GAME DEVELOPMENT IN UNITY



Submitted by

MUHAMMAD ATIF

Supervised by

DR. SARA SHAHZAD

BS Computer Science

Session 2019-2020

Department of Computer Science

**University of Peshawar**

**Introduction:**

The game name Operation-Bio Purge is an action game based on a player who will be eliminating all the enemies that will prevent him from progressing further in the game. The type of enemies will be pests (natural type of enemies).The player will embark on the mission of controlling the further spread of such types of pest in the current environment.

**Story Line:**

The environment was mutated and strange type of pests were born, the role of the player is to terminate them and protect people. The player plays as a skilled terminator who is charged with the mission of terminating all the pests for that particular environment. As the player progresses in the game, they will face more stronger and skilled enemies trying to make the levels harder to complete. The player will uncover the hidden conspiracy and origin of mutation.

**Features:**

1) **Uniqueness in environment:** The game provides a unique environment for every level and player will experience game play in different environment every times.

2) **Diverse Bestiary:** The game features 3 different types of enemies and they will attack the player at different stages, to make the game more interactive and playable for end users.

3) **Different Types of Arsenal:** The game provides a store where you can purchase different types of abilities to defeat your enemies in powerful way. The user can buy different types of weapons and abilities from store.

4) **Puzzles:** The game provides an environment where the player will need to observe and use their abilities in more sensible ways as not to waste them.

5) **Upgrade Abilities:** The store provides different types of weapons and magic abilities to help the player. These will be purchased with money earned during missions.

6) **Learn Game Development:** The design and implementation of this game will help me learn the basic interaction with unity environment and try the animation, scripting and level design of the game.

**Target Audience:**

The target audience for this game is players who enjoy action-adventure games with focus on exploring different conspiracies and dealing with combat and a light amount of puzzle solving and the developer can learn something new with a game development. The moderate difficulty level suits both casual and experienced users around.

**Problem Description:**

Many aspiring game developer lacks practical experience in the field of game development and they do not know how to fit their experience in practical projects. This project aims to provide a practical experience for learners to learn and develop a project which can enhance their skills and provide a good learning experience.

Aspiring game developers lack practical experience in game development, this project provides a platform for learning the basic interaction with unity environment as well as hand on experience on in animation, scripting and level design.

The main focus of this project is to gain industrial level experience in gaming and learn all the basic technologies related with this field.

**Project Objectives:**

The objectives of this project are to:

* Develop a 3D mobile game called Operation-Bio Purge using Unity Game Engine.
* Implement a variety of gameplay systems;
* including an inventory system,
* a health system,
* a damage system,
* a generic team ID system,
* an AI perception system,
* an AI behavior tree system,
* a projectile system,
* an ability system,
* a shop system,
* a UI management system and
* A level management system.
* Use the latest Unity technologies, including scriptable objects, Addressable, the new input system, and Timeline.
* Test the game on a variety of devices, including Android and iOS devices.

Unity Game Engine use C# (Sharp) language for programming. This Engine was developed by Unity Technologies release in June of 2005 in Apple Developer Conference as a Mac OS X Game Engine. The Engine has gradually extended to support various platforms. Unity Game Engine is proprietary software but free for students, this project was developed using an educational version of the Unity Game Engine.

Unity Engine targets the following APIs

* Direct3D on Windows and Xbox 360: Used to render in three-dimensional graphics in applications where performance is very important. It uses hardware acceleration of the 3D rendering pipeline.
* OpenGL on Mac: Abstract API for drawing 2D and 3D graphics. It is designed to be implemented mostly or entirely in hardware instead of software.
* OpenGL ES on Android and iOS: A subset of the OpenGL API designed for embedded systems. It is a cross-language and multi-platform API that is why it is the most widely deployed 3D graphics API in history.

The Unity Game Engine supports the use of texture compression and resolution settings for all the platforms that the game engine supports. The Engine provides support to bump mapping, reflection mapping, parallax mapping, screen space ambient occlusion (SSAO), dynamic shadows using shadows maps, render-to-texture and full screen- post-processing effects.

The Engine supports shader with many variants and declarative fallback specification which allows Unity to detect the best variant for the current hardware.

**History of Unity Game Engine:**

The engine made its first appearance in June of 2005 in Apple Worldwide Developer Conference, it was extended to 21 platforms and the latest version of Unity is currently called *Tech Stream* with version number 2023.1.5 released in July of 2023.

The Unity version 5 allowed many inexperience developers to start producing games and many people started criticizing Unity. Games developed by Unity were downloaded more than 5 billion time and about 2.4 billion different mobile devices were used to develop them.

That’s the reason Unity is the leading software in Game Development.

**Main Concepts of Unity:**

The workflow of unity is built around the structure of component. A component is a smaller part of larger machine and in simple words its something that is complete on its own. Every component of a machine works independently and can accomplish its task without the help of any outside sources.

For example in a PlayStation controller, it has many buttons but each button has no idea that there are other buttons with different behavior. Every button function independently and the function controller is a one way street, and its task will never change due to what it is plugged into. This component can work as a standalone device and with multiple devices.

Unity allow you to test your projects in separate windows and make edits to your code or game objects and these changes are reflected live in real time. These features are possible due to Unity component based architecture.

**Project Motivation:**

This project aims to revolutionize the genre of adventure based games with modern design and that provide a fresh feel to the new generation. There were a lot of other motivations for the game including the creative environment of Unity which will allow the developer to experience new game mechanics, design quirky bug AI and craft captivating environments. It’s a chance to provide the developer with a learning curve and improve their knowledge of game development. One of the reasons that motivate me to this project was the programming language used as a developer I like to program in C++ so I decided to give a try to game development with C# without switching to another language.

We want to develop a game that can entertain and challenge users and also to inspire others to learn game development and think about the artistry efforts behind the game development.

**Project Significance:**

The significance for this project is as followed

**Refreshing the Adventure Game Genre:**

Many of the modern entries/players still adhere to this category of gaming and Operation-Bio Purge on the other hand filled with strategic planning and humorous tone could attract wider range of audience. This could also inspire other developers to experience this genre and lead to a more innovative adventure games.

**Raising Awareness about Environmental Issues:**

This game also provides a subconscious message to the player about the disturbance of the ecosystem and the causes of the environmental problems due to climate changes.

**Show Casing the Power of Unity:**

This game serve as a proof about the informing developers about the power of unity by making this game more visually appealing and engaging in term of graphics and 3D objects with a unique mechanics.

**Encourage Developers:**

The development of this game will be documented and shared with public, encouraging them to learn game development and make their own games using the power and features provided by Unity in a guided way. This could encourage the gaming community and lead to collaboration and knowledge sharing.

**Project Uniqueness:**

This game development project puts many aspects from real world in to this project. The most exciting features are the blending of genre, that is an action and adventure genre is mixed in this game providing player with an amazing experience of interaction with enemies and the provided environment in the game.

Player navigating through different environment experiences different types of enemies, enemies with different level of power and abilities. Player should expect them anywhere and every time in the game because the game is designed to add strategic depth and make it more engaging for users.

One of the most important feature of the game is the story which is molded in such way that due to environmental conditions the pest are produced and are disrupting the environment. This also sends a subconscious message to everyone to take care of their environment and maintain ecosystem balance.

The game features an encouraging perspective towards development, inviting everyone from the community to learn and collaborate in this development. The documentation will be written in such a style to allow more people to easily read it and find their way through game development.

**Project Scope:**

The Operation-Bio Purge is an exciting foray into the world of pest control before diving into squishing virtual roaches, it’s important to define the project scope. Project Scope is a map that guides the project keeping it on the track to the development journey, ensuring the team is on the track and in the end delivers an excellent product.

**Imagine:**

* You, the fearless hero navigating through the bustling area of pests that are very poisonous.
* Fighting with a diverse set of enemies in which each carries a different set of abilities and power that can cause a lots of damage to you.
* Equipping you with huge arsenal of bug-bashing tools, along with some special abilities from store and some new experimental gadgets from shop/inventory.

The project scope will clarify:

* **What’s In:** We will have 10-15 hour of level design, 10-15 different insects to fight with along with at least 8 upgradable extermination weapons/tools, Leaderboards, achievements, and an optional humorous touches add spice to the mix.
* **What’s Out:** VR support, complex multiplayer features and extensive character customization won’t be part of the initial launch. The main focus will be on delivering the core experience first.
* **Why these Choices:** Budget, timeline and team size play a key role in these deliverables. We aim to allocate all the resources with great care and completely utilize them without compromising the project.

The project scope keeps the project in a fence. We can always adjust and adopt the boundaries, ensuring a fun and achievable development process. The table below summarize these features in a more understandable way.

|  |  |  |
| --- | --- | --- |
| **Elements** | **What’s Included** | **What’s Excluded** |
| Platforms | PC and Mobile | VR |
| Engine | Unity | None |
| Gameplay hour | 10-15 | N/A |
| Environment | Diverse city locations | None |
| Insects | 10-15 unique types | None |
| Extermination Tools | 8+ Upgradable Options | None |
| Features | Leaderboard, Achievements and humor | Complex multiplayer, deep character customization |

**Chapter 2**

**Feasibility and Analysis:**

**Existing Systems:**

Earth Defense Force, often abbreviated as EDF, is a third-person shooter video game centered on humanity's desperate struggle against overwhelming waves of giant insects, and alien invaders. Developed by Sandlot and published by D3 Publisher, and is known for its over-the-top action, absurd enemy variety, and tongue-in-cheek humor.

**Giant Enemy Monsters:**

* **Insect Armageddon:** Imagine ants the size of buildings, gargantuan spiders spewing acid, and locust swarms blotting out the sun. That's just a taste of the insecticide nightmares you'll face in EDF.
* **Alien Onslaught:** Prepare for laser-blasting bipedal lizards, hulking cybernetic monstrosities, and mother ships deploying endless waves of drone fighters. You'll need every weapon in your arsenal to repel these threats.
* **Mesh Mania:** EDF throws in the ultimate curveball with towering robotic enemies that pack devastating firepower. Dodging skyscraper-sized fists and laser barrages adds a whole new layer of excitement to the combat.

**Weapons:**

* **From Pea Shooter to Planet Cracker**: EDF's weapon selection is delightfully ridiculous. You'll yield everything from humble pistols and shotguns to rocket launchers, rail guns, and orbital lasers.
* **Vehicular Carnage:** Hop into tanks, jets, and helicopters to rain fire upon your enemies from above.

**Over-the-Top Action:**

* **Explosions:** EDF thrives on its over-the-top action. Buildings crumble, entire cityscapes erupt in fire, and your character can be flung through the air by enemy attacks. Don't expect realism, embrace the chaotic spectacle.
* **Co-op Chaos:** Team up with three friends for some truly unforgettable co-op mayhem (violent). The shared laughter and frantic coordination as you try to overcome impossible odds are what make EDF truly special.

**A Series Full of Options:**

* **Multiple Games, Multiple Threats:** With over 6 main entries and numerous spin-offs, the EDF series offers a diverse set of experiences. Each game features new enemy types, weapons, and mechanics, keeping the action fresh.
* **Different Flavors:** From the voxel-based charm of "Earth Defense Force: World Brothers" to the gritty sci-fi atmosphere of "Earth Defense Force 6," there's an EDF game for every taste.

**Advantages:**

* **Unparalleled Monster Mech** (Mechrefers to a fictional giant robot or powered exoskeleton**):** EDF's enemy variety is unmatched. From skyscraper-sized ants to laser-blasting alien lizards, each fight feels fresh and exhilarating. Prepare for giant spiders, burrowing worms, flying saucers, and much more!
* **Weaponized Playground:** EDF's weapon arsenal is a mad scientist's dream. From humble shotguns to orbital lasers and mech suits, you'll have a blast experimenting with different tools to obliterate your enemies.
* **Co-op Carnage:** Team up with three friends for chaotic co-op fun. Coordinating strategies, reviving fallen comrades, and witnessing the shared devastation in an experience unlike any other.
* **Pick Your Poison:** With multiple entries and spin-offs, the EDF series offers diverse experiences. "Earth Defense Force: World Brothers" boasts charming voxel graphics, while "Earth Defense Force 6" delivers a unpleasant sci-fi atmosphere.

**Drawbacks:**

* **Repetitive Rampage:** While the enemy variety is impressive, the core gameplay loop can become repetitive after a while. Defeating waves of giant monsters, even with different weapons, might lose its initial appeal for some players.
* **B-Movie Bonanza:** EDF wears its campy, B-movie humor proudly. If you're not a fan of cheesy dialogue and over-the-top scenarios, you might find it grating.
* **Technical Quirks**: The series is known for its junky physics, occasional frame rate drops, and sometimes awkward controls, while not game-breaking, these technical quirks can be frustrating at times.

**Problems:**

* **Accessibility Barrier:** The steep difficulty curve and lack of tutorials can be daunting for newcomers. EDF throws you into the action without much hand-holding, which might discourage some players.
* **Story Takes a Backseat:** The narrative in EDF is mostly an afterthought. The focus is purely on the chaotic action, so don't expect a deep or engaging story.
* **Confusing Content:** Depending on the specific game, the lack of endgame content or replay ability value might leave you wanting more after the initial campaign is over.

**Overall:**

EDF is a unique and undeniably fun experience for those who embrace its over-the-top action, B-movie charm, and monster mayhem. However, its repetitive gameplay, technical quirks, and lack of narrative depth might not appeal to everyone. If you're looking for a serious, polished shooter, EDF might not be your cup of tea. But if you crave chaotic co-op action with a side of cheese and bug splatters, EDF is definitely worth checking out.

**Operation-Bio Purge:**

**Urban Exterminator:** Step into the shoes of a professional pest control technician navigating the gritty reality of city apartments, bustling restaurants, and even luxurious mansions, each with its own unique pest challenges and eccentric clientele.

**Global Pest Control:** Travel the world as a specialist exterminator tackling infestations in diverse environments - from the sweltering jungles of the Amazon to the icy tundra of the Arctic, each biome teeming with its own unique insect foes.

**Scientific Exterminator:** Take on the role of a researcher-turned-exterminator, utilizing cutting-edge technology and innovative traps to study and eradicate invasive species threatening ecosystems and human health.

Twist:

**Insect Apocalypse:** In a world overrun by giant, mutated insects, humanity's last hope lies with a ragtag group of Exterminators wielding outlandish weapons and battling for survival against bug-lords and their monstrous hordes.

**Dream world Exterminator:** Enter the surreal realm of dreams where nightmares manifest as monstrous insects. As a oneiric exterminator, you must navigate the ever-shifting landscape of the subconscious, solving puzzles and using dream-warping tools to vanquish these fantastical pests.

**Mythical Exterminator:** Face off against legendary creatures of folklore and mythology reimagined as colossal insects. From fire-breathing dragonflies to venomous spider-centaurs, each encounter demands unique strategies and legendary weaponry.

**Target Audience:** Is Exterminator aiming for a different audience than EDF? Perhaps it targets a more casual market with simpler controls and less intense action. Or maybe it focuses on educating players about real-world pest control, making it appealing to science and nature enthusiasts.

**Positive Impact**

**Educational Value:**

Exterminator could raise awareness about responsible pest control practices and the importance of protecting ecosystems. Educational elements could be subtly woven into the gameplay or story, making it both entertaining and informative.

**Co-op Fun:** Teaming up with friends to tackle infestations could foster teamwork and communication, making Exterminator a fun and social experience.

**Detail Feasibility Report:**

Below is a detail feasibility report for Operation-Bio Purge.

**Technical Feasibility:**

The technical requirements required for this project are a system that can support the game engine which in this case will be Unity, Unity requires a subscription but I will be using the student plan, in which I can use all the features for free. Unity works with C# which is a similar language like C++. As a C++ Programmer I have a very good understanding of the concepts in C++ which I can easily apply to this scenario. The IDE the project will be coded with is Visual Studio Community which have a built in compiler with it.  
The design phase of the project will take a little longer because I will have to consult someone to deal with the design of the interfaces and design architecture of the system.

The system can be easily completed with the above mention tools and techniques. However the system will also be tested and development will be continued in small phases as to have the room for maximum improvements to interface, internal mechanisms and other features to make a very engaging.

The development will also requires advance features like complex AI or detail environment, which will requires additional learning resources.

The problems faced by implementing the system will requires an expertise in testing for which the system must be test be a person from out of the team, as the a solo developer I will have to manage the time and available resources with great efficiency in order to complete all the phases of the project. The testing and designing will require some extra time which can be solve either by hiring a person from out of the team or I will develop them myself but the last one will requires time.

The system will probably take months to be completed because it requires the process of learning along with development of the system. The team will try to adjust everything accordingly in order to achieve the development of the system in the limited time available.

**Economic Feasibility:**

The resources required to learn the basic interaction with Unity environment will requires the team to have some skills in becoming familiar with the environment. The team will purchase some courses from Udemy in order to achieve their objective in faster and efficient way.  
The team will use assets which are probably free or low cost but once the testing is done the team will invest in the purchasing of assets but if there was sufficient time most of the assets will be developed for the system by the team which at some stage of development will include a designers and testers.

As development is completed the team will be testing and finding bugs in the system before publishing it online, once everything is good it will be uploaded at some platforms like steam and mobile app stores with a revenue model like paid download and in-app purchases. The game market is very competitive; it would require some time to adjust itself to stakeholders out there. The team will also keep a backup plan to have budget for the marketing of the system. If the system requires some developers to be hired for some parts of the project, the team will make sure there is enough budget to get the best developers out there.

**Social Feasibility:**

The most important of the social feasibility is the ethical considerations in the game, as discussed before the game aims to highlight a point to the nation which is responsibility; Responsibility is one of the important aspect of the humans. The game shows a story that the pests are born because of the humans irresponsibility’s toward the environment like climate changes and pollution. The all forms of pollutions can effect indirectly humans in the last. This will provide a message to the nation to be aware and be awake to take action now instead of ignoring it.

The system will be designed in such a way that no culture, race, age or gender is targeted. The player will be able to experience a very friendly environment in which they will no idea of the they being discriminated in anyway instead the team will design strategies in order to remove anything that will contribute to discrimination of that particular group. Instead the game target audience globally.

The development of the game will be and educational asset for other students, developers and anyone who wants to start with game development but requires a clear road map for them. All the resources, documentation and any assets that are required for redesigning of the game will be available to the everyone from around the globe.

The last point is basically highlighted to give the project and educational value.

Accessibility features will be given more diverse touch in order to make the game playable for people with different abilities like adjusting the difficulties level and color blind options along with subtitle options to be incorporated in to the game.

**Chapter 3**

**Requirement Specification:**

This part of the document outlines the requirement specification of the game Operation-Bio Purge which will serve as the blueprint or the base for the features, functionality and quality of the game. The aim of clearly defining these requirements is to keep everyone including developers, designers, testers and even the lovely audience to be on the same page leading to a successful development journey.

Requirement specification is extremely important for the success of a system. Vague instruction set can lead to confusions among the team and the promised end product will not be up to the mark.

The requirement specification is categorized into functional and non-functional requirements which are discussed in details with reference to the game Operation-Bio Purge below.

**Functional Requirements:**

* **Main Gameplay:**
* Player controls a character.
* Levels filled with different enemies.
* Player uses different weapons and tools to eliminate enemies.
* Boss enemies will be present at the end of every level.
* **Progression:**
* Unlock new game level with experience or in-game currency.
* Difficulty increases with every new level.
* Optional side objectives to make the game more engaging (Optional).
* **Inventory and Upgrades:**
* Player can use different weapons and tools with different attributes.
* Option to upgrade weapons for improving power and efficiency.
* Able to use some special abilities in the game.
* **Menus and UI:**
* Feature an extremely smooth and easy User interface for the players.
* Pause menus with options to save, quite or adjust setting of the game.
* Health bar, objective status indicator and other elements for feedback.

**Non-Functional:**

The non-functional requirements of the system are about how a system should behave instead of what specific function to perform. The non-functional requirements for the Operation-Bio Purge are defined below.

* **Performance:**
  + Maintain smooth frame rate and responsiveness on target platforms (iOS, Android).
  + Optimize every feature in order to avoid performance issues.
* **Graphics And Audio:**
  + Graphics should be visually appealing and according to the theme and tone.
  + Good sounds and background music.
  + Sounds that inform the user about the certain actions like low health and enemy response fire.
* **Controls:**
  + Responsive and faster controls for aiming, and interacting with the environment.
  + Support for different input methods like keyboard, mouse (Optional).
  + Sufficient options for customizations.
  + Sensitivity features.
* **User Interface:**
  + New game, continue game, exit.
  + Links to social media platforms.
  + Setting button to adjust controls.

**UI Requirements:**

This includes the guidelines for how a game user interface should look and function when the player is interacting with the system. It includes menus, buttons, maps, inventory screen and health bar.

* **Main menus:** 
  + Start game, continue game, and option buttons.
  + Information about the game and social links.
* **Gameplay Screen:**
  + Health bar, Objectives status indicators, ammo/resources indicators.
  + Mini map or level overview (Optional).
  + Button to access inventory.
* **Inventory Screen:**
  + Display of the available resources.
  + Upgrade options with cost and description.
  + Special abilities management with usage indicators.
* **Pause menu:**
  + Options to save, resume, quit and adjust game settings.
  + Control layout and settings overview.
* **Other UI elements:**
  + Tutorials to instruct player how to play and how to navigate the UI.
  + Victory screen at the end of the level.

The main and most important requirement of the game will be learning how the process of designing and developing a video game works. To extract useful results from all the phases involved in game development like preproduction, production and post-production. More requirements include learning the art of how to draw graphics and music for game, scripting, artificial intelligence, level creation and user interface.

**Persona:**

The Operation Bio-Purge has a very simple persona in which a user named Ali, the Casual Gamer.

**Demographics:**

* Name: Ali
* Age: 23
* Occupation: Marketing Specialist
* Location: Peshawar City
* Device: IPhone 11

**Gaming Habits:**

* Play mobile game in short breaks or during free time.
* Prefer casual, puzzle like games with simple mechanics and clear goals.
* Play games with light heart themes and great visuals.
* Gets bored with complex controls and demanding mechanics.

**Motivation:**

* For relaxing himself and enjoying in free time.
* Enjoys the satisfaction of completing short objectives.
* Appreciates game with quick to do actions.
* Like good game designs.

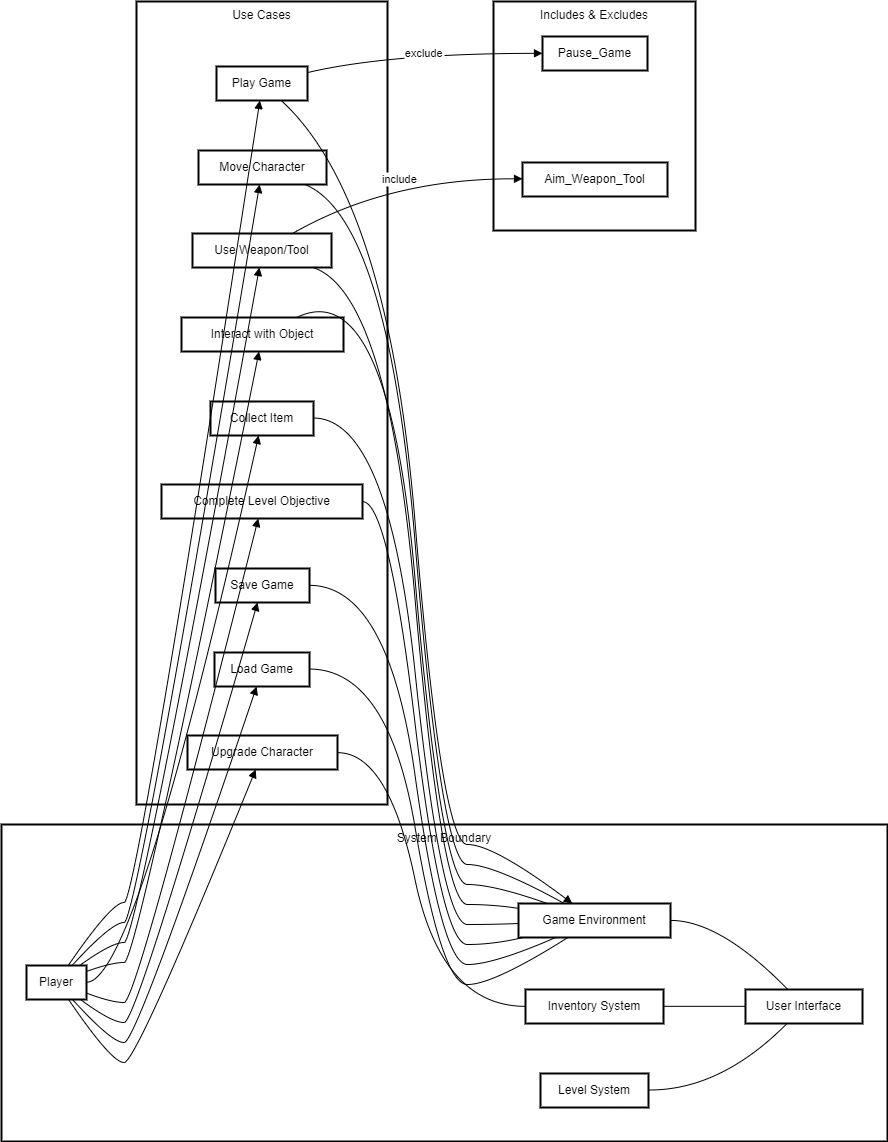
**Concerns:**

* Limited time to play the game
* Dislike ads and in-game pop-ups for purchases or any sort of disturbance.
* Do not like repetitive game play.

**User Interactions with the System through Use Case Diagram:**

This section dives into the user interaction between the user and the Operation-Bio Purge game using a use case diagram. A use case diagram describes all the functionalities of the system along with external users aiming to describe how an actor (user) interacts with the system.

A use case diagram also specifies the main functionalities of the system that a user can perform while interacting with the system. This diagram also communicates the system behavior to the stakeholder in an easy and understandable way. The testing phase also uses the use case diagram as a base.



The UML diagram describes the user interaction and functionalities of the “Operation Bio-Purge” game system.

* **System Boundary:**
  + **Player:** The player represents the user interacting with the system.
  + **Game Environment:** This represents the virtual environment where the game takes place including elements like terrains, enemies and objects.
  + **Inventory System:** Manages the player inventory, the items that a player collects during the gameplay or purchases them from a store.
  + **Level System:** This functionality manages the progression and objectives with in each level.
  + **User Interface:** Provides the visual and interactive way through which a user interacts with the game.
* **Use Case:**

The use case describes various actions or functionalities that a player can perform while interacting with the system.

* + **Play Game:** begins the game play with the game environment.
  + **Move Character:** Allows the player to move their character with in the game.
  + **Interact with Object:** Enables the player to interact with objects present in the game environment.
  + **Use Weapons/Tools:** Allows the player to utilize weapons or tools with in the game.
  + **Collect Item:** Enables the player to collect game items found with in the game environment.
  + **Upgrade Character:** Allow the user to upgrade their character abilities or attributes.
  + **Complete Level Objectives:** Indicates the accomplishment of objectives specific to a level.
  + **Save Game:** Allow the players to save their current progress within the game.
  + **Load Game:** Allow to load the game from previously saved state to provide more engaging feeling the users.
* **Include and exclude:** Indicate the relationships between use cases.
  + **Play game exclude pause game:** This means that when the player is playing the game, the pause functionality is not available.
  + **Use Weapons/Tools includes Aim Weapons/Tools**: This signifies that aiming is a part of the process of using weapons within the game.
* **Actor Use Case Relationships:**
  + Arrows connecting actors (Player) to use cases indicate that players interact with those functionalities.

**Development Environment Requirements:**

Development of this game involves various tools and software with their own system requirements, below is a very detail of the development environment required for this game.

**Development Environment:**

* **Operating System**
  + Minimum: Windows 10 64-bit (recommended latest stable version).
  + Alternative: macOs Mojave 10.14+ (recommended: latest stable version).
  + Justification: Both Unity and macOs are officially supported by Unity.

**Hardware:**

* **Processor:**
  + Minimum: x86 or x64 architecture with SSE2 instruction set support(e.g. Intel core i5-4460 or AMD equivalent).
  + Recommended: Newer processor with multiple cores (e.g., Intel core i7 or AMD Ryzen) for smoother performance during development and testing.
* **RAM**
  + Minimum: 8GB
  + Recommended: 16GB for multitasking and handling larger projects
* **Graphics Card:**
  + Minimum: DX10, DX11, DX12 capable (e.g., NVidia GTX 970 or AMD Radeon R9 290)
* **Storages:**
  + Minimum: 20GB available space for Unity and Project Files
  + Recommended: More space depending on project size, additional tools and asset libraries.

**Software:**

* **Unity Game Engine:**
  + Download the latest stable version that is compatible with your system.
  + Consider Unity Personal for small projects or Unity Plus for additional features.
* **Version Control:**
  + Git recommended
* **Graphics Designing Software:**
  + Photoshop, GIMP for creating UI elements textures or logos.
* **3D Modeling Software:**
  + Blender
* **Audio Editing:**
  + Audacity

**Asset Creations:**

* Asset Creation: Asset will be used from unity market place.

**Minimum Hardware Requirements for Running the Game:**

These are the requirements for running the Operation Bio-Purge game on Android or iOS. These are the general requirements needed for running the system.

* **Android:**
  + **Processor:** Dual-core 1.2 GHz processor (recommended: Quad-core 1.5 GHz or better)
  + **RAM:** 1GB RAM (recommended 2GB or more)
  + **Storage:** 500 MB free space
  + **Operating System:** Android 5.0 or later (recommended Android 8.0 or later).
  + **Graphics:** Adreno 305 GPU or equivalent (recommended: Adreno 405 or later).
* **iOS:**
  + **Device:** iPhone 6 or later (recommended iPhone 7 or later).
  + **Operating System:** iOS 10 or later (recommended: iOS 12 or later).
  + **RAM:** 1GB RAM (recommended: 2GB or more)
  + **Storage:** 500 MB free space.