6COSC023W – Final Project Report

**ARTVISIO**

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This report is submitted in partial fulfillment of the requirements for the

BSc (Hons) Computer Science degree

BEng Software Engineering degree

at the University of Westminster.

School of Computer Science & Engineering

University of Westminster

Date

# Document Scope

The purpose of this document is to describe and reflect on the processes that took place in developing the Final Project. Discuss any ethical issues associated with your project and explain the methodology adopted to develop its design, implementation and testing.

All chapter word counts in this document are approximate and are not intended to be prescriptive.

*All sections in orange (like this one) must be removed before submitting the report.*

# Declaration

This report has been prepared based on my own work. Where other published and unpublished source materials have been used, these have been acknowledged in references.

Word Count:

Student Name:

Date of Submission:

*This is an important section!*

*Add the updated word count (do not count words in the Acknowledgments, Table of Contents, Table of Figures, Table of Tables, References, Bibliography and Appendix). Add your name and the date of submission.*

# Abstract

*500 words*

*Summarise here the problem statement and the project aim(s). Briefly describe the methodology followed, the main results, your conclusions, and observations.*

# Acknowledgements

*Thank those who helped you build your project and supported you during its development if you wish to hear*.

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*Provide a list of tables (if any), linking table numbers to page numbers. If you can, hyperlink the page numbers/tables*.

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# Introduction

This project is an ambitious endeavour to revolutionize the art industry by introducing a digital platform that fundamentally transforms how art is shared and experienced. With the goal of creating a universally accessible and engaging space, the project seeks to address the current limitations of the art world by providing a solution that is inclusive, educational, and innovative.

In this introduction, we have outlined the aim to create a new digital ecosystem for art, detailed the objectives that will guide our development, and discussed the problem domain we aim to address. As we proceed, this project will endeavour to meet these challenges head-on, leveraging technology to foster a richer, more connected art world.

## Problem statement

*500 words Give some background on the problem you intend to solve and the need for the software/application. Use references to support your statements, when possible, illustrations, diagrams, and figures, if needed.*

The realm of art has been a hub for creative expression and progress for ages. Nonetheless, we cannot overlook the obstacles it encounters with regards to accessibility and outreach. Although conventional modes of exhibiting art have served us well, it is now imperative to adopt fresh technologies and seek inventive approaches that can aid us in connecting with a larger and more diverse audience. By harnessing virtual reality and multimedia installations, we can generate more captivating and interactive experiences that are likely to appeal to the tech-savvy generation. This transformation will not only benefit artists and art enthusiasts but also prove advantageous to budding talent seeking the exposure required for success.

It's regrettable that the physical confines of galleries and museums can impede the presentation of art in all its diversity. The finite nature of these spaces can pose challenges to curators and exhibition planners, who must contend with the logistics of transporting and setting up art, often without the necessary resources. In such circumstances, institutions with limited financial and staffing capacities may be forced to prioritise established artists over emerging talent. This can result in a more conservative approach to exhibition planning.

The limited physical spaces of art exhibitions can inadvertently Favor established artists over emerging talent, hindering diversity. Additionally, navigating the art market can be challenging for newer artists. This, in turn, may limit the potential for emerging artists to gain exposure and recognition, contributing to a lack of diversity and inclusivity within the art community. Therefore, initiatives like mentorship programs, grants, and funding opportunities for emerging artists are crucial to fostering a more vibrant and dynamic cultural landscape.

The limited dissemination of art techniques and knowledge creates a barrier to entry for many aspiring artists, leading to a lack of diversity and inclusivity within the art community. To address this issue, institutions and established artists should provide access to their knowledge and techniques through mentorship programs or public workshops. Additionally, initiatives like grants and funding opportunities can support emerging artists financially, fostering a more vibrant and dynamic cultural landscape.

Furthermore, the current methods used to display and share artwork are not conducive to the digital-native generation, which seeks immediacy, interactivity, and immersive experiences. The static displays and silent galleries seem increasingly anachronistic in an age where virtual reality, interactive installations, and multimedia experiences are becoming the norm. The art world's reluctance to embrace these technologies hinders its relevance and ability to engage with a broader, more technologically savvy audience.

It's become increasingly apparent that the art world could benefit from a software application or platform that effectively addresses its current challenges. Thanks to the power of digital innovation, there is enormous potential to create a virtual space that can transcend physical distance and time constraints. This would allow the art world to expand its reach to new audiences while democratising art display by rotating diverse works without physical space limitations. Additionally, such a platform would provide emerging artists with a valuable opportunity to showcase their work, facilitate the sharing of knowledge and techniques, and make art education more accessible and interactive.

The realm of art encounters various challenges that impede the availability of art and education. To address this, we present a website application that is a hub for cultural exchange, learning, and exploration - unrestricted by physical boundaries. We aim to establish an interactive, immersive, and globally accessible platform that promotes inclusivity and encouragement for artists and enthusiasts worldwide. Our method aligns with the shift towards accessibility and democratisation of art and education in our digital age. We invite you to join us in cultivating a more inclusive and supportive art world that empowers everyone.

## Aims and Objectives

*300 words the aim(s) describe, in a few sentences, the overarching purpose(s)/intention(s) of the software/application. What is the point of developing the software/application, what you wish to achieve? Objectives describe in detail the steps you will take to fulfil the project aim(s)*.

1. **AIM**

This project aims to spearhead a revolutionary shift in the art industry by crafting a digital ecosystem that transcends traditional boundaries. This platform is envisioned as a beacon of innovation, making the art world more accessible and engaging for a global audience. The project is designed to enable a symbiotic relationship between artists, galleries, educators, and art enthusiasts, fostering an inclusive environment that encourages interaction, learning, and sharing of artistic experiences.

The project aims to create a space where traditional art exhibitions' physical limitations are overcome. This digital convergence seeks to amplify the voices of emerging artists, providing them with the exposure necessary to thrive in the global art community. By integrating cutting-edge technologies, the project strives to curate an immersive experience that resonates with the sensibilities of contemporary audiences, thereby revolutionising the way art is consumed and appreciated.

1. **Objective**:

In pursuit of our aim, we have delineated a series of strategic objectives that will be instrumental in realising our vision:

* **Development of a Virtual 3D Art Gallery:**

We will construct an immersive virtual gallery that mimics physical art spaces' aesthetic and emotional impact, enhanced with optional spatial audio features for a multi-sensory experience.

* **User Requirement Gathering:**

Through comprehensive stakeholder engagement, we will capture diverse insights that will inform the design and functionality of the platform, ensuring it meets the nuanced needs of its users.

* **Diverse Artwork Rotation:**

By collaborating with art historians and curators, we will curate a dynamic range of artworks that reflects the rich tapestry of global artistic expression, powered by an algorithm designed to personalize the user experience.

* **Accessibility and Inclusivity:**

We will prioritize making the platform accessible to all by conducting rigorous usability testing and incorporating real-time language translation features, dismantling language barriers, and creating a universally welcoming space.

* **Flexible Exhibition Design:**

The platform will empower curators with advanced tools to design and adapt virtual exhibitions, ensuring that the gallery remains a vibrant and dynamic space for artistic exploration.

* **Support for Emerging Artists:**

We will establish networks and resources to mentor and guide emerging artists, aiding them in navigating the complexities of the art world and promoting their work effectively.

* **Educational Enrichment:**

Interactive tours and educational materials will be developed to enrich the understanding of artworks, drawing on historical and contemporary gallery practices to engage and inform visitors.

* **Future Improvement and Expansion:**

The project will continuously evolve, seeking partnerships and exploring new technologies like VR to further enrich the user experience and expand the platform's reach.

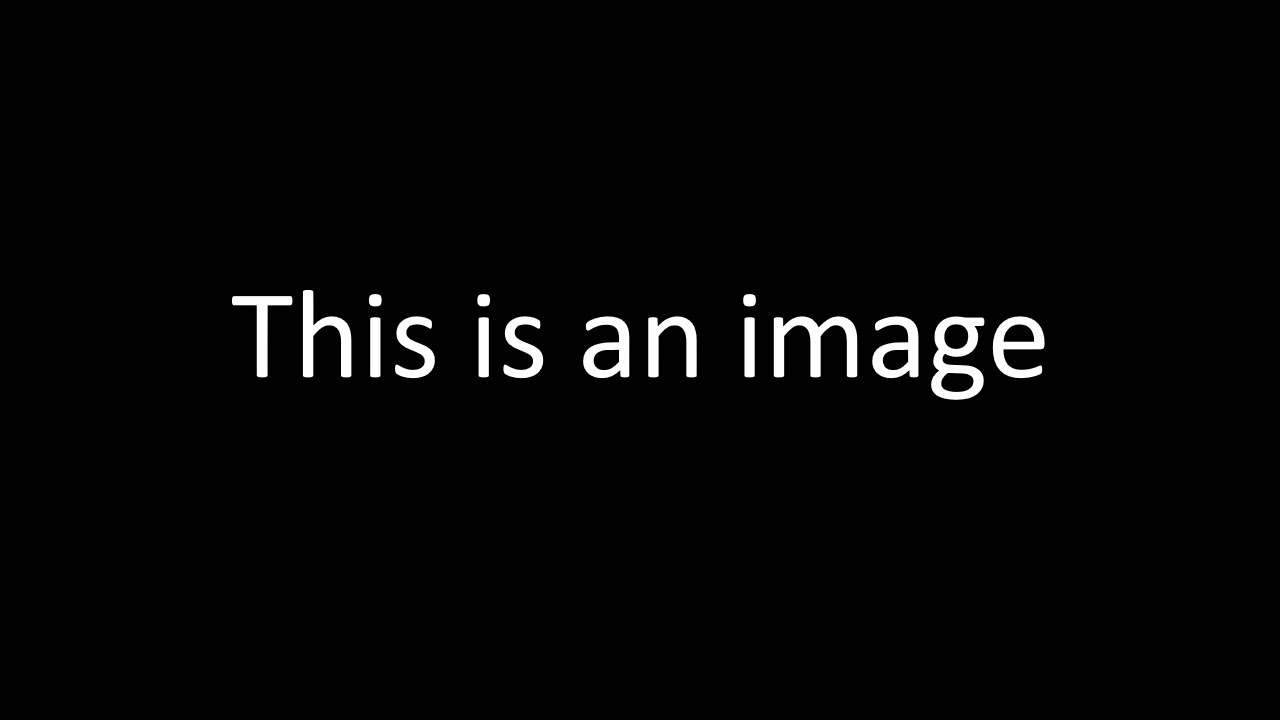


Figure 1. Add a caption explaining the image here.

# 2. Background

*Include a literature survey in the topic, discuss existing similar or relevant applications to yours and the result of a review of tools and techniques that are used to tackle projects similar to yours*.

## 2.1 Literature survey

*800 words*

*Describe initial results of a literature survey on a selected research topic or application area related to your project subject. Use relevant books, published research articles as well as Internet content for the purpose. Make use of in-text references to indicate your sources*.

**Introduction**

The advent of Virtual Reality (VR) has inaugurated a new era in the realm of education and art, ushering in innovative methodologies that transform how knowledge is imparted and how art is consumed. This literature survey scrutinizes pivotal contributions by Chamekha & Hammamib (2020) and Polys et al. (2022), whose research delineates the profound impacts of VR on education and the immersive experience within virtual art galleries. These scholarly works argue for VR's capability to not just enhance educational outcomes through engaging, interactive environments but also to democratize access to art, allowing for a broader and more inclusive audience engagement. By leveraging VR technology, educators and curators can overcome traditional barriers, offering experiences that are both pedagogically rich and widely accessible, thereby redefining the landscapes of education and art appreciation in the digital age.

**Impact of VR in Education**

The advent of Virtual Reality (VR) technology marks a pivotal evolution in educational paradigms, offering a leap from traditional, often passive learning methodologies to an immersive, interactive educational experience. Chamekha & Hammamib (2020) underscore VR's transformative potential in modern education, illustrating how it facilitates an engaging, experiential learning environment that significantly diverges from conventional teaching methodologies reliant on rote memorization and passive absorption of content. The immersive nature of VR, where learners can navigate, manipulate, and interact with three-dimensional representations of subject matter, offers a dynamic platform for experiential learning. This hands-on approach not only aids in solidifying comprehension and retention of knowledge but also appeals to a wide array of learning styles, accommodating visual, kinesthetic, and auditory learners with equal efficacy.

VR's application in art education serves as a compelling case study for its potential. Through VR, students are transported beyond the confines of the classroom into virtual art galleries, historical sites, and artist studios, enabling them to explore and interact with art in unprecedented ways. This immersive experience fosters a deeper understanding and appreciation of art, allowing students to examine artworks from multiple angles, delve into the intricacies of artistic techniques, and even step into the shoes of the artists themselves. Furthermore, VR democratizes access to art education, bridging geographical divides and making world-renowned artworks and cultural heritage sites accessible to students regardless of their location. This global accessibility not only enriches the educational experience but also cultivates a broader cultural awareness and empathy among learners.

Moreover, the interactive capabilities of VR introduce novel pedagogical opportunities, enabling educators to design curricula that are not only informative but also engaging and motivational. For instance, gamified learning experiences within VR environments can enhance motivation and engagement by incorporating elements of competition, achievement, and reward, making learning an enjoyable and memorable experience. These interactive experiences also encourage critical thinking and creativity, as students are often tasked with solving problems, making decisions, and creating within the VR space.

However, the integration of VR in education is not without challenges. Issues such as the digital divide, the need for technical infrastructure, and the requirement for educators to possess a certain level of technological proficiency can hinder the widespread adoption of VR in educational settings. Despite these challenges, the ongoing advancements in VR technology and the increasing availability of affordable VR hardware are gradually mitigating these barriers, making VR a more accessible tool for educators and learners alike.

In summary, the impact of VR on education extends far beyond mere technological novelty. It represents a fundamental shift towards more interactive, experiential learning methodologies that have the potential to revolutionize how knowledge is imparted and experienced. By leveraging the immersive and interactive capabilities of VR, educators can create rich, engaging learning environments that not only enhance educational outcomes but also inspire a lifelong love for learning and exploration among students.

**User Interaction Design in Virtual Art Galleries (350 words)**

The design of user interaction within virtual art galleries stands at the forefront of redefining art appreciation and engagement in the digital age. Polys et al. (2022) delve into the intricacies of crafting virtual spaces that not only replicate the physical experience of art galleries but also enhance it through the unique capabilities afforded by VR technology. The essence of their research underscores the pivotal role of user-centered design in cultivating a virtual environment that is both intuitive and immersive, capable of captivating a diverse audience ranging from art aficionados to casual visitors.

A critical aspect of user interaction design in virtual art galleries involves the navigation and exploration of the virtual space. Unlike physical galleries where spatial constraints can limit access and exploration, virtual galleries offer the possibility of limitless exploration, free from physical barriers. However, this freedom also presents a challenge: ensuring that navigation is intuitive and that users can easily locate and engage with artworks of interest. Polys et al. emphasize the importance of designing navigation tools that are both simple and effective, such as virtual maps, teleportation points, and guided tours, which enable users to effortlessly traverse the virtual gallery and discover artworks.

Interactive features that allow users to engage with art in novel ways are another cornerstone of user interaction design in virtual art galleries. These features can range from multimedia presentations that provide contextual information about the artwork and the artist to interactive elements that allow users to manipulate the artwork or explore it from different perspectives. Such interactions not only enrich the user's understanding and appreciation of the art but also create a more engaging and memorable gallery visit. Furthermore, the incorporation of social interaction features, such as virtual chat rooms or the ability to share and discuss artworks with others within the VR environment, introduces a communal dimension to the virtual art gallery experience. These social features replicate the shared experience of art appreciation found in physical galleries, fostering a sense of community and dialogue among visitors.

However, the effective design of user interaction in virtual art galleries is not without its challenges. Designers must balance the desire for rich interactive features with the need for simplicity and ease of use, ensuring that the virtual gallery is accessible to users with varying levels of technical proficiency. Additionally, considerations of virtual presence and immersion are paramount; the virtual environment must be designed in a way that feels authentic and engaging, encouraging users to spend time exploring and returning to the gallery. Polys et al. advocate for an iterative design process, where user feedback is continuously sought and incorporated into the design, ensuring that the virtual gallery evolves to meet the needs and preferences of its audience.

In conclusion, the design of user interaction within virtual art galleries is a multifaceted endeavor that requires careful consideration of navigation, interactivity, and social engagement. By prioritizing user-centered design principles, virtual art galleries can transcend traditional limitations, offering immersive, interactive art experiences that engage a wide audience. As technology continues to evolve, so too will the possibilities for innovative user interaction design, promising a future where virtual art galleries continue to enrich and expand the horizons of art appreciation.

**Technological Advancements and Their Role (500 words):**

Technological advancements have played a crucial role in enabling the creation and proliferation of virtual art galleries, transforming the landscape of art appreciation and education. These advancements, spanning from high-fidelity graphics to interactive elements and social connectivity features, have significantly enhanced the quality and accessibility of virtual art experiences. The evolution of VR technology, in particular, has been instrumental in overcoming previous limitations, offering increasingly realistic and immersive representations of artworks and gallery spaces.

High-resolution imaging and 3D modeling technologies have allowed for the accurate reproduction of artworks and sculptures, enabling users to observe fine details and textures that would be difficult to appreciate in a two-dimensional representation. This level of detail not only enriches the visual experience but also allows for a deeper understanding of the artist's techniques and intentions. Similarly, advancements in spatial audio technology have introduced new dimensions to the virtual gallery experience, enabling auditory exploration of art spaces. Ambient sounds, audio guides, and artist interviews can now be integrated seamlessly into the virtual environment, providing contextual information that enhances the overall appreciation of the art.

Interactive technologies have further expanded the capabilities of virtual galleries, introducing elements such as virtual reality annotations, interactive timelines, and gamified learning experiences. These interactive features not only make art more accessible but also more engaging, particularly for younger audiences or those new to art appreciation. By allowing users to interact with artworks in meaningful ways—such as exploring different layers of a painting or participating in virtual art-making workshops—these technologies foster a more active and participatory form of art engagement.

Moreover, social connectivity features enabled by advancements in network and communication technologies have transformed virtual art galleries into dynamic social spaces. Users can now share their art experiences with friends, participate in guided tours, and engage in discussions within the virtual environment, mirroring the social aspect of physical gallery visits. This social dimension not only enhances the enjoyment and understanding of art but also builds communities of art enthusiasts, facilitating cultural exchange and dialogue across geographical boundaries.

Despite these advancements, challenges remain in ensuring that virtual art galleries are accessible to a broad audience. Issues such as digital divide, the need for specialized hardware, and the requirement for digital literacy can limit access to these rich art experiences. However, as VR technology becomes more widespread and affordable, and as designers continue to prioritize accessibility and user-friendliness, virtual art galleries are poised to become an increasingly integral part of the art world.

In conclusion, technological advancements have been instrumental in the development of virtual art galleries, offering new ways to experience, appreciate, and learn about art. As these technologies continue to evolve, they promise to further democratize access to art, breaking down barriers and opening up new avenues for cultural engagement and education. The future of art appreciation lies in leveraging these technological innovations to create immersive, interactive, and socially connected art experiences that are accessible to all.

**Conclusion (100 words)**

In conclusion, the surveyed literature highlights VR's significant potential in transforming art education and engagement. By fostering immersive experiences and facilitating interactive learning, VR technology opens up new avenues for cultural exploration and education. As VR continues to evolve, future research should focus on overcoming current limitations and exploring innovative applications of VR in art and beyond.

## 2.2 Review of projects / applications

*800 words*

*Describe your background research on existing projects/software/applications, tools/frameworks/methods/algorithms/techniques relevant to your project, their advantages, and disadvantages. Use illustrations, diagrams, screenshots for the purpose.*

*You may produce a Table of Features in this section, comparing the main features of the above projects/software/applications and the one you developed.*

*A comparison table may also be provided to distinguish the key characteristics of features/methods/algorithms/techniques relevant to your project*.

The digitisation of art and education through virtual reality (VR) platforms like KUNSTMATRIX and Shape Spark has initiated a renaissance in how art is exhibited and experienced. These platforms are at the forefront of blending technological innovation with artistic expression, challenging traditional constraints and democratizing access to art. This review critically examines KUNSTMATRIX and Shape Spark, alongside similar VR applications, to evaluate their contributions to virtual art exhibitions and education.

**KUNSTMATRIX: A Pioneer in Virtual Art Exhibitions**

KUNSTMATRIX stands out as a comprehensive platform designed for artists, galleries, and educators to create virtual 3D exhibitions. Its user-friendly interface allows for the easy curation of exhibitions, offering tools for art placement, lighting adjustments, and spatial configuration. This accessibility ensures that even those with minimal technical expertise can effectively display their work or curate exhibitions. The platform supports a variety of media, including paintings, sculptures, and digital art, facilitating a multidimensional art experience.

However, while KUNSTMATRIX excels in exhibition creation and versatility, it faces limitations in interactivity and user engagement. The platform primarily focuses on visual presentation, with less emphasis on interactive elements that could enrich the user's experience. For instance, opportunities for viewers to interact with the art or engage in discussions within the virtual space are limited. This aspect points to a broader challenge within virtual art platforms: balancing the aesthetic presentation with dynamic, engaging features that mimic the social and exploratory nature of physical galleries.

**Shape Spark: Advancing Interactivity in Virtual Spaces**

Shape Spark takes a different approach, emphasizing interactivity and realism in its virtual environments. The platform allows for the creation of detailed, navigable 3D spaces that users can explore freely, much like in a video game. This level of interactivity, combined with high-quality graphics, offers an immersive experience that closely mimics visiting a physical gallery. Shape Spark also incorporates features such as real-time lighting adjustments and the ability to embed multimedia content, enhancing the presentation of artworks and providing additional context to viewers.

Despite its strengths in creating realistic and interactive environments, Shape Spark's complexity and the required technical proficiency can be barriers to wider adoption. The platform demands a higher level of technical skill from its users, both in terms of creating and navigating exhibitions. This complexity can deter artists and curators who lack the time or resources to invest in mastering the platform, potentially limiting its accessibility and the diversity of exhibitions available.

**Comparative Analysis: User Experience and Accessibility**

When comparing KUNSTMATRIX and Shape Spark, a key distinction emerges in their approach to user experience and accessibility. KUNSTMATRIX prioritizes ease of use and accessibility, making it a more inclusive platform for artists and curators. In contrast, Shape Spark focuses on delivering a highly interactive and immersive experience, appealing to users seeking depth and realism in virtual exhibitions. This divergence highlights the spectrum of needs within the art community, from those requiring straightforward tools for virtual exhibition creation to those desiring advanced interactivity and realism.

**Similar VR Applications in Art and Education**

Exploring similar VR applications reveals a broader landscape of platforms aiming to transform art appreciation and education. VR museums and educational platforms have emerged as significant contributors to this field, offering curated experiences that blend educational content with interactive exploration. These applications often leverage the immersive potential of VR to engage users in learning experiences that are both informative and emotionally resonant. For example, virtual reality museum tours allow users to explore historical artifacts and artworks in detail, often accompanied by narrated guides that provide historical context and insights.

However, similar to the challenges faced by KUNSTMATRIX and Shape Spark, these applications must navigate the balance between technological innovation and user accessibility. High-quality VR experiences typically require specialized hardware and software, which can be cost-prohibitive for many users and institutions. Moreover, the design of these experiences demands careful consideration of user interface and navigation to ensure they are accessible to a broad audience, including those with limited VR experience.

**The Future of Virtual Art Platforms**

The future of virtual art platforms lies in addressing the challenges of interactivity, realism, and accessibility. As VR technology continues to evolve, there is significant potential for these platforms to offer even more immersive and engaging art experiences. Advances in haptic feedback, for example, could introduce tactile interactions with virtual artworks, further bridging the gap between digital and physical art experiences. Additionally, the development of more intuitive user interfaces and the integration of AI-driven guides could enhance navigability and educational value, making virtual art platforms more accessible and informative.

In conclusion, KUNSTMATRIX and Shape Spark, along with similar VR applications in art and education, represent pivotal developments in the digitization of art exhibition and appreciation. By critically evaluating their contributions and limitations, it becomes evident that the future success of virtual art platforms will depend on their ability to merge technological innovation with user-centric design principles. Emphasizing interactivity, realism, and accessibility will not only enhance the user experience but also ensure that the digital realm becomes an inclusive space for art exploration and education.

## 2.3 Review of tools, frameworks and techniques

*800 words*

*Describe results of a survey on relevant tools/frameworks that can be used to develop applications such as the one you built for your project, such as programming languages and environments, libraries. List their advantages and disadvantages. Use illustrations, diagrams, screenshots for the purpose*.

# 3. Legal, social and ethical issues

*300 words*

*Consider any legal, ethical, social, professional and security issues associated with your research and the software/application you are building and/or the data you are collecting/analysing*.

# 4. Methodology

*800 Words*

*Describe the life cycle stages of the project, methodology, and development techniques you followed in the design and implementation of your project.*

*As examples: Gantt chart for life cycle, Waterfall or Agile for development methodology. Use an appropriate methodology for the project and list the key steps and milestones.*

*Discuss the implementation of your project and your consideration for UX, UI. Describe your testing methodology and give adequate examples, e.g., unit testing for typical client-server applications, white box for algorithmic and mission critical code etc. Discuss why your chosen methodology is suitable for the project.*

*Please note that even if you are using Agile methodology, you will still need to provide a high-level waterfall plan with key milestones, with any agile iterations also detailed in this report*.

|  |  |  |  |
| --- | --- | --- | --- |
|  | Category 1 | Category 2 | Category 3 |
| Item 1 |  |  |  |
| Item 2 |  |  |  |
| Item 3 |  |  |  |

Table 1. Add caption here.

# 5. Design

*Describe your final software structure using diagrams where necessary.*

*800 Words*

*Discuss in some detail (if relevant) issues relating to:*

* *User Interface*
* *Infrastructure*
* *Functionality*
* *Algorithm development*
* *Content creation*
* *Other*

*Discuss how this address the project requirements.*

*Use appropriate design methods for your project and extend your design to include implementation details that were not included in your Project Specification Design and Prototype (PSPD) report. e.g. make use of UML such as class diagrams, sequence/activity/state diagrams for complex algorithms and workflows, use UI design methodology and heuristics for predominately UX based projects. If you intend to develop an app/software/dashboard, you may have to use/create ERD, flowcharting, storyboarding, prototyping. It is up to you to use the appropriate design that best describes your implementation*.

# 6. Tools and implementation

## 6.1 Tools

*300 words*

*Describe the tools (programming environments & languages, frameworks, and libraries,) you used for the development of your application. Justify your choices with references to your use cases or list of requirements.*

*State existing skills development and any new skills you employed for building your project*.

## 6.2 Implementation

2500 words

Explain implementation of main code by use case. Include pseudocode or snippets of any novel code. Highlight any code that is adopted/adapted and give the original sources. Make references to your design documentation where appropriate.

# 7. Testing

*Create sufficient test cases to determine that the applications satisfy the requirements and works correctly*.

## 7.1 Test coverage

*800 words*

*Discuss black box and/or white box testing against the requirements. Include specific test cases labelled by the relevant requirements*.

## 7.2 Test methodology

*800 words*

*Describe how the output was tested and why. Discuss how you obtained and used feedback, using expert or/and non-expert users*.

# 8. Conclusions and reflections

*1000 words*

*Provide critical reflections on ALL aspects of the project lifecycle. Include conclusions on the resulting application, research, and findings. Reflect on each aspect of your project life cycle. Critically evaluate how effectively your results meet your stated objectives. Reflect on strengths and weaknesses of your implementation, discuss the acquisition of any new knowledge and skills and consider further work*.

Character customisation,

Multiple camera point of view for user to select,

Watermarking and download feature.

3d objects upload for sculptures,

Expand the scene for more artwork to display,

Allow user to customise their scene to the specific type of artwork.

Allow multiple users into a single scene,

Proximity communication after user accepts.

Include galleries to allow multiple images upload simultaneously.

Machine learning to compare image against database and internet to confirm its unique.

Ai generated image detection.

# 9. References

*Include a list of cited in your text items (books, papers, websites, etc.). Use Harvard style for the purpose, or any other preferred standard referencing style*.

# 10. Bibliography

*Include here a list of general reading items (books, papers, websites, etc.). List the items in alphabetical order, using Harvard style to describe them*.

# Appendix I

*Provide additional material, if appropriate, in separate appendices.*

*Use one Appendix to provide a link to an on-line video demo of the project.*

*Do not include the entire code in print as an appendix.*