

BSc Computer Science for Games Programming

Honours Stage Project

Project Definition Document

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Project Background and Purpose

Introduction

The accurate recognition, collection, analysis, preservation and storage of evidence are foundational aspects of criminal investigations. The success of any investigation relies heavily on the ability of forensic investigators to efficiently search for, identify, and recover critical traces at crime scenes. However, this ability is not developed overnight, nor is it one that should be learned on the job. Officers and support staff must go through extensive training to learn, practice and master these skills. The transition from the classroom to real-world application is often very challenging. Studies show that novice crime scene investigators may miss critical evidence, and make errors in the decision-making process during evidence recovery due to a lack of real-world experience. (Source: [Expertise in crime scene examination](#))

My project proposes the development of a mixed-reality game aimed at supporting the training of forensic investigators and support staff. By creating a simulated yet realistic crime scene environment, this application will gamify the learning process and will allow trainees to practise and refine their skills without the high stakes associated with real-world situations. Mixed-reality technology combines virtual elements with real-world settings, offering an immersive training experience which can be used in any and all kinds of environments. The goal of the game is for players to identify the greatest number of useful traces present at a crime scene, as quickly and accurately as possible. I aim, with my project, to significantly improve the skills and performance of trainees to transfer into real-life crime scene investigations.

Objectives

My overall aim with this project is to create an effective training tool for trainee crime scene investigators. Below is a detailed breakdown of my objectives, focusing on the key aspects in priority order.

1. **Develop Realistic Mixed-Reality Crime Scene Simulation:** Create an immersive, interactive environment for novice forensic investigators or others to practise identifying and collecting evidence.
2. **Implement Evidence Recognition Mechanisms:** Design a system to simulate various types of evidence, such as fingerprints, bloodstains, criminal damage, and weapons, requiring users to apply forensic principles to identify them.
3. **Enhance Evidence Collection Skills:** Teach users approved techniques for collecting evidence while maintaining the integrity of crime scenes in mixed-reality.
4. **Incorporate Real-Time Feedback for Users:** Provide real-time, context-sensitive feedback to users when they make mistakes or successfully collect evidence, reinforcing learning outcomes.
5. **Ensure Realism and Variety of Crime Scenes:** Include multiple crime scene scenarios with varying levels of complexity to simulate real-world challenges.
6. **Support Integration with Formal Training Programs:** Ensure the application aligns with official crime scene investigation training standards and protocols for training investigators and other users.
7. **Develop User-Friendly Interface for Novices:** Design intuitive controls and navigation to ensure accessibility for relative beginners in the field of forensic investigation.

Scope

The scope of the project includes the design, proof of concept, development, testing and eventual deployment of the mixed-reality game. The game will simulate real-world crime scenes with interactable objects that trainees must identify, examine, and mark as evidence. It will also include user interfaces for users to interact with the virtual environment and scoring mechanisms to track their performance.

The hardware I will be developing my game for is the Meta Quest 3, as it is currently the most affordable and consumer-loved VR/MR headset. I want my game to focus on crime scene reconstruction, but unfortunately it will not include multiplayer collaboration.



(Source: [Meta Quest Lineup](#))

Deliverables

Mixed-Reality Game: A fully functional and tested mixed-reality game designed specifically for forensic investigation training.

Documentation: Comprehensive documentation covering game mechanics, design features, technical specifications and everything in-between.

Pilot Testing Feedback: A report detailing the feedback from testing conducted, focusing on the game's usability, engagement, and effectiveness.

Constraints

Time: This project must be completed within the academic year, leaving approximately 8 months for all phases of design, development, testing, and eventual submission.

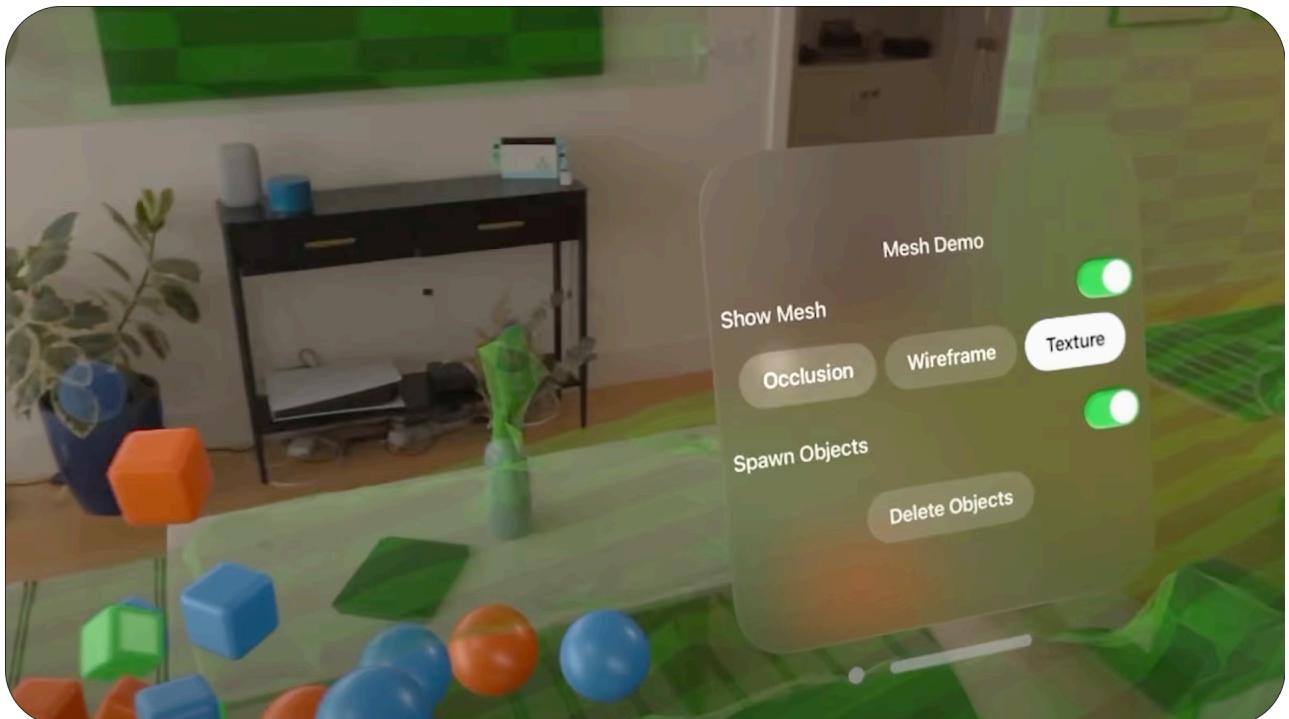
Technology: The game must be completely functional with my specified platform, in this case the Meta Quest 3. There may be constraints related to performance, battery life, processing power, and graphical fidelity.

Budget: This does not apply to me, but I wanted to mention it anyway, as in a real world development situation, this often is a large consideration.

Assumptions

Key assumptions of this project include:

- The game will be developed using Unity, which is widely supported and compatible with numerous VR/MR hardware, not just the Meta Quest 3.
- In an ideal world, having Forensic Investigators to test my application and give feedback would be the best way to make this application the best it can be, however, I do not think I will have access to these resources. I will investigate whether the client would be willing to participate.



(Source: [Augmented Reality \(AR\) App & Game Development Solution | Unity](#))

Project Rationale and Operation

Project Benefits

Improved Training Effectiveness: The immersive nature of mixed-reality games and environments will enhance the quality of training. Trainees will engage in hands-on practice that bridges the gap between classroom knowledge and real-world field work, as I explained earlier.

Skill Retention: Interactive and immersive learning environments result in higher retention rates compared to traditional methods. By practising crime scene investigation in a simulated setting, trainees are more likely to retain skills. (Source: [Immersive Learning Explained: What It Is & Why It Works](#))

Cost Efficiency: Simulating crime scenes using mixed-reality will reduce the need for physical reconstructions or field exercises. It will also provide a reusable training tool that can be used in different environments/spaces.

Trainee Engagement: The game-based nature of the training will likely (hopefully) increase engagement and motivation, especially for younger trainees who are accustomed to gaming environments. (e.g. wanting to have the highest score in the class)

Project Operation

The game could be incorporated inside police training centres, where it'll complement existing education programs. Trainees will use the game to practise for more realistic physical recreations and field work. The game will consist of a scoring mechanism that gives marks on overall performance, allowing trainees and supervisors to pick out areas for focused revision.

Options

During the project selection process, I considered using Augmented Reality (AR), Virtual Reality (VR), and Mixed-Reality (MR). The decision to use MR was made due to its ability to blend real and virtual elements. Unlike VR, which fully immerses users, MR allows interaction with both physical objects and virtual clues, offering a more realistic training experience. Additionally, it was specified by the client, Humberside Police.

Risk Analysis and Mitigation

Technological Risks: Potential hardware defects or malfunctions, such as headsets crashing or running out of battery, could disrupt training sessions. **Mitigation:** Regular maintenance checks, charging stations, and backups of data to minimise downtime.

Skill Transfer Risk: There is a possibility that trainees may not transfer the skills gained in the virtual experience to real-world crime scenes. **Mitigation:** The game will be designed to replicate real-world conditions as closely as possible.

Time Overrun: Time limitations may exceed initial estimates. **Mitigation:** An organised development should reduce the risk of this happening.

Emotional Distress: Crime scenes can distress people and cause harm. **Mitigation:** I will need to take into consideration how these environments will affect people, and take the necessary steps to ensure they have support.

Resources Required

To successfully develop and implement the mixed-reality game, the following resources need to be acquired:

- **Hardware:** VR/MR headsets, in this case Meta Quest 3 which I purchased for this project.
- **Software:** Unity for game development, along with any necessary plugins or libraries for VR/MR integration.
- **Training Participants:** A sample group of forensic trainees (friends and classmates) who will participate in pilot testing and provide feedback.

Ethical and Legal Considerations

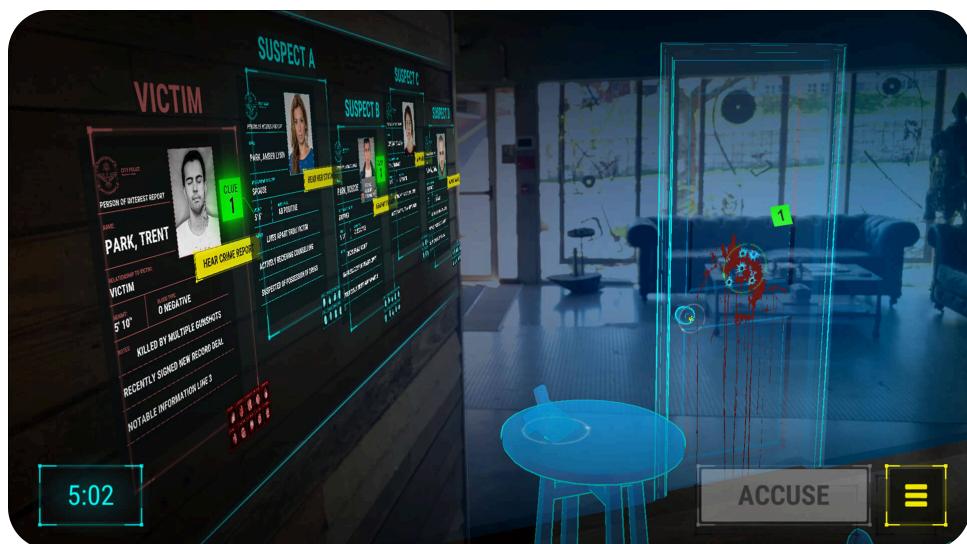
Ethical and legal considerations are paramount when developing a training tool that could be used by law enforcement agencies. The following issues have been discussed below:

- **Privacy concerns:** The game may track trainee performance and collect personal data. To comply with GDPR, data will be anonymized, securely stored, and users informed beforehand.
- **Legal considerations:** All external datasets or materials must be properly licensed for educational or commercial use.
- **Emotional distress:** Given the crime scene simulations, care will be taken to provide psychological support for trainees who may be affected by these scenarios.

Commercial Considerations

While this project is primarily educational, it has potential commercial value:

- **Development Costs:** The total cost of development is projected at £300, covering only the hardware costs.
- **Market Potential:** Once developed, the game will be offered to the humberside police and hopefully some academic institutions. It could also be adapted for use in civilian training, such as crime scene investigator courses or watered down for just an experience/game.
- **Competition:** There are existing crime scene simulation tools, but some, if any, integrate mixed-reality technology in the way my project aims to do. This gives the game a competitive edge in the training market.



(Source: [Forensic Detective | NeoPangea](#))

Project Methodology and Outcomes

Initial Project Plan

I will implement an Agile methodology for this project, ensuring flexibility. This approach means I can continuously adapt, change requirements/wants, and deliver a product I am proud of. By incorporating controlled feedback throughout the process, I aim to refine the product to meet the police's exact needs.

Tasks and Milestones

The development of my mixed-reality game will aim to follow these key milestones. This will be visualised in my Gantt Chart in my appendix:

- **Task 1:** Research and define requirements for crime scene simulation (weeks 1-2).
- **Task 2:** Design the game's mechanics, crime scene scenarios, and interaction models (weeks 3-6).
- **Task 3:** Develop 3D models and environments for crime scene simulations using blender (weeks 7-10).
- **Task 4:** Integrate game mechanics with VR/MR hardware (weeks 11-12).
- **Task 5:** Conduct pilot testing (weeks 13-14).
- **Task 6:** Finalise game development, incorporating feedback (weeks 15-16).
- **Task 7:** Produce user manuals and supporting documentation (weeks 17-18).

Below, is a much more in detail look on what I want to accomplish, week by week.

- **Week 1:** Research crime scene investigation methods; define simulation requirements.
- **Week 2:** Analyse user needs and existing training tools to inform design.
- **Week 3:** Start designing evidence collection mechanics.
- **Week 4:** Develop player interaction models for mixed reality.
- **Week 5:** Draft crime scene scenarios for the game.
- **Week 6:** Finalise game mechanics and scenarios.
- **Week 7:** Create 3D models for objects and evidence.
- **Week 8:** Design 3D crime scene environments.
- **Week 9:** Integrate 3D models and mechanics.
- **Week 10:** Test interactions with game environments.
- **Week 11:** Begin integrating mechanics with VR/MR hardware.
- **Week 12:** Conduct hardware testing and troubleshoot.
- **Week 13:** Pilot test game with small group.
- **Week 14:** Analyse pilot feedback, identify improvements.
- **Week 15:** Implement feedback to enhance experience.
- **Week 16:** Final review and adjustments.
- **Week 17:** Create user manuals and guides.
- **Week 18:** Finalise documentation and project delivery.

I know I do have 8 months to finish this project, and this plan is for around 4 months. I have done this on purpose to ensure that holidays, possible illness, and possible delays will not affect my product for its hand in date.

Schedule Gantt Chart

For the Gantt Chart, please check the Appendix. The chart will be regularly updated to ensure that the project remains on schedule and within scope.

Project Control

My project control mechanisms are as follows:

- Weekly meetings with project supervisor to review progress.
- Continuous feedback loops with testers.
- Regular project health assessments, focusing on time, and deliverables.

Project Evaluation

The project will be evaluated based on following criteria:

- **Trainee Performance:** Improvements in evidence recognition and collection will be measured through before and after training assessments.
- **User Engagement:** Feedback from trainees will assess the usability, engagement, and realism of the game.
- **Skill Retention:** Ideally, I would like to use long-term studies to evaluate whether skills acquired in the game are retained and applied in real-world scenarios.

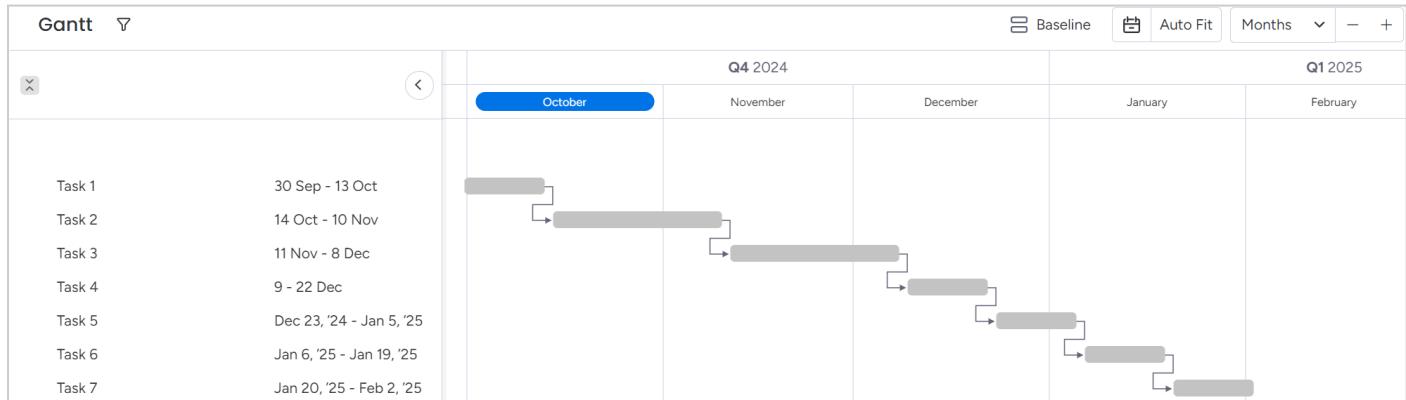
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Appendix

Gantt Chart

For my Gantt chart and project management I'm using a software called Monday. Whilst doing research for this project, I stumbled across it and instantly fell in love. I highly recommend it.



	Task	Owner	Status	Timeline	Dependent On
	Task 1	SL	Working on it	30 Sep - 13 Oct	
	Task 2	SL	Not Started	14 Oct - 10 Nov	Task 1
	Task 3	SL	Not Started	11 Nov - 8 Dec	Task 2
	Task 4	SL	Not Started	9 - 22 Dec	Task 3
	Task 5	SL	Not Started	Dec 23, '24 - Jan 5, '25	Task 4
	Task 6	SL	Not Started	Jan 6, '25 - Jan 19, '25	Task 5
	Task 7	SL	Not Started	Jan 20, '25 - Feb 2, '25	Task 6
	+ Add task				

Risk Matrix

5x5 Risk Matrix

		Severity →				
		1 Insignificant	2 Minor	3 Moderate	4 Major	5 Death
Likelihood →	1 Rare	1	2	3	4	5
	2 Unlikely	2	4	6	8	10
	3 Possible	3	6	9	12	15
	4 Likely	4	8	12	16	20
	5 Certain	5	10	15	20	25

Technical Challenges:

12

Developing my game involves technical elements, such as precise tracking and real-time rendering. I know that bugs and performance issues can and will arise.

User Safety:

6

Since my game encourages players to move around in real-world environments, I need to be mindful of user safety. Accidents can happen if players aren't aware of their surroundings.

Privacy Concerns:

4

Collecting data from users is important. I'll need to ensure compliance with data protection laws and be transparent about how I use their information.

Market Competition:

15

The VR/MR space is competitive, so I understand that my game needs to offer something unique. However I have not seen anything that comes close to what I want to do.

User Experience:

8

Balancing engaging gameplay with MR elements can be challenging. Poor user experience can lead to negative reviews and low retention rates.

Emotional Distress:

9

As we will be dealing with real-life crime scenes and scenarios, I will need to take into consideration how these environments will affect people, and take the necessary steps to ensure they have support.