**COMP1682.1 Project Proposal**

**[Game 2D Metroidvania: Legends of Abyss]**

**[Nguyen Phuoc Loc]**

**BSc H Computing (Final Year Entry) (FPT, CAN THO)**

**[001392246]**

Contents

[1 Overview 4](#_Toc163928706)

[2 Aim 4](#_Toc163928707)

[3 Related works / Literature review 5](#_Toc163928708)

[4 Objectives 9](#_Toc163928709)

[5 Project Framework or Any Methodology Used. 10](#_Toc163928710)

[6 Legal, Social, Ethical and Professional 11](#_Toc163928711)

[6.1. Legal 11](#_Toc163928712)

[6.2. Social 11](#_Toc163928713)

[6.3. Ethical 11](#_Toc163928714)

[6.4. Professional 11](#_Toc163928715)

[7 Planning (see Appendix A) 12](#_Toc163928716)

[8 Initial References 16](#_Toc163928717)

[9 Appendix A 17](#_Toc163928718)

[Figure 1 Phase 1: Research Report 13](#_Toc163928500)

[Figure 2 Phase 2: Design document 13](#_Toc163928501)

[Figure 3 Phase 3: Implementation 14](#_Toc163928502)

[Figure 4 Phase 4: Testing 15](#_Toc163928503)

[Figure 5 Phase 5: Evaluation and reflection reporting 15](#_Toc163928504)

# Overview

In today's fast-paced world, people often gravitate towards shallow entertainment, neglecting the world's complexities. However, this presents an opportunity to merge entertainment with enlightenment through a multi-dimensional game. Such a game would captivate users with its immersive experience and convey profound messages relevant to contemporary society.

*(Valkenburg, Meier and Beyens, 2022)*

By intricately weaving social themes into the game's storytelling and gameplay mechanics, this is an effective solution to the above problem and will be applied to this project. This project encourages players to delve deeper and reflect on essential issues. The interactive nature of a game allows users to participate in these topics actively, fosters a sense of self-determination, and fosters proper awareness of the topic being conveyed.

*(Martinez, Gimenes and Lambert, 2022)*

Integrating social themes into the rich gaming experience offers a unique combination of entertainment and education, which offers many benefits to players. This approach easily appeals to the target audience that this project targets. From there, it helps to convey the message slowly but deeply during the game. They are subtly encouraged to explore complex topics and thereby foster critical thinking of individuals, empathy for life's challenges, and awareness of social issues. This solution can be especially effective in promoting young people's thinking and understanding of society, especially in today's digital context.

Keywords: [Game development, C#, OOP, Game design pattern, Metroidvania]

# Aim

This project aims to create an exciting 2D Metroidvania game that engages users through open-world exploration by applying programming techniques such as OOP and design patterns for optimisation—application performance. From there, the final product will bring a great entertainment experience and co-convey meaningful messages. The project will be implemented on a scale in Vietnam.

# Related works / Literature review

## Exploring the Essence of Metroidvania: Origins, Characteristics, and Player Experience

Before implementing the project, it is necessary to study the genre and its approach carefully. This project focuses on developing one 2D game of the Metroidvania genre, so it is essential to define what Metroidvania is. According to (Gangopadhyay & Acherjee, 2021), Metroidvania is derived from the names of 2 games, Castlevania and Metroid. Both games are famous for their platform gameplay, requiring characters to move flexibly. Besides, there are elements of a freely explored world for players, but many areas need special conditions to unlock and character development during the game. Another study (Mawhorter, Ruslanova, and Mawhorter, 2022) reveals that the world of Metroidvania is a confined world of interconnected rooms that give the impression that they are a large world. Communicating the content is also emphasised through flexible action gameplay that brings a sense of drama to players. Both articles emphasise character development, although open gameplay and spatial connection of levels create a sense of freedom for the player. However, there are also limitations to the need for players to make efforts. Here, (Gangopadhyay & Acherjee, 2021) proposed the term "Key". The term "Key" is a condition to unlock parts or locations that the player could not previously reach, which is often incorporated into the story in the game to increase drama or merely the pure puzzles of the Platform genre, the genre that Metroidvania inherited. However, other genres still misunderstand Metroidvania if it does not convey its true spirit. Follow (Andiloro, 2023); many genres are similar to Metroidvania, such as Soulsborne and Rouelike. They all focus on the mechanics of action and discovery. While the Souldsborne series focuses on an atmosphere of breathtaking dramatic tension, Roughlike will explore randomly generated mazes and repeat that process forever. Metroidvania is different; it is like a blend of both when bringing an atmosphere like Soulsborne and mechanics to unlock skills and conquer mazes like Roughlike. Understanding the genre that the project is aiming for is very important in implementing the project; if the wrong approach is chosen, it can cause the essence of the product and its meaning to be miscommunicated from the original purpose.

## Crafting Gameplay Experiences: Insights into Game Development

One thing that needs to be clear when making a game project is game development. Follow (Karlsson, Brusk and Engström, 2023), In the game development process, there should be many things to pay attention to. One of them is Level-Design, whereby level can be understood as the space where the player will explore the mechanics and rules of the game. Level-Design is not clearly defined; it will have different constraints in different types of games or different developers. Many documents may relate to this issue, but it is heterogeneous. Two concepts that are most mentioned on this topic are "White-boxing" and "Set-dressing", with "White-boxing" referring to a level design that does not include any of the artistic assets of the project, mainly to provide an objective view to the developer. "Set-dressing" will be the step of adding resources to the design to perfect it. Between these two steps will be the conformity assessment stage. That evaluation will vary from project to project but will generally evaluate the compatibility between the game mechanics and the level space. Various studies have worked to find an easy method to implement level design, in which (Djafarova *et al.*, 2023) mentioned a framework that aids in game development. The ASGD (Art Serious Game Development) framework is presented as a circle, with each quadrant representing an element they think is critical in game development. It has four elements: learning, game story, gameplay, and user experience. Notably, the technological element is omitted from this process to make the development team's creativity as advanced as possible. ASGD works in iterative research steps in each aspect of the circle, and the result is interference in a smaller circle in the centre; it distils the most quintessential things in development. This is a feasible solution for a professional development team but is unsuitable for individual projects when an individual does not have enough time and energy to undertake research and implement the cycle of 4 framework elements simultaneously. Another important topic in game development is performance, which directly affects the player's experience and is a basis for evaluating the perfection of the product. According to (Salin et al., 2022), FPS (Frame per second) is the most important test that affects the user's experience with the product, and the basic measure to evaluate a good game is FPS. The author emphasises that the FPS index is significant for the playing experience and gives the standard number for the standard FPS level for games to be 30 to 60 FPS. Whenever the FPS is lower than the minimum of 30, the player will have the feeling that the image is choppy and think that the game is having problems, and higher than 60 will not too much improve the smoothness of the image due to the limitation of the human eye, however, for games that require high reflexes, FPS levels above 60 will be an advantage because images will display faster on the screen. The author also offers many solutions to help improve the performance of the game, such as using the MonoGame framework in the game programming process, synchronising the game FPS with the user's hardware, computing, strictly controlling objects in the game and applying design patterns such as Object Pool to optimise the source code and objects in the game. Overall, the author has developed beneficial solutions to an important problem in game programming: game performance optimisation, which is very useful for research and project implementation. One last thing worth noting when developing a 2D game is the gameplay mechanism or the characteristic gameplay of the product. In addition to storyline, image, sound, and performance, gameplay is the biggest factor affecting a player's experience. Article by (Guzsvinecz, 2023), Gameplay elements create the soul of the game, helping to shape the experience, atmosphere and genre of games it represents. The author of the article takes the example of the Soulsborne game series (also known as Soulslike); featured in this series is the game Dark Souls; in this game, the special combat mechanism is considered extremely difficult when any enemy can finish the player with 3 or 4 attacks, and players must focus on dodging and using openings to attack and win. Intense combat in the combat mechanism creates the characteristics of the background game series and the feeling it gives players. Back to the new Metroidvania series, which is also inspired by the Soulsborne series, but in the 2D platform, the gameplay mechanism somewhat reduces the difficulty of basic enemies. However, with strong opponents called bosses, the tension in combat is still evident and stimulates the player's enjoyment. Products of the same type above all have unique mechanisms that make up their brand, such as Dark Souls, which are endurance mechanisms in combat, increasing difficulty and creating a feeling of suffocation in combat. As for the Hollow Knight, it is the main character's sword; it can attack, defend, support movement, and overcome obstacles. In game development, a certain investment from idea to time must be spent implementing the core mechanics that make up the game's soul, which helps shape the gameplay but also helps convey various meanings. Finally, the game development process has many factors that developers need to pay attention to, each of which takes a lot of time and research to implement well so that the final product of the project meets those factors requires a lot of investment and research and above all links them together to create a successful product.

## Technique in Game Design: Leveraging OOP and Design Patterns

During the implementation of the project, the technologies applied to the product are also necessary. As mentioned, game performance can be improved by applying particular design patterns to the project. Following (Paschali et al., 2021), Design patterns (DPs) provide solutions to various problems during game development; the author has given many examples of applying different DPs to the author's sample project. The article has introduced some of the critical uses of popular DPs in game programming, such as Observer, that are often used to monitor the state of characters or objects in games effectively, which can be applied to many problems or can specifically be applied to the plot direction or direction of the story in the game. The Factory template simplifies the creation of complex objects by creating a built-in framework. Singleton guarantees access to unique objects in the game; for example, in many games with only one character, Singleton is a way to ensure the uniqueness of the character and help other objects access a single player. Strategy can help flexibly change the behaviour of an object in the game. Finally, there is the Object Pool that optimises performance during game operation. From this article, it can be concluded that using design patterns helps streamline the product's development process and makes it easy to expand and maintain in the future. The potential of DPs is immense in creating an optimal game with a robust system. Take an already practical product to study, the article of (Nuriyeva *et al.*, 2023); the author has developed 1 product on the Unity Engine platform and applied the rules of object-oriented programming and design to the project. Unity is used because of the flexibility in managing and using objects effectively; Unity's components are very diverse to support development significantly, and the Hierarchy object management bar brings convenience in project management; the author evaluates this as a potent engine suitable for game or application development. The author also mentions object-oriented programming as a critical component of their project. The game uses OOP to design around objects instead of events, facilitating the implementation of additional design patterns; DPs are applied, including three common design patterns in game programming: Singleton, State machine and Observer. OOP is an essential model that reduces workload and optimises project performance. Going back to this project, creating a 2D game Metroidvania required much technology to be applied, the best example being the Finite State Machine (FSM). Following (Jagdale, 2021), FSM is an advanced State machine pattern used for Non-Player-Characters (NPCs) in games. With the Metroidvania game genre, the combat action element must be focused a lot, and creating enemies with diverse difficulty and fighting methods is a huge plus. FSM provides an effective solution to this problem; it is understood that FSM will provide a framework available for NPCs and track players to act according to the previous design. This is a great solution when applied to the Metroidvania 2D project, but many issues are worth noting in this article. The first is about designing frames for NPCs; if the design is too tight and perfect, there is no chance for the player to counterattack, causing absurd difficulty to the game; if the design is not reasonable, the NPC can become stupid and act strange. Although the author has given some basic patterns consisting of 4 states of attack, defend, idle and escape, it is necessary to adapt to different projects. Elements such as cooldowns can be added to add logic to the game, such as limiting the time it takes to launch NPC attacks or how long NPCs will defend. In short, many different technology solutions can be applied to game development. However, carefully considering the relevant factors that will affect the game, such as gameplay or level design, is necessary. It is necessary to adapt and use it appropriately, avoid causing complications and uncomplicated problems and optimise the source code and game system.

# Objectives

* 1. **Research report.** 
     + 1. The outcome is a document on project development orientation, including work to be performed and research objectives.[1]
       2. Define project objectives.[1]
       3. Define project scope. [1]
       4. Define the project’s hypotheses. [2]
       5. Conduct research in related works or technologies [5]
       6. Writing Research Report Document [5]
  2. **Design Documentation.**
     + 1. The outcome is an essential document about the final product, including required game mechanics, features, story, technology, etc.
       2. Conceptualization for game content [7]
       3. Define main game mechanics and non-mechanical requirements [7]
       4. Design use case [3]
       5. Design class diagram. [2]
       6. Design and write documents [3]
  3. **Implementation**
     1. The outcome is that the product will be completed after this stage and ready for testing.
        1. Implement core game mechanics (movements, skills, etc.) [20]
        2. Implementing general secondary mechanics (algorithms of enemy types, cut scenes, etc.) [90]
        3. Implement audio, sprites, and animations to the project [10]
        4. Implement level design for the project [10.0]
        5. Implement GUI and Menu functions and export the project to the app. [1]
  4. **Testing**
     + 1. The outcome is ensuring the game's quality, functionality, and user experience, identifying, and resolving any issues or bugs before release.
       2. Identify requirements, plan, and design the test cases. [1]
       3. Execute test cases following the plan and requirements. [2]
       4. Bug identification and debugging [7]
       5. Execute regression testing, making sure not to affect other parts [7]
       6. Write a document about the testing and debugging process [1]
  5. **Evaluation and Reflection Report**
     1. The outcome describes this goal in more detail than conducting a comprehensive review of the completed project.
        1. Evaluation of final product (game performance, features, etc.) [1]
        2. Evaluation process of development [1]
        3. Evaluation of user feedback [1]
        4. Complete the final project report [3]

# Project Framework or Any Methodology Used.

The Agile method will be applied in this project because of its suitability for the game development process. Iterating over project segments is excellent for developing a project feature. Features need to be thoroughly completed and error-free to be able to continue to the following parts. Precise planning also helps a lot in controlling the progress of the project. A small final product in each segment is gradually accumulated one after another. It will eventually become a finished product, entirely consistent with developing a game product. Finally, check and evaluate the results. At the end of each stage, a step will be used to assess the progress made, thereby determining strengths and weaknesses, and overcoming them in the following stages. At the same time, the quality of the product should be evaluated to supplement it if necessary.

The tool or framework for implementing the project chosen is the Unity Engine. It is a viral game development engine in the world. Its unique features compared to similar products on the market can be mentioned as accessible, simple to use, with many supported features, and suitable for many types of machines. They can be used for many game genres. It can also make products on many platforms. Compared to other tools of the same kind, such as Unreal Engine or Godot, Unity is best suited for this project because Unreal Engine needs powerful hardware and is a highly graphical engine, while Godot has more limited features than Unity. Finally, Unity has a large community and diverse resources, which is very convenient for the research learning process to carry out the project.

# Legal, Social, Ethical and Professional

The project aims to convey modern messages profoundly through an entertainment application. The most significant benefit of the product is that with the passive transmission of the game's story, users will actively learn and explore it without feeling constrained or oppressed. Legal, Ethical, Social, and Professional elements are essential to the project. This project prioritises legal compliance, ethical integrity, social responsibility, and professional excellence. It aims to comply with intellectual property laws, promote inclusivity, address social issues sensitively and maintain high standards of quality and professionalism.

## Legal

**Intellectual property issues**: The resources used in the project need to be transparent about their origin or have a full license and right to use. Ensure you do not use images or sounds infringing on proprietary copyright. Use unlimited resources and copyrights and actively contact third parties for assistance in creating exclusive project assets.

## Social

**Global impact and cultural sensitivity issues**: On the social side, this project aims to positively impact society by raising awareness and empathy about everyday life issues. It aims to raise awareness of sensitive social issues and arouse positive thoughts so players can reflect on their beliefs and actions about life around them. Moreover, cultivating a supportive community around the game is also necessary for players to connect, creating an engaging environment to attract players and create social impact.

## Ethical

**Bias and discrimination issues**: The project is committed to upholding 100% of the ethical principles and values in Vietnam and strives to avoid ethical violations on a global scale as much as possible. This includes respectfully portraying players' perspectives and experiences when exploring the story in the game and avoiding stereotypes or objectionable content.

**Transparency issues**: If the product is put into business, transparency with stakeholders such as publishers or advertisers should also be carefully considered and transparent.

## Professional

**Professionalism issues**: To maintain professionalism during project development, Agile methodology is applied to plan the work process, list tasks and specific plans to be completed, and easily change requirements during work. In addition to the working process, professional expertise also needs to be ensured; in this project, design patterns will be applied to the product along with OOP to optimise performance and comply with the programming standards of the language being used, applying SOLID standards to optimise code in the project.

# Planning (see Appendix A)

The Agile model was chosen for the project because of its suitability for a project with a complex implementation process and many features. Because with the orientation of a game, the development process at each stage will be suitable. When developing Metroidvania 2D games, features such as running, attacking, surfing, jumping, etc., are essential. With so many functions to perform, adopting an Agile model is appropriate because the requirements are unclear. This model's flexible working model will help apply new requirements to the project quickly. Fast. Breaking down the stages of task management and implementing several functions will help deliver results for features and products faster than waiting for a critical function to complete the process. Finally, sprinting allows Agile to focus on specific goals and tasks while helping to manage project progress closely.

* **Research Report Phase**: In this initial phase, the focus will be on research to establish a solid foundation for the project. Essential tasks include defining clear project objectives, outlining the scope of work, and formulating hypotheses to guide the research process. A thorough study of existing works and technologies related to the project topic will be conducted to gather precious information for the project. The outcome of this phase will be the creation of a comprehensive research report document that summarises all findings and lays the groundwork for further stages of development.

A calendar with numbers and days

Description automatically generated

Figure 1 Phase 1: Research report.

* **Design Documentation Phase**: Project ideas are translated into detailed plans and blueprints during the design documentation phase. The main goal is to materialise the final product by outlining game mechanics, features, story elements, and technology requirements. This phase involves defining fundamental game mechanics, non-mechanical requirements, and system architecture by creating use cases and class diagrams. Comprehensive documents will be drafted to provide a clear roadmap for the implementation phase, ensuring alignment with project objectives and objectives.

A calendar with numbers and days

Description automatically generated

Figure 2 Phase 2: Design document

* **Implementation phase**: With the design documentation completed, the project will move to the implementation phase, where planned features and mechanisms will be incorporated into the product. Core game mechanics such as movement and skill will be implemented, along with secondary mechanics such as enemy algorithms and cutscenes. Adding sound, spite, and animation will enhance the project's visual and auditory experience. Level designs will be developed to create engaging gaming environments, while GUI and menu functions will be implemented to enhance user interaction. Finally, the project will be exported to an executable file, marking the completion of this phase.

A calendar with numbers and days

Description automatically generated

Figure 3 Phase 3: Implementation

* **Testing phase:** As the project nears completion, it shifts to ensuring its quality through comprehensive testing. Test cases will be meticulously planned and designed to cover all aspects of the project, from functionality to performance. Functional testing will verify that all features work as intended, while performance testing will evaluate the effectiveness and responsiveness of the project. Any defects or problems discovered during testing will be resolved promptly to ensure the quality of the final product. The testing phase will end with the reporting of test results.

A calendar with days and days

Description automatically generated

Figure 4 Phase 4: Testing

* **Evaluation and reflection reporting phase**: In the project's final phase, attention will shift to evaluating the finished product and reflecting on the development process. The goal is to evaluate the final product's overall performance, features, and quality and reflect on its development journey. User feedback will be collected and analysed to identify strengths and areas for improvement. The result of this phase will be the completion of a comprehensive final project report summarising the project results, lessons learned and recommendations for future developments.

A calendar with a date and days of the week

Description automatically generated

Figure 5 Phase 5: Evaluation and reflection reporting.

# Initial References

Andiloro, A. (2023). ‘Understanding Genre as Atmospheric Assemblage: The Case of Videogames’, *Television & New Media*, 24(5), pp. 559–570. Available at: https://doi.org/10.1177/15274764231171076.

Djafarova, N. *et al.* (2023). ‘The Art of Serious Game Design: A Framework and Methodology’, *AIS Transactions on Human-Computer Interaction*, 15(3), pp. 322–349.

Gangopadhyay, T. & Acherjee, A. (2021). ‘Scaffolding in Gamification: Metroidvania and Cognitive Behaviorism’, *International Journal of English: Literature, Language and Skills*, 10(3), pp. 66–73.

Guzsvinecz, T. (2023). ‘The correlation between positive reviews, playtime, design and game mechanics in souls-like role-playing video games’, *Multimedia Tools and Applications*, 82(3), pp. 4641–4670. Available at: https://doi.org/10.1007/s11042-022-12308-1.

Jagdale, D. (2021). ‘Finite State Machine in Game Development’, pp. 384–390. Available at: https://doi.org/10.48175/IJARSCT-2062.

Karlsson, T., Brusk, J. and Engström, H. (2023). ‘Level Design Processes and Challenges: A Cross Section of Game Development’, *Games and Culture*, 18(6), pp. 821–849. Available at: https://doi.org/10.1177/15554120221139229.

Martinez, L., Gimenes, M. and Lambert, E. (2022). ‘Entertainment Video Games for Academic Learning: A Systematic Review’, *Journal of Educational Computing Research*, 60(5), pp. 1083–1109. Available at: https://doi.org/10.1177/07356331211053848.

Mawhorter, P., Ruslanova, I. & Mawhorter, R. (2022). ‘Representing Exploration in Metroidvania Games’, in. *Proceedings of the FDG workshop on Procedural Content Generation*.

Nuriyeva, F. *et al.* (2023). ‘Pixel Dungeon - Turn Based Game With Unity’, *Journal of Artificial Intelligence and Data Science*, 3(2), pp. 88–98.

Paschali, M. *et al.* (2021). ‘Implementing game requirements using design patterns’, *Journal of Software: Evolution and Process*, 33(12), p. e2399.

Salin, L. *et al.* (2022). ‘Game Performance’, *Game Development with MonoGame: Build a 2D Game Using Your Own Reusable and Performant Game Engine*, pp. 1–24.

Valkenburg, P.M., Meier, A. and Beyens, I. (2022). ‘Social media use and its impact on adolescent mental health: An umbrella review of the evidence’, *Current Opinion in Psychology*, 44, pp. 58–68. Available at: https://doi.org/10.1016/j.copsyc.2021.08.017.

# Appendix A

