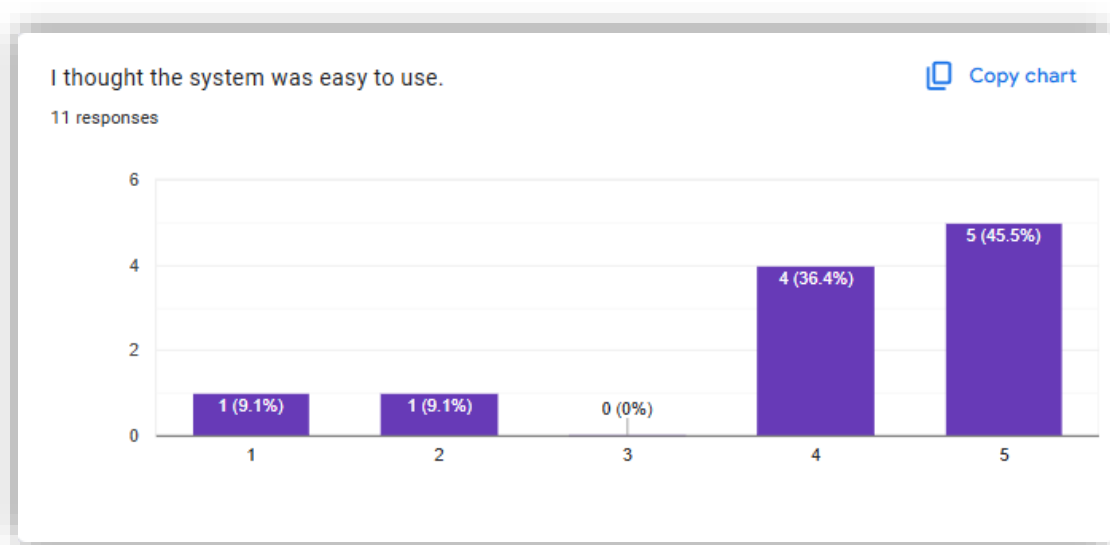


Figure 0.9: SUS Question No. 3

Based on the results shown in the bar chart above, most respondents agreed that the system was easy to use. Out of 11 participants, 45.5% selected a rating of 5, and 36.4% selected a rating of 4, indicating strong agreement with the statement. This means that over 80% of users had a positive experience regarding the system's ease of use. Only two respondents (9.1% each) chose ratings of 1 and 2, and none selected the neutral option (3). These findings indicate that the system is generally considered user-friendly, with most users finding it easy to operate.

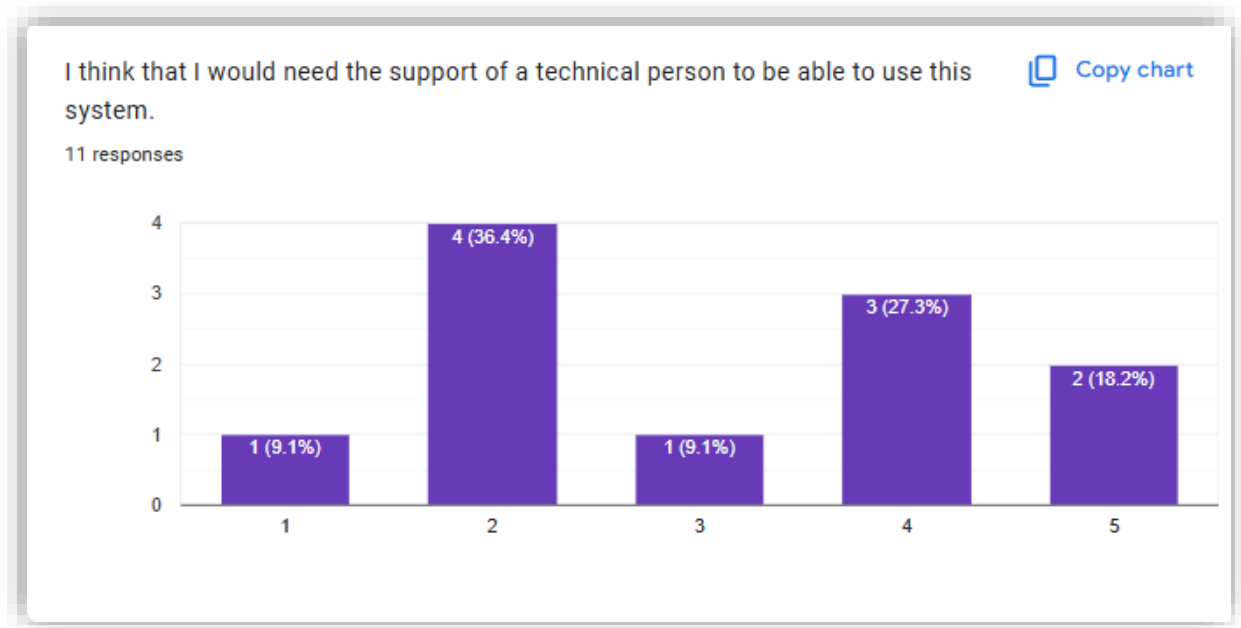


Figure 0.10: SUS Question No. 4

Based on the results shown in figure above, most respondents felt they would not need much technical support to use the system. 36.4% selected a rating of 2, and 9.1% selected a rating of 1, indicating disagreement with the statement. Meanwhile, 27.3% gave a rating of 4, and 18.2% gave a rating of 5, suggesting that some users felt they might need assistance. One respondent (9.1%) chose a neutral rating of 3. These results suggest that while a few users may require some help, the majority found the system easy enough to use without needing much technical support.

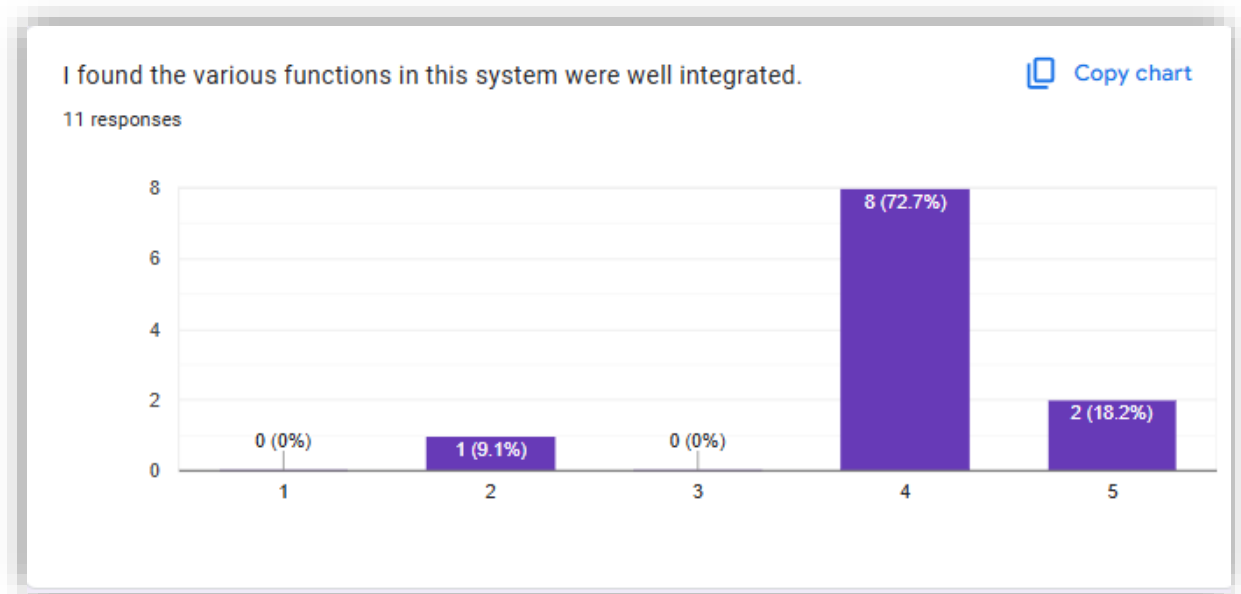


Figure 0.11: SUS Question No. 5

Based on the results shown in figure above, most respondents agreed that the various functions in the system were well integrated. 72.7% selected a rating of 4, and 18.2% selected a rating of 5, indicating strong agreement with the statement. Only one respondent (9.1%) gave a rating of 2, and none selected ratings of 1 or 3. These findings suggest that users generally found the system features to work well together, reflecting positively on the overall design and consistency of the PathoSphere system.

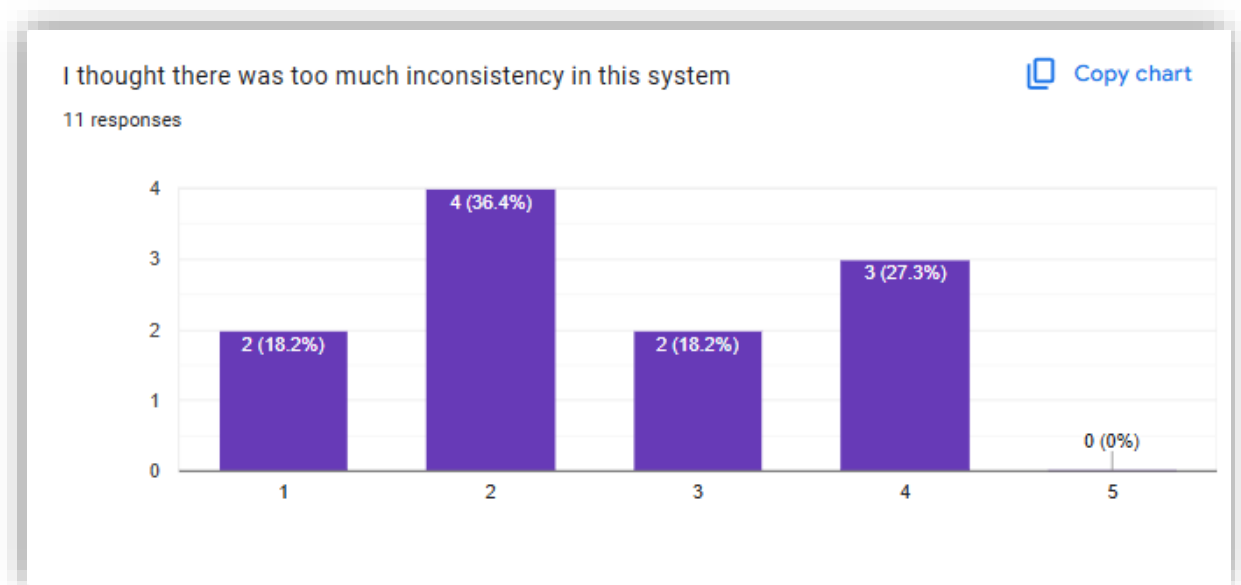


Figure 0.12: SUS Question No. 6

Based on the results shown in the bar chart, most respondents did not feel that the system was overly inconsistent. 36.4% selected a rating of 2, and 18.2% selected a rating of 1, indicating disagreement with the statement. An additional 18.2% chose a neutral rating of 3, while 27.3% selected a rating of 4, suggesting a moderate level of agreement. None of the respondents strongly agreed. These findings indicate that while a few users noticed some inconsistency, the majority did not perceive it as a major issue, suggesting that the system was generally consistent in its design and behaviour.

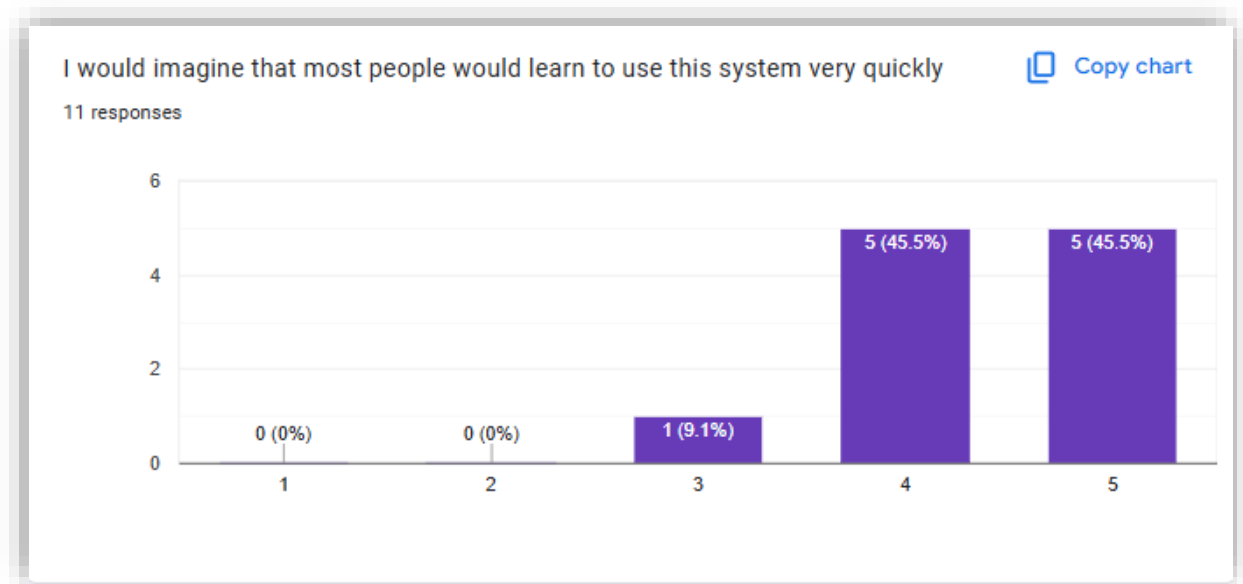


Figure 0.13: SUS Question No. 7

Based on the results shown in figure above, the majority of respondents believed that most people would learn to use the system very quickly. 45.5% selected a rating of 4, and another 45.5% selected a rating of 5, indicating strong agreement with the statement. Only one respondent (9.1%) gave a neutral rating of 3, and none selected ratings of 1 or 2. These results suggest that users found the system intuitive and easy to learn, reflecting positively on its overall usability and design.

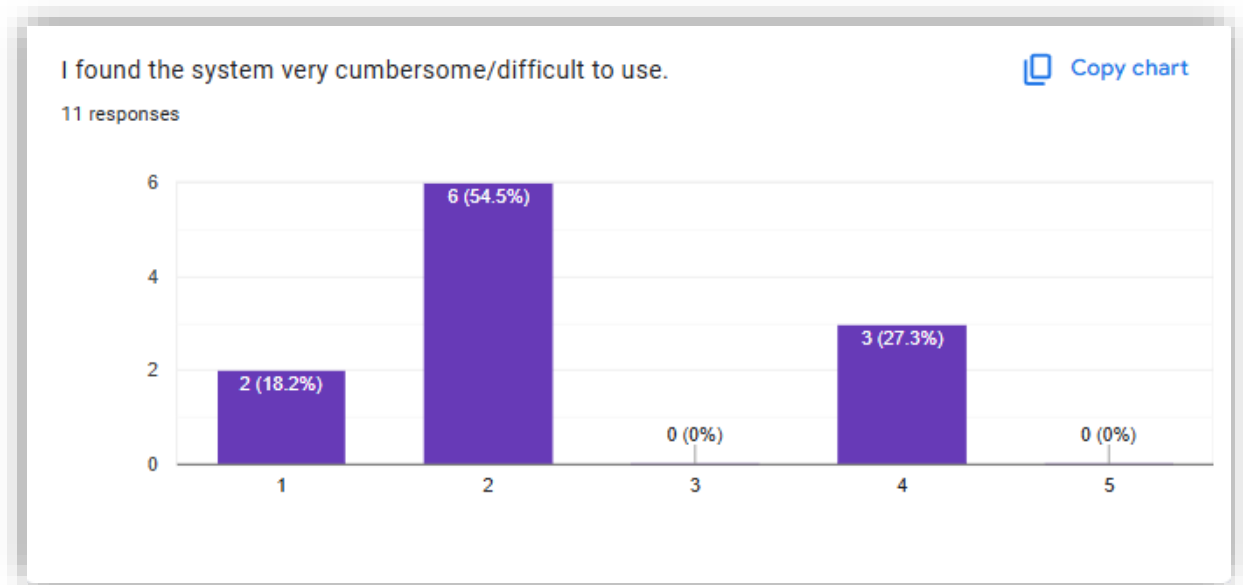


Figure 0.14: SUS Question No. 8

Based on the results shown in the bar chart, most respondents did not find the system cumbersome or difficult to use. 54.5% selected a rating of 2, and 18.2% selected a rating of 1, indicating disagreement with the statement. Additionally, 27.3% gave a rating of 4, suggesting that a smaller group experienced some difficulty. No respondents selected neutral (3) or strongly agree (5). These findings suggest that while a few users found the system slightly challenging, the majority considered it easy and comfortable to use.

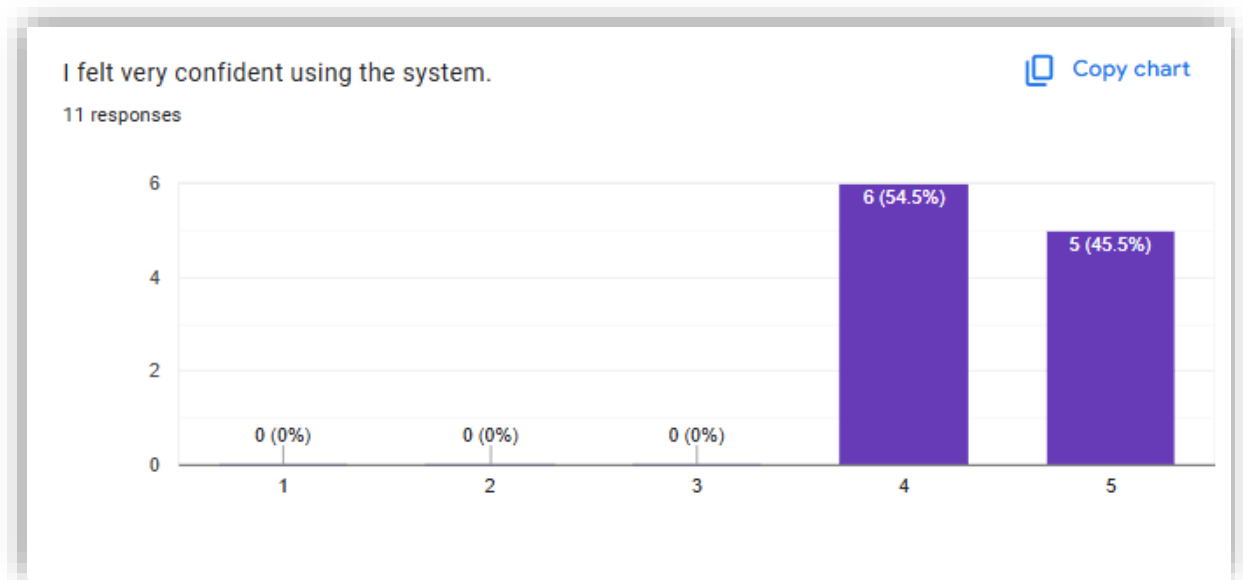


Figure 0.15: SUS Question No. 9

Based on the results shown in figure 5.15, all respondents reported feeling confident while using the system. 54.5% selected a rating of 4, and 45.5% selected a rating of 5, indicating strong agreement with the statement. None of the respondents chose ratings of 1, 2, or 3. These findings suggest that the PathoSphere system was well-received in terms of usability, with all users expressing a high level of confidence while interacting with it.

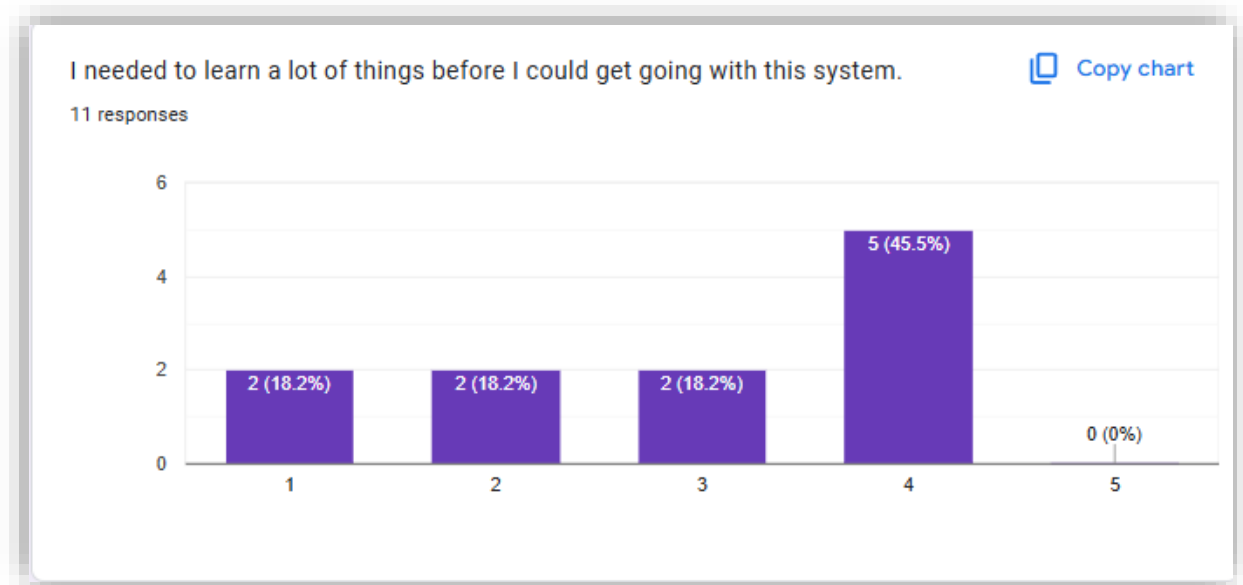


Figure 0.16: SUS Question No. 10

Based on the results shown in the bar chart, user responses were mixed regarding the need to learn a lot before using the system. 45.5% selected a rating of 4, suggesting that nearly half felt they needed some learning before getting started. Meanwhile, 18.2% selected ratings of 1 and 2 each, indicating disagreement with the statement, and another 18.2% chose a neutral rating of 3. No respondents selected the highest rating of 5. These results suggest that while some users found the system fairly easy to begin with, others felt that a moderate amount of learning was required before they could use it effectively.

### 5.4.3 Overall Evaluation of PathoSphere

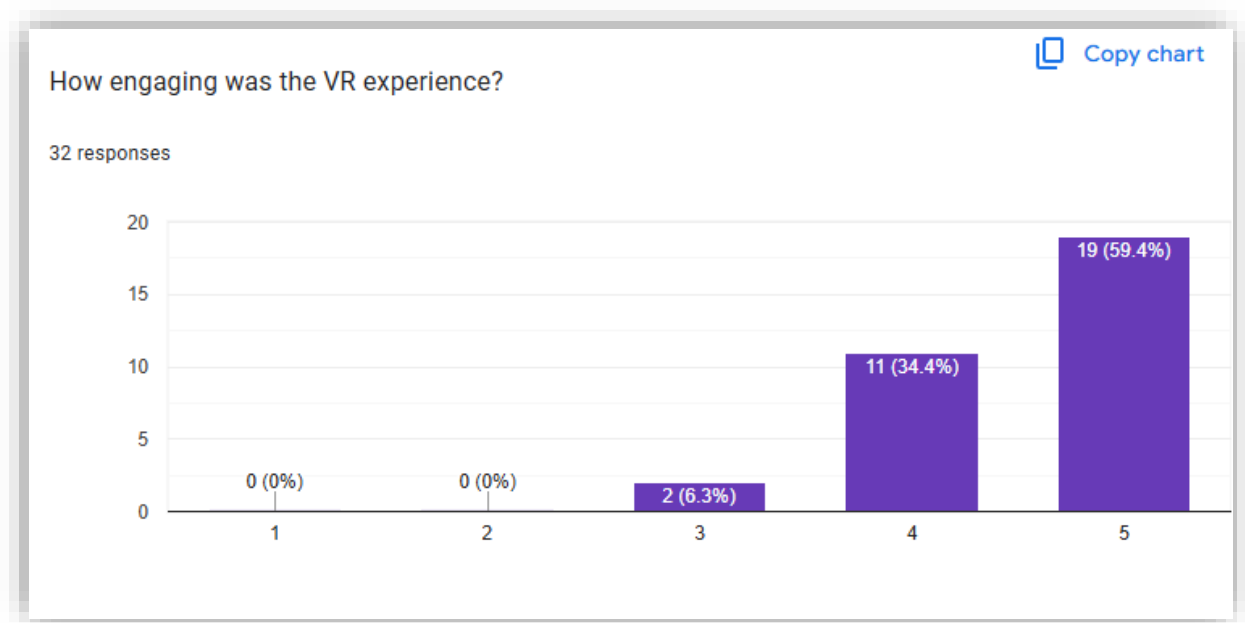


Figure 0.17: Respondent's feedback with the PathoSphere VR experience.

The overall evaluation of *PathoSphere* shows a highly positive response from users. As shown in the results, **59.4% of respondents rated the experience as very engaging**, giving it a full score of **5 out of 5**, while **34.4% rated it 4 out of 5** and **6.3% rated 3 out of 5**, still reflecting a strong level of satisfaction. This suggests that *PathoSphere* successfully captured users' attention and maintained their interest throughout the session. The consistently high engagement ratings also support the idea that the interactive and immersive features of the VR museum created a meaningful and enjoyable learning experience.

## Summary

This chapter explained the testing process for the *PathoSphere* VR museum. Three types of testing were done: functional testing, non-functional testing, and user testing. From the functional testing, all main features like scene changes, object interaction, and information panels worked correctly. The non-functional testing showed that the app ran smoothly on the Meta Quest 3, with quick loading time and clear visuals.

User testing gave helpful feedback about how easy and comfortable the system was to use. Most users said it was easy to move around, and they felt comfortable during the session. All of them said that *PathoSphere* helped them learn about human anatomy, and most found the experience very engaging.

In conclusion, the testing shows that *PathoSphere* works well as an educational tool. It is easy to use, helps with learning, and gives users an enjoyable VR experience.

# Chapter 6: Future Work And Conclusion

## 6.1 Introduction

This chapter highlights the achievements, limitations, and potential future improvements for the *PathoSphere* Virtual Reality (VR) museum project. After completing the development, testing, and evaluation processes, the project has shown promising results in creating an immersive educational experience for anatomy and pathology learning. Although the current version fulfils the minimum requirements, there are still areas that can be further enhanced to improve user engagement, accessibility, and content depth.

## 6.2 Achievement

The *PathoSphere* project has achieved the following objectives:

Table 0.1: Achievement Table

Objective	Achievement
1. To simulate a virtual museum experience that overcomes the time and capacity constraints of the physical museum, allowing students to access the content remotely and at any time.	Successfully developed a VR museum prototype using Unity and deployed it on the Meta Quest 3 headset, enabling users to explore the museum anytime and from anywhere.
2. To develop interactive features for the virtual specimens, allowing users to manipulate, inspect, and explore organs and other anatomical structures in detail, thereby improving their understanding of complex biological systems.	Created an interactive environment with 3D anatomical and pathological models, including features like hover info panels, audio-visual guides, and quizzes for self-paced learning.
3. To validate the functionality and usability of the virtual museum through User Acceptance Testing (UAT).	Conducted functional, non-functional, and user testing (UAT) to ensure performance, stability, and usability. Received positive feedback from participants.

These achievements confirm that *PathoSphere* is a viable tool to complement traditional anatomy education and offers an alternative method for users who cannot access physical museum resources.

## 6.3 Limitations

Despite its successes, the project still has several limitations:

- **Limited content:** Only selected body systems and specimens were included due to time and resource constraints.
- **No AI assistant:** Although planned, the intelligent chatbot feature was not implemented in this version.
- **Single-language support:** The current interface only supports English, limiting accessibility for some users.
- **Hardware-dependent:** The application requires VR hardware, which might not be accessible to all users.

## 6.4 Future Enhancements

To improve and expand *PathoSphere*, the following future works are proposed:

Table 0.2: Future Work table

Future Work Item	Description
1. Content Expansion	Add more anatomical systems and pathological samples.
2. AI Chatbot Integration	Implement an AI assistant to answer user questions during VR exploration.
3. Language Option	Add support for <b>Bahasa Melayu</b> and possibly other languages.
4. PC and Mobile compatibility	Adapt the experience for desktop and mobile devices for wider access.

These improvements can make *PathoSphere* more robust, accessible, and effective as a digital education tool.

## Conclusion

In conclusion, *PathoSphere* has demonstrated that Virtual Reality can be an innovative and effective method for learning anatomy and pathology. The project addressed the real-world limitation of restricted access to the physical museum at UNIMAS by offering a digital alternative that is engaging, self-paced, and visually rich. Through interactive learning and immersive design, students are able to better understand complex biological structures and diseases.

The feedback received from user testing was encouraging, with most participants reporting increased understanding and interest in anatomy. Although there are areas for improvement, *PathoSphere* has laid a strong foundation for future VR-based educational systems.

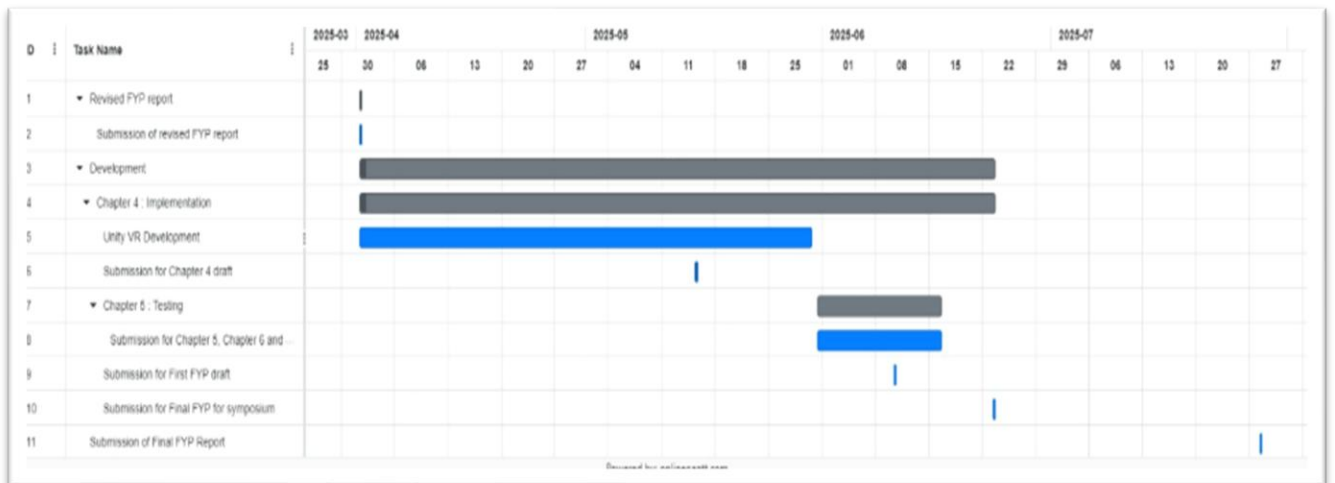
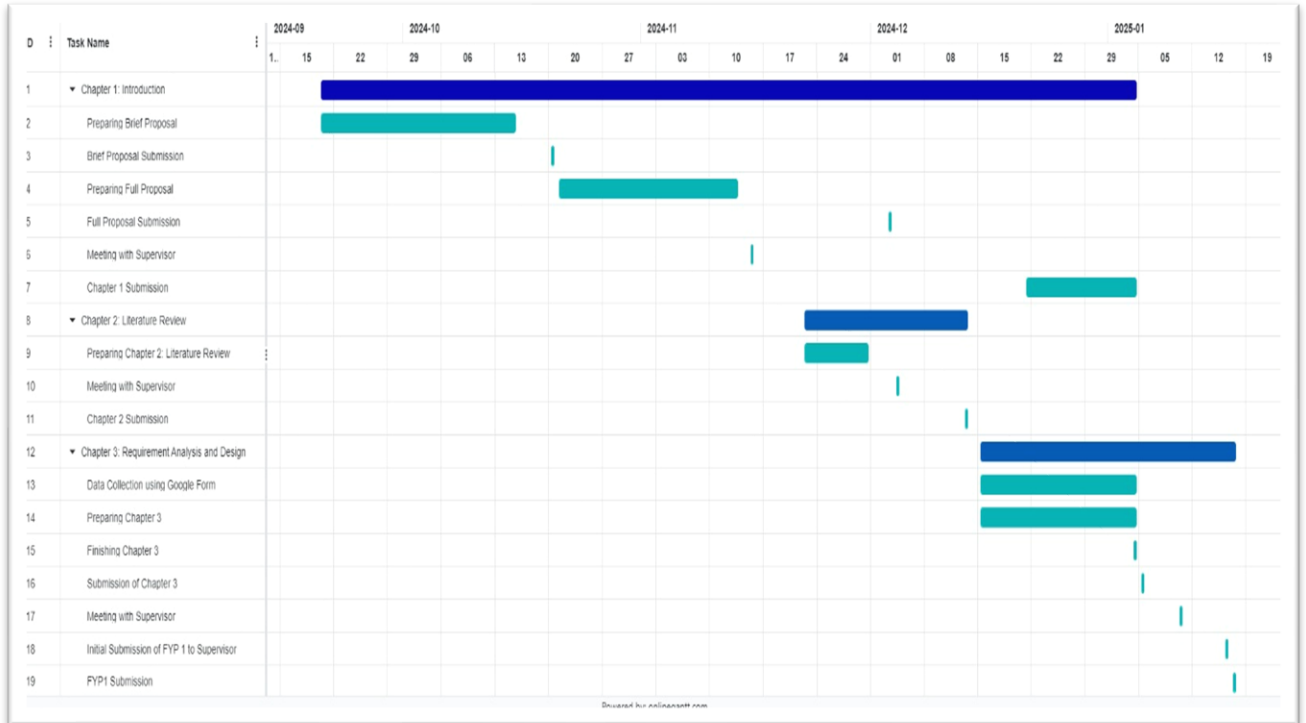
It is hoped that this project will continue to evolve, offering a modern learning experience for future students, and helping institutions improve digital accessibility in science and medical education.

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# Appendix A:

## PROJECT SCHEDULE & GANTT CHART



6 Disember 2024

**Kepada Sesiapa Yang Berkenaan**

Tuan/Puan

**Kerja Lapangan Pelajar Tahun Akhir dari Universiti Malaysia Sarawak  
- Haziq Syahmi bin Hasamudin (79529)**

Dengan segala hormatnya perkara di atas adalah dirujuk.

Sukacita dimaklumkan bahawa pelajar berikut akan mengumpul maklumat untuk projek beliau.

Berikut adalah butir-butir pelajar:

Nama Penuh	:	Haziq Syahmi bin Hasamudin
No. Matrik	:	79529
No. Kad Pengenalan	:	980117135109
Program	:	Pengkomputeran Multimedia
Tahun Pengajian	:	4
Tajuk Projek	:	<i>PathoSphere – Exploring UNIMAS Anatomy and Pathology Museum in VR</i>
Penyelia	:	Ts. Dr Suriati Khartini binti Jali
Emel	:	<a href="mailto:iskhartini@unimas.my">iskhartini@unimas.my</a>
Telefon	:	082 – 592647

Sehubungan itu, sukacita kiranya pihak tuan/puan dapat memberikan kerjasama kepada pelajar berkenaan untuk menyalurkan maklumat yang diperlukan bagi memenuhi syarat kursus. Segala maklumat yang diperolehi akan hanya digunakan untuk tujuan akademik semata-mata dan akan dijamin kerahsiaannya.

Ini adalah sebagai makluman kepada pihak tuan dan sekiranya ada sebarang pertanyaan, sila hubungi penyelia pelajar tersebut.

Sekian, terima kasih.

Siti Lydiawati binti Sahmat  
**Penolong Pendaftar Kanan**

s.k. - Timbalan Dekan, Prasiswazah, FSKTM

Appendix B:

## Google Form Survey

### PathoSphere - Exploring UNIMAS Anatomy & Pathology Museum in Virtual Reality Survey

**B** *I* U  

My name is Haziq Syahmi, a final-year undergraduate student at the University of Malaysia Sarawak (UNIMAS), pursuing a degree in Multimedia Computing under the Faculty of Computer Science and Information Technology (FCSIT).

As part of my final year project, I aim to design a Virtual Reality (VR) version of the *UNIMAS Anatomy & Pathology Museum*, which is located within the Faculty of Medicine and Health Sciences (FMHS). This project seeks to enhance accessibility and improve the learning experience for users.

To better understand your thoughts and gather valuable insights, I have created this survey. Your participation is greatly appreciated and will significantly contribute to the success of this research.

The survey consists of **four(4)** parts and is estimated to take approximately 10-15 minutes to complete.

Part 1(a): Personal Background.

Part 1(b): User Familiarity with Virtual Reality (VR) and Learning Needs.

Part 2: Preferences for VR Features.

Part 3: Accessibility and Technical Requirements.

Part 4: General Feedback and Learning Outcomes.

The responses you provide will be documented and included as part of my final year project. Please rest assured that your responses will remain confidential. All information collected will be securely stored and used solely for academic purposes. Your privacy and trust are highly valued.

I appreciate your kind response and valuable time for taking my survey.

For further questions, feel free to reach me through my email ([haziqhasamudin24@gmail.com](mailto:haziqhasamudin24@gmail.com)).

Thank you!

6 Disember 2024

**Kepada Sesiapa Yang Berkenaan**

Tuan/Puan

**Kerja Lapangan Pelajar Tahun Akhir dari Universiti Malaysia Sarawak  
- Haziq Syahmi bin Hasamudin (79529)**

Dengan segala hormatnya perkara di atas adalah dirujuk.

Sukacita dimaklumkan bahawa pelajar berikut akan mengumpul maklumat untuk projek beliau.

Berikut adalah butir-butir pelajar:

Nama Penuh	:	Haziq Syahmi bin Hasamudin
No. Matrik	:	79529
No. Kad Pengenalan	:	980117135109
Program	:	Pengkomputeran Multimedia
Tahun Pengajian	:	4
Tajuk Projek	:	<i>PathoSphere – Exploring UNIMAS Anatomy and Pathology Museum in VR</i>
Penyelia	:	Ts. Dr Suriati Khartini binti Jali
Emel	:	<a href="mailto:jskhartini@unimas.my">jskhartini@unimas.my</a>
Telefon	:	082 – 592647

Sehubungan itu, sukacita kiranya pihak tuan/puan dapat memberikan kerjasama kepada pelajar berkenaan untuk menyalurkan maklumat yang diperlukan bagi memenuhi syarat kursus. Segala maklumat yang diperolehi akan hanya digunakan untuk tujuan akademik semata-mata dan akan dijamin kerahsiaannya.

Ini adalah sebagai makluman kepada pihak tuan dan sekiranya ada sebarang pertanyaan, sila hubungi penyelia pelajar tersebut.

Sekian, terima kasih.

Siti Lydiawati binti Sahmat  
**Penolong Pendaftar Kanan**

s.k. - **Timbalan Dekan, Prasiswazah, FSKTM**

1. I agree to participate in the research study. I understand the purpose and nature of this study and I am participating voluntarily. I understand that I can withdraw from the study at any time, without any penalty or consequences. \*

Yes.

No

### Part 1(a): Personal Background

1. What is your age? \*

7-12

13-17

18-24

25-34

35-44

45-54

55-64

65 and over

---

2. What is your gender? \*

Male

Female

### 3. What is your Occupation?

- Employed full-time
- Employed part-time
- Retired
- Student
- Unemployed
- Other: \_\_\_\_\_

## Part 1(b): User Familiarity with VR and Learning Needs

### Untitled Title

Virtual Reality (VR) is a technology that creates an immersive, computer-generated 3D environment where users can interact with virtual objects and surroundings as if they were real. This is typically achieved through specialised VR headsets, controllers, and sensors, allowing users to engage visually, audibly, and sometimes physically with the virtual world.

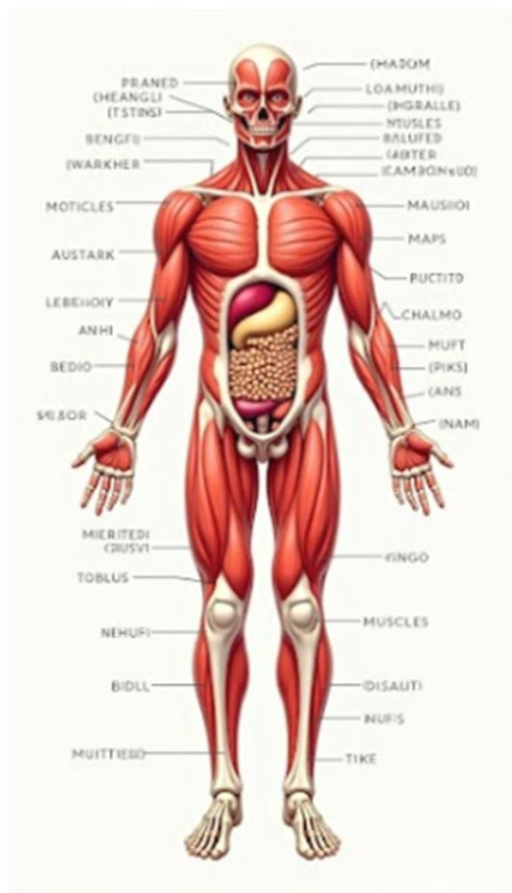
### 4. Have you used Virtual Reality (VR) Technology Before?



- Yes
- No

## Human Anatomy:

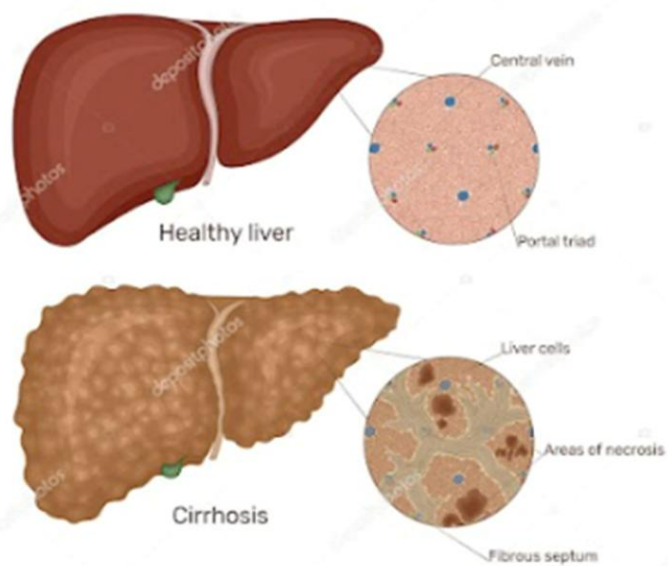
Anatomy is the science that studies the structure of the body



Human Pathology:

Human pathology is the study of diseases in humans, including their causes, mechanisms, and extent. It involves examining tissues, organs, bodily fluids, and sometimes the entire body to understand how the body responds to disease.

## Cirrhosis of the liver



depositphotos

Image ID: 41487014 www.depositphotos.com

5. Do you currently study anatomy and pathology?

Yes

No

6. Would you prefer a VR Museum over a traditional textbook for studying anatomy and pathology?

Yes

No

---

7. How effective do you think VR can be in helping you learn complex topics like anatomy and pathology?

Not very effective.      1      2      3      4      5      Very effective.

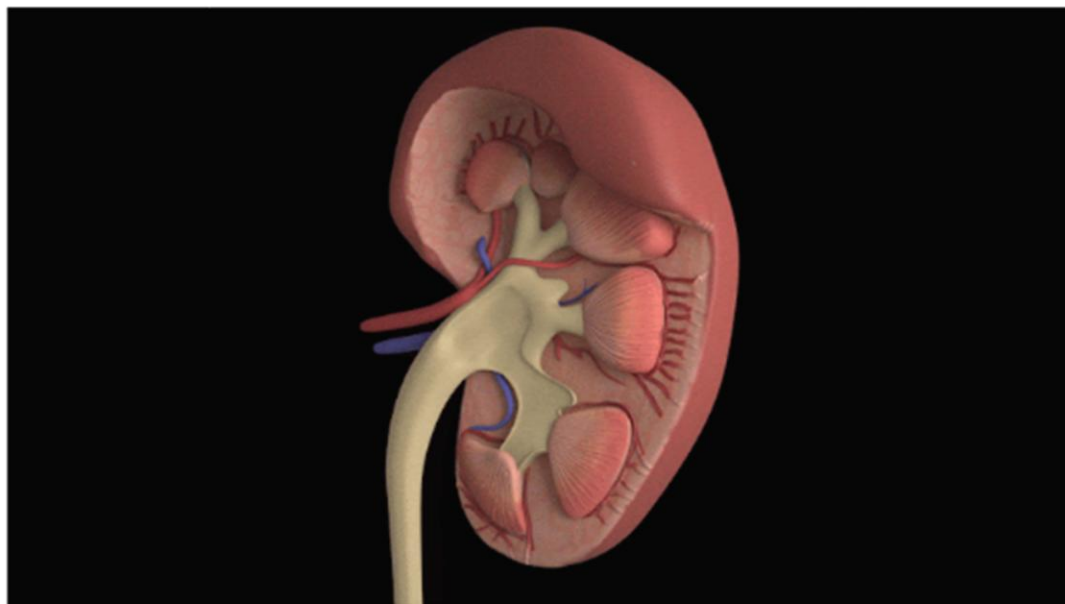
---

8. How important is it to have virtual access to a museum when physical visits are limited?

Not Important      1      2      3      4      5      Very Important

## Preferences for VR Features

9. Do you think interactive features like zooming and rotating 3D models are essential?



Yes.

No.

10. Would you prefer the option to explore the museum freely rather than following a set path?

Yes.

No.

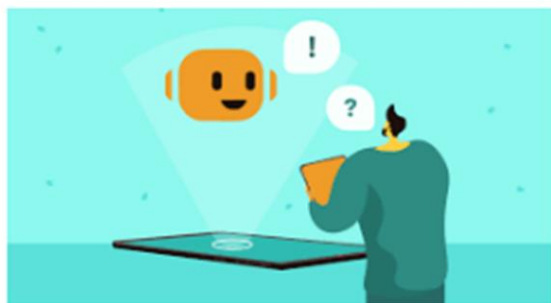
11. How useful do you find gamified features like quizzes or puzzles in enhancing learning? (Scale: 1 = Not Useful, 5 = Very Useful)

1	2	3	4	5
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

12. How important is it for the VR Museum to include realistic, highly detailed models? (Scale: 1 = Not Important, 5 = Very Important)

1	2	3	4	5
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

13. Do you think a virtual assistant (Artificial Intelligence) or guide would improve your experience in the VR Museum?



- Yes.
- No.

### Part 3: Accessibility and Technical Requirements

14. Do you have access to a VR headset or compatible device?

- Meta Quest
- Pico
- PlayStation VR
- Google Cardboard
- None
- Other: \_\_\_\_\_

---

15. Would you consider using the VR Museum on a non-VR device like a laptop or tablet? (Multiple Choice Answers)

- Tablet
- Laptop
- Smartphone
- None
- Other: \_\_\_\_\_

16. How confident are you in using VR technology for educational purposes?  
(Scale: 1 = Not Confident, 5 = Very Confident)

- 1            2            3            4            5
- 

---

17. Do you think the VR Museum should be available offline for better accessibility?

- Yes
- No

#### Part 4: General Feedback

18. Would you recommend the VR Museum to others if it meets your expectations?

Yes

No

---

19. How likely are you to use the VR Museum regularly for studying? (Scale: 1 = Very Unlikely, 5 = Very Likely)

1

2

3

4

5

---

20. Do you think the VR Museum will help improve your understanding of anatomy and pathology?

Yes

No

21. How important is it to include supplementary materials like videos or diagrams alongside the 3D models? (Scale: 1 = Not Important, 5 = Very Important)



1

2

3

4

5

22. How engaging do you think the VR Museum would be compared to traditional learning methods? (Scale: 1 = Not Engaging, 5 = Very Engaging)

1

2

3

4

5

Do you have any suggestion you want to add for this project? (Leave blank if there is none.)

Your answer

---

---

There will be a demonstration held for PathoSphere VR Museum on June 2025. If you would like to participate for the demonstration, please leave your contact below:

1. Name
2. Email Address
3. Phone Number

(Feel free to leave this question blank if you do not wish to participate in the demonstration.)

Your answer

---

# PathoSphere User Testing Survey

This form contains questions regarding the pre-testing and post-testing of PathoSphere. The questions are being separated into few sections.

\* Indicates required question

I agree to participate and allow the data collected from the survey to be used in improvement of PathoSphere. \*

Yes I agree.

Next

Page 1 of 9

Clear form

## Section A : Pre-testing survey

This section is to be answered before testing the VR application.

What is your age group? \*

- Under 18
- 18-22
- 23-27
- 28 or above

What is your academic background? \*

- Medical/Health Sciences
- Computer Science/Multimedia
- Education Department
- Other: \_\_\_\_\_

Have you ever visited a physical anatomy or pathology museum before? \*

- Yes
- No

### Section B: Pre-testing, Familiarity with VR, Anatomy and Pathology

This section falls under pre-testing category. This is to ask how familiar the user is with VR system and their knowledge with Anatomy and Pathology.

**Human anatomy : Focused more on human bodily structure such as separation of organs**



How familiar are you with Virtual Reality (VR) technology? \*

	1	2	3	4	5	
Not familiar	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Very familiar

How would you rate your knowledge of human anatomy/pathology? \*

	1	2	3	4	5	
Not familiar	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Very familiar

[Back](#)

[Next](#)

Page 3 of 9

[Clear form](#)

## Section C: Pre-testing, Expectations

This section falls under pre-testing, asking user expectations before using the system.

What features do you expect in a VR anatomy museum? (Select all that apply) \*

- Interactable 3D organs
- Guided narration or audio explanation
- Scene transitions between systems (e.g., skeletal to muscular)
- Quiz or learning checkpoints
- Other: \_\_\_\_\_

How useful do you think a VR museum would be for learning anatomy/pathology? \*

	1	2	3	4	5	
Not useful	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Very useful

## Section D: Post-Test Questions (After Using PathoSphere)

This section is to be answered after the user enter the PathoSphere VR environment.

How easy was it to navigate the VR museum? \*

	1	2	3	4	5	
Very hard	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Very easy

Were the controls intuitive and easy to use? \*

	1	2	3	4	5	
Not intuitive	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Very intuitive

Did you face any discomfort while using the VR headset (e.g., dizziness, eye strain)? \*

- Yes
- No
- Not sure

## Section E: Learning and Engagement

This section is about how useful PathoSphere is in terms of learning and how engaging it is.

Did PathoSphere help you understand the anatomical structures better? \*

Yes

No

Which part of the VR museum did you find most educational or memorable? \*

Your answer \_\_\_\_\_

How engaging was the VR experience? \*

Not engaging      1      2      3      4      5      Very engaging

How confident do you feel in identifying human organs/pathological features after the session? \*

Not confident      1      2      3      4      5      Very confident

I agree to participate and allow the data collected from the survey to be used in improvement of PathoSphere.

[Copy chart](#)

32 responses



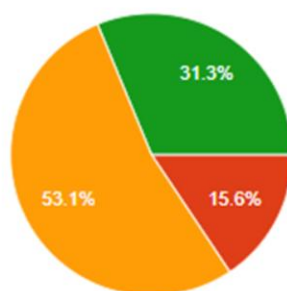
● Yes I agree.

### Section A : Pre-testing survey

What is your age group?

[Copy chart](#)

32 responses

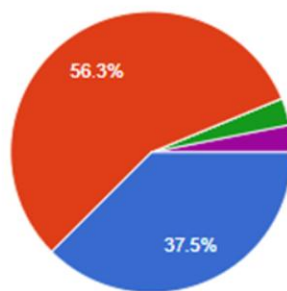


● Under 18  
● 18-22  
● 23-27  
● 28 or above

What is your academic background?

[Copy chart](#)

32 responses

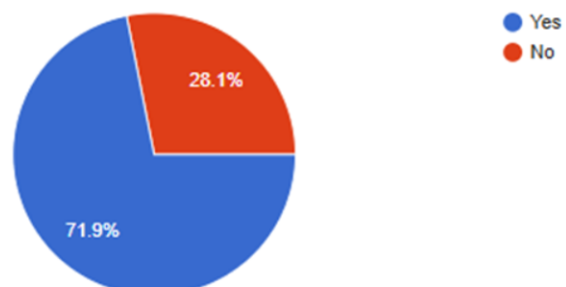


● Medical/Health Sciences  
● Computer Science/Multimedia  
● Education Department  
● Cognitive Science  
● Social Science Department

Have you ever visited a physical anatomy or pathology museum before?

 [Copy chart](#)

32 responses



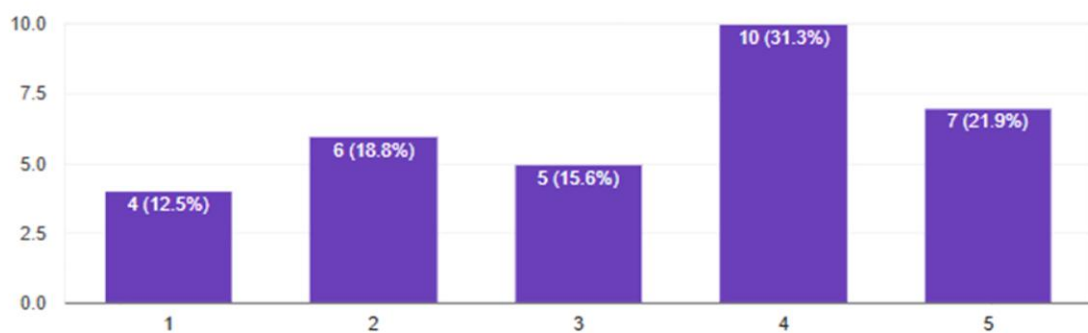
## Section B: Pre-testing, Familiarity with VR, Anatomy and Pathology

### Examples of virtual reality (VR)

How familiar are you with Virtual Reality (VR) technology?

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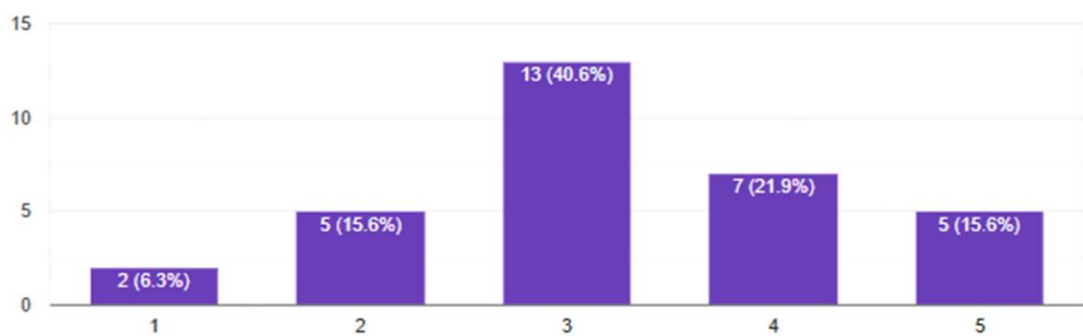
32 responses



How would you rate your knowledge of human anatomy/pathology?

 Copy chart

32 responses

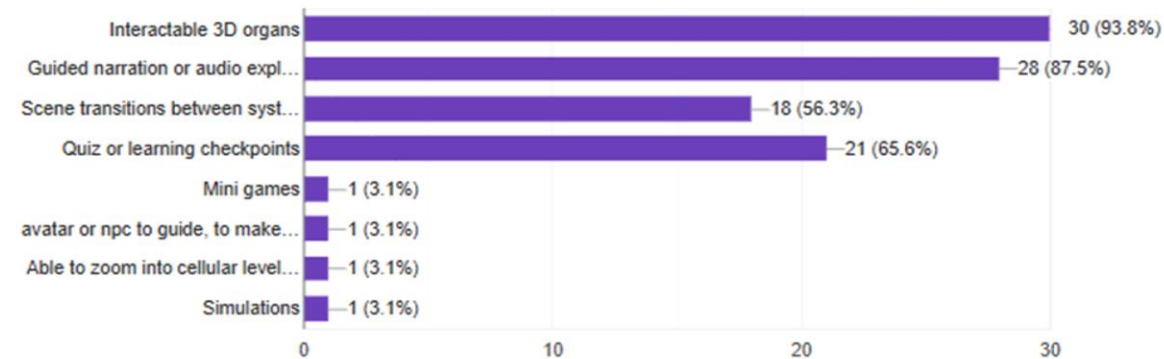


## Section C: Pre-testing, Expectations

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What features do you expect in a VR anatomy museum? (Select all that apply)

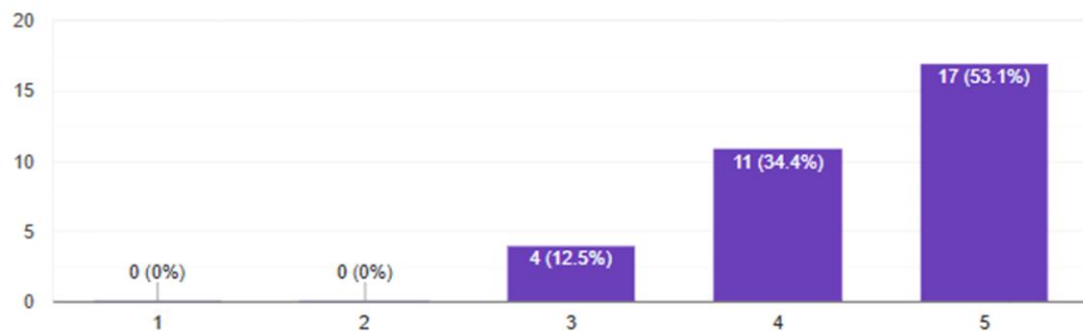
32 responses



[Copy chart](#)

How useful do you think a VR museum would be for learning anatomy/pathology?

32 responses

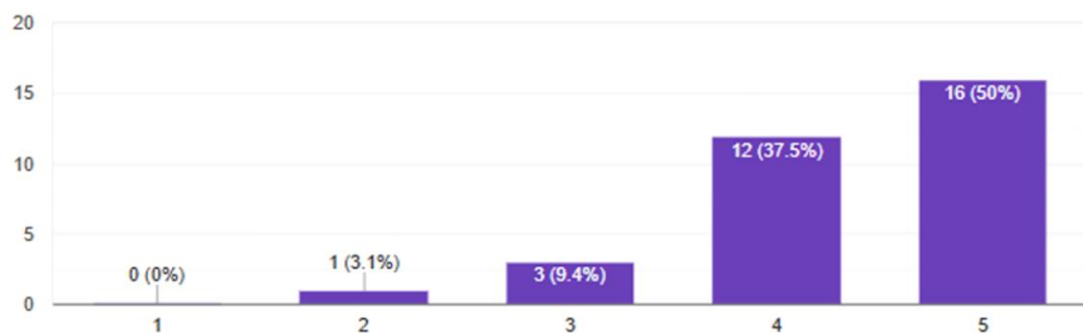


## Section D: Post-Test Questions (After Using PathoSphere)

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How easy was it to navigate the VR museum?

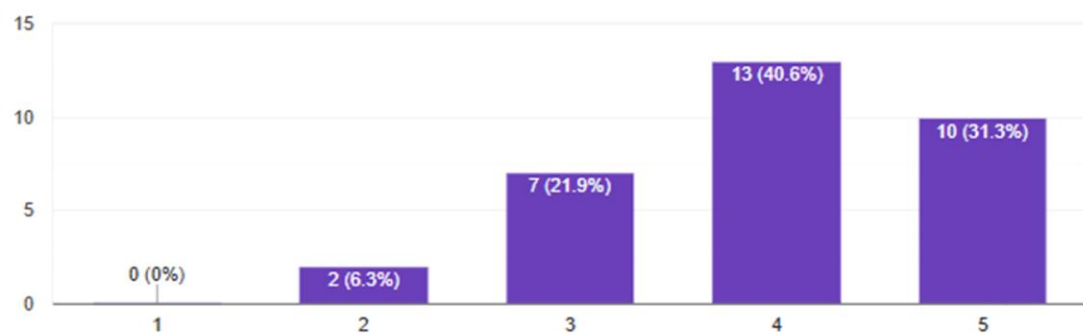
32 responses



 Copy chart

Were the controls intuitive and easy to use?

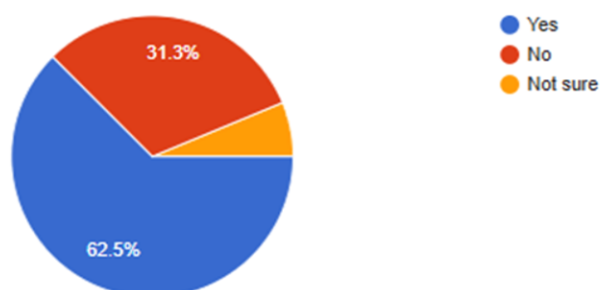
32 responses



Did you face any discomfort while using the VR headset (e.g., dizziness, eye strain)?

 Copy chart

32 responses



### Section E: Learning and Engagement

Did PathoSphere help you understand the anatomical structures better?

 Copy chart

32 responses



Which part of the VR museum did you find most educational or memorable?

32 responses

Interactive organ

The quizzes

Morgue

Slashing the doctor

Scanner at mortuary, quiz

The morgue

showing the organ - lung

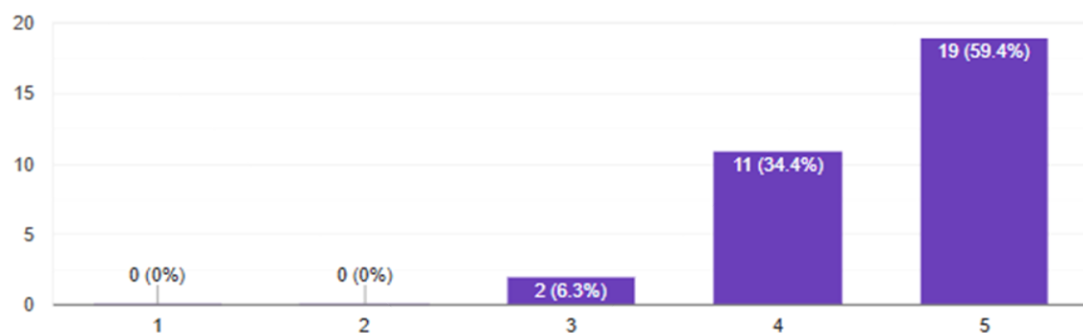
able to interact with the museum contents was fun.

it is fun to walk around the museum

### How engaging was the VR experience?

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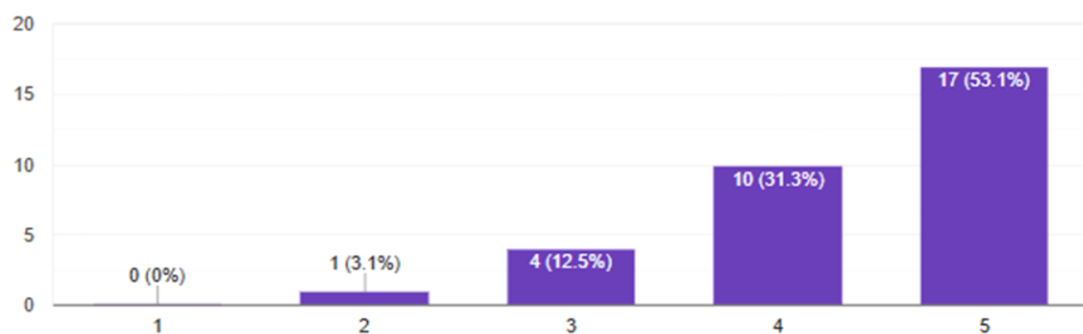
32 responses



### How confident do you feel in identifying human organs/pathological features after the session?

 Copy chart

32 responses



Appendix C:

Live Survey Testing





