**CMP6200/DIG6200**

**Individual Undergraduate Project (FYP)**

**Project Interim Report**

**[Project Title Here]**

**Student Name: Joshua Barnes**

**Student ID:** 23130205

**Course: Computer Games Technology**

**Supervisor:** Jan Krasniewicz

**Date:** [Date of Submission]

Table of Contents

[1.0 Introduction and Context 3](#_Toc211241892)

**List of Figures**

**List of Tables**

# Introduction and Context

Procedural content generation (PCG) has become a defining feature in modern game development, allowing developers to produce expansive and varied environments automatically through algorithms instead of manual design (Togelius et al., 2011). While this approach offers scalability and replayability, it also poses challenges to the behaviour of artificial intelligence (AI) in procedurally generated games as they are often unable to fully exploit these uniquely generated levels or environments (Jutesen et al., 2018). Because of this games that utilise procedural generation often lead to enemy AI or non-playable characters (NPCs) using basic routines for their behaviour such as idle, attack and chase.

Player immersion is strongly linked to the adaptability of NPCs. Research shows that NPCs showing diverse, context-sensitive behaviour relates to player immersion by creating more natural interactions (da Silva et al., 2021, Cavadas., 2025). In procedurally generated environments the key to immersion is maintaining an appropriate difficulty that scales with player skill. Traditional static difficulty with enemy AI often fail to match different player skill levels resulting in boredom or frustration (Hunicke & Chapman, 2004).

## 1.1 Problem Statement

AI within PCG currently relies on pre-determined behaviour, which prevents them from making intelligent decisions within the environment (Pereira, Viana & Toledo, 2021). This limits adaptability and promotes predictability which highlights the need for an algorithm that receive and adapt to real-time information about PCG levels and adjust its behaviour accordingly (Khalifa et al., 2020).

The following project will create an AI algorithm that tackles immersion in PCG games. This will involve creating an algorithm that is context-sensitive and diverse creating more natural interactions from the player(da Silva et al., 2021). Another feature this AI plans to tackle is difficulty scaling in PCG games as static difficulty often fails to match player skill levels resulting in boredom or frustration(Hunicke & Chapman, 2004).

# 2.0 Review of Existing Knowledge

### 2.0.1 Procedural content generation

PCG has become a cornerstone for modern game development allowing for developers to create a variety of vast level designs without the need for manual labour. It refers to the creation of game elements through rule-based methods rather than handcrafted designs saving on time and resources (Togelius et al., 2011). The use of PCG not only enhances replayability and unpredictability but also scalability by allowing developers to create near infinite worlds such as Minecraft or No Mans Sky (Shaker, Togelius & Nelson., 2016).

Comprehensively outline and expand on the primary concepts and established models presented in studies relevant to your problem statement. What is the existing knowledge on this subject? What are the main findings and conclusions derived from these studies? This should not merely be a descriptive summary; rather, a critical analysis of the information to construct a coherent narrative regarding the current state of knowledge.

**Note***: The review of concepts could be broken down into further sub-sections depending on the themes relevant to your topic that you identify during the review.*

**2.1 Critical Analysis and Gap Identification**

During this phase, you carry out a critical reflection of the sources you have examined, identifying their limitations, contradictions, or disagreements within the literature. Establish which questions remain unanswered. This critical scrutiny should help you pinpoint a specific "gap”; whether it is an unresolved issue, an underexplored area, a new perspective that has not been considered, or a practical solution that is missing from existing studies.

**2.2 Project Justification**

Building on the identified gap in section 2.1, clearly explain how your project will fill the identified gap. This is where you can outline your question, hypothesis or proposed solution. Specifically link your project idea to the shortcomings or unanswered questions in existing studies. It would add value if considerations are given to how the project would be relevant to your industry, e.g., the benefits of using an AI-based prediction model by financial advisors in the stock exchange. This section confirms that your project is not only attractive but also crucial and relevant.

# 3.0 Project Aims, Objectives, and Scope

## 3.1 Project Aim

This research aims to improve immersion and difficulty scalability of enemy AI/ NPCs in procedurally generated environments (PCG) by implementing an adaptive algorithm optimised to change its behaviour with PCG.

## 3.2 Project Objectives

* Develop an AI algorithm that adapts within procedurally generated levels to improve player experience.
  + Create an AI framework that reads environmental data.
  + The AI will successfully identify and store at least three environmental factors and use them in behavioural decisions.
  + This will be achieved through grid-based coordinates system and ray casting.
  + This tackles the bridge between PCG and enemy AI
* Implement a test environment that evaluates AI adaptability.
  + Build different PCG environments for the built algorithm and static AI to be tested in.
  + Success is determined based off the amount of times the player can see/ attack the AI and the number of tactical decisions the AI makes.
  + Achieved using custom debugging logs.
  + Shows the effectiveness of AI adaptation.
* Integrate difficulty scaling that adjust AI decision-making based on player performance.
  + Implement a difficulty adjustment system that modifies AI aggression or accuracy in response to player succession rate
  + AI should adapt based off amount of hits and survival rate of player
  + Retrieve player stats in real time
  + Combats immersion and scalability.
* Evaluate immersion and scalability of the algorithm within PCG by retrieving feedback from user experiences.
  + Conduct a small user study comparing static AI and adaptive AI behaviours.
  + Using a controlled test scenario with 20-30 participants,
  + Directly measures the research goal.

Set out 4-6 specific objectives that break down the project aim into smaller tasks, that are: Specific, Measurable, Achievable, Relevant and Time-bound (SMART).

* **Objective 1:** *[State your first SMART objective]*
* **Objective 2:** *[State your second SMART objective]*
* **Objective 3:** *[State your third SMART objective]*
* **Objective 4:** *[State your fourth SMART objective]*
* **Objective 5:** *[State your fifth SMART objective]*
* **Objective 6 (Optional):** *[State your sixth SMART objective]*

## 3.3 Project Scope

This project will concentrate on enemy AI within PCG environments not within a static environment. The focus will be on creating a new adaptive AI and comparing against an existing static AI. The adaptive AI will be a singular algorithm used within several different PCG algorithms. The difficulty scaling will focus on the AI tactical decisions not strength of the enemy.

Clearly define the project's boundaries. What will it include, and just as importantly, what will it exclude? This helps manage expectations and keeps the project on track. For instance: "This project will concentrate on preventative cybersecurity measures and will not cover incident response protocols."

**4.0 Project Design**

This section outlines the practical steps, methods, tools, and schedule you will follow for your project, covering the 'how' aspect.

**4.1 Design and Methods**

Outline the overall approach you plan to take. For example, will your project involve an experiment, survey, case study, development, filmmaking or literature-based analysis? If so, what kind of data/information do you need? Detail the specific methods and techniques you will use to achieve each objective, such as qualitative interviews, statistical analysis, user-centred design, etc.

**Note:** *Considering the diverse availability of methods and design approaches, it is strongly recommended that discussions be made with the main supervisor to align the choice of project design with your chosen topic.*

**4.2 Justification of Methods**

Justify your selection of these methods, explaining why they are the best fit for addressing your needs and meeting your project objectives. Briefly compare them to other methods and defend your decision.

**4.3 Project Timeline**

Create a realistic project schedule. A Gantt chart is the best way to visualise this. The chart should cover all major tasks (e.g., literature review, data collection, development, analysis, writing), key milestones, and their deadlines from start to finish.

**5.0 Feasibility, Risks, and Ethical Aspects**

This final section shows that you have considered your project's execution in a practical and responsible way.

**5.1 Feasibility**

Evaluate how realistic and achievable your project is. Think about the resources you have available, including time, access to necessary data, software or equipment, and your own skills. Give a brief explanation for why you are confident the project can be completed successfully within these constraints.

**5.2 Risk Analysis and Mitigation**

Identify at least 3-4 potential risks that could threaten your project's success. For each risk, suggest a practical mitigation strategy to minimise its impact. The table below shows how you can present this in an effective way.

|  |  |  |  |
| --- | --- | --- | --- |
| Potential Risk | Likelihood (Low/Med/High) | Impact (Low/Med/High) | Mitigation Strategy |
| e.g., Delay in receiving access to required datasets | *Medium* | *High* | *e.g., Identify alternative open-source datasets in parallel; start work on other objectives.* |
| e.g., A key software tool has a steep learning curve | *High* | *Medium* | *e.g., Allocate specific time in the project plan for tutorials; seek guidance from supervisor.* |
| e.g., Difficulty recruiting participants for interviews | *Medium* | *High* | *e.g., Start recruitment early; use multiple recruitment channels; have a backup plan.* |

Table 4.1: Risk Assessment and Mitigation

**5.3 Ethical Considerations**

Reflect on the ethical aspects of your project. If working with human participants, how will you secure informed consent, ensure anonymity, and maintain confidentiality of their data? If utilising datasets, are there any concerns regarding data protection? Consider the potential social influence of your project's outcome. Clarify the steps you will take to conduct your project ethically and responsibly.

**References**

List all the academic and professional sources you have cited in your report, formatted in accordance with the Harvard Referencing Style.

**Appendices (Optional)**

Include any additional material here, such as review steps, specifications, and methodologies.