

## **ADVANCED PROJECT**

### **PROJECT ALPHA: GUARDIAN (Unity Tower Defense Game)**

Discipline: **INFORMATION TECHNOLOGY**  
Major: **INFORMATION TECHNOLOGY**

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## **COMMENT OF THE SUPERVISOR**

## **ACKNOWLEDGE**

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We want to thank the HUTECH University Institute and International HUTECH for giving us a chance to explore and do an experiment in a new category of the project. All the acknowledgement we gain during the project is the most valuable resource that we can apply to the future.

As the last, we want to show our gratitude to the people who lend us a hand to make this project become possible.

# Chapter 1: Overview

## 1.1 Reason for choosing the topic

### 1.1.1 The development of video games.

For the golden era of the internet, with the convenience of modern technology, entertainment becomes an essential part of the individual routines. People never stop finding new ways to solve the problem, to improve the technology to serve more complicated purposes. In the entertainment categories, video games are becoming better and better in time as well.

Video games have been developed widely in both width (categories of game genre) and depth (the content they spend a long time just to make the story touching and make people synergy to the characters). It is no longer a waste-time and benefits lesser activities, and becomes a high priority of individual experience in the virtual world.



*Figure 1: Game of the Year 2024: Astro Bot from Team Asobi  
The game leaves a strong impression in the community due to the lovely design, friendly character but has a well-developed gameplay that can be played by all members in a family. It also won Best Family Game.*

“Important research has already been conducted for decades on the negative effects of gaming, including addiction, depression and aggression, and we are certainly not suggesting that this should be ignored,” said lead author Isabela Granic, PhD, of Radboud University Nijmegen in The Netherlands. “However, to understand the impact of videogames on children’s and adolescents’ development, a more balanced perspective is needed.

Playing video games may also help children develop problem-solving skills, the authors said. The more adolescents reported playing strategic video games, such as role-playing games, the more they improved in problem solving and school grades the following year, according to a long-term study published in 2013. Children’s creativity was also enhanced by playing any kind of video game, including violent games, but not when the

children used other forms of technology, such as a computer or cell phone, other research revealed.”

- American Psychological Association - Video Games Play May Provide Learning, Health, Social Benefits, Review Finds

### 1.1.2 Strategic category

#### 1.1.2.1. What is a strategy game?

Strategy is a major video game genre that emphasizes thinking and planning over direct instant action in order to achieve victory. Although many types of video games can contain strategic elements, as a genre, strategy games are most commonly defined as those with a primary focus on high-level strategy, logistics and resource management. They are also usually divided into two main sub-categories: turn-based and real-time, but there are also many strategy cross/sub-genres that feature additional elements such as tactics, diplomacy, economics and exploration.

- Wikipedia - Strategy video games

This genre of game attracts a large group of people worldwide. For instance, the top 10 most played Strategy games all get more than 50 thousands of current players per day, with the first place get more than 1.7 million of players a day.

Most played Strategy games						Compare
#	SteamDB.info	Name ↓↑	Current ↓↑	24h Peak ↓↑	All-Time Peak ↓↑	
1.		Counter-Strike 2	1,738,651	1,740,261	1,818,773	+
2.		PUBG: BATTLEGROUNDS	762,608	776,094	3,257,248	+
3.		Dota 2	668,008	668,465	1,295,114	+
4.		Marvel Rivals	338,534	435,415	480,990	+
5.		Baldur's Gate 3	72,179	83,226	875,343	+
6.		Sid Meier's Civilization VI	68,975	72,153	162,657	+
7.		Football Manager 2024	64,404	64,404	89,478	+
8.		Hearts of Iron IV	61,859	68,277	93,196	+
9.		Tom Clancy's Rainbow Six Siege	57,279	65,503	201,933	+
10.		Don't Starve Together	55,723	59,926	115,925	+

Figure 2: Most played Strategy games - December 2024 - SteamDB  
This list shows the number of players in real time. This list also contains Game Of The Year 2023 - Baldur's Gate 3

#### 1.1.2.2. The benefits from strategy game

The benefits players can get from the strategy game:

1. Improved cognitive function
2. Increased focus and concentration
3. Improved decision-making skills
4. Enhanced problem-solving abilities
5. Improved social skills
6. Reduced stress levels
7. Improved creativity
8. Increased confidence

- Incline Magazine - The benefit of strategy games.

#### 1.1.2.3. Tower Defense genre

Tower Defense is a genre that has been around for a significant period in the gaming industry, which suggests its timeless appeal to a broad audience. The simplicity of the concept - defending a base against waves of attackers by placing units along a set path - is deceptively complex, offering endless variations and strategies that can be explored and analyzed.



Figure 3: Plants vs. Zombies from PopCap (2009)

*The well-known game of type Tower Defense. Players consider the characteristics of each plant to push back waves of zombies.*

The genre's evolution over the years also presents a rich tapestry of design choices and mechanics that can be dissected. From the classic fixed path layouts to more open-ended, maze-like structures, the way developers have approached level design has varied greatly, offering unique challenges and solutions.

- Wikipedia - Tower Defense

Recently, there are a lot of games that bring people the place to implement their knowledge, their strategic planning skills, or their skill to quickly react to some unexpected things that suddenly appear that require a short amount of time. In that situation, we are really into the genre that gives people a plenty of choice to make a complete plan, with the ability to adapt to the unexpected variety of circumstances that can occur in the player's adventure. That is the reason for our genre choice - Tower Defense with some flavors of random exile.

### *1.1.3 Adventure experience*

The adventure experience gives players a start and an ending point, but leaves them a lot of choices that they can make to optimize their chance of success. For instance, if the game told the player to survive on the island for as long as they can, but they instructed them to defeat all the monsters on that island, this game will become a type that requires an individual skill with a limited strategic planning skill. On the other hand, if the game developers refuse to give players instructions and show them a monster, some players will figure out a way to defeat them, but not all of the players. A different type of them will try some innovative move like finding somewhere to hide until the morning, or try to dive deep into a forest and try their best to avoid them, or a more silly way like finding a steel to craft a weapon, increasing their strength,... All of that is accessible and is accepted by the developers, because the reason for the implementation of adventure experience is to give the people a chance to figure out a hypothetical case in order to make the players unleash their creativity and enjoy the entertainment that the game can bring during their break, or a short time at the end of the day.



*Figure 4: Minecraft from Mojang AB (2011)  
The sandbox game that leaves players on the world with different kinds of living organisms and materials that they can interact or build innovatively.*

To implement the adventure experience to the game required game developers to overhaul all circumstances. The creativity of the people is unlimited, that both give advantages and drawbacks. An impressive game with that element should include a wide selection of action but still can be controlled by the game system itself. If developers do not calculate the result for each action carefully, it can be a really bad technical bug that interrupt the player experience.

That leaves developers an interesting problem that can be solved by a lot of creative solutions with the corresponding cost. If they narrow the variety of options, the game can avoid the bugs but the game does not have an iteration value. If they create the boundaries for the innovations, people are limited by the boredom of the border. But if they ignore all the limits and give the players full access to the game, the game only has shallow joy without anything strategic.

## **1.2 Project objective**

Scope:

- Target Audience: Players want to play management game because
- Platform: Available on PC.
  
- Art style: 2D Pixel with image model assets
  
- Language: Vietnamese

Objective:

By choosing the Tower Defense as a main category of our project, we want to make a game that gives the player an adventure with random elements appearing on the path that make players give a decision for each option to make each run of an adventure different from the rest.

Project Alpha: Guardian is the project that combines the Tower Defense, which is the main genre and Adventure element, to give players access to a wide range of content, and satisfy their creativity to find a new way to gain a victory each run.

Significance:

- For players: We want to make a game that entertains players by making a strategic plan, a surprise by random element and creating balance between difficulty and character strength to make the strategy an essential part to player victory instead of fully based on their skill.
  
- For scientific: We try a new way to control the boundary of the game. Instead of limited character power, we mix the different random outcomes and convert it into additional power to let players mix and make to find their best strategy to win the game.

## **1.3 Project structure**

We will introduce the overview of the main contents of the project, which are divided into 4 chapters.

### **Chapter 1: Overview**

This chapter introduces the present of the game effect in real life, the benefits of the Strategic category, the attraction of this game type and the Adventure element.

Beside that, we also introduce the scope, objective and significance of the project.

### **Chapter 2: Theoretical Basis**

We introduce our game theories that our project has been implemented in the development state, technologies and tools used on the project.

We also introduce the game mechanics, concept, some definition and terminology that we use in this project.

### **Chapter 3: Experimental Results**

This is the place where we show all the game features, including Start game, Level select, Team select, Adventure map, Event, ... up to Combat and Result scene.

In this chapter, we dive deep into how to implement things into the UI, interaction from people to screen, data from folder to screen, calculated character stat, damage dealt,... and many more.

### **Chapter 4: Conclusion and Recommendations**

This is the end of the report where we introduce the orientation for the future, the additional features we want to implement, some lessons and experiences that we learn during the project. Final is a conclusion to the report.

## Chapter 2: Theoretical Basis

### 2.1 Introduction to game development theories

At the beginning of the project, we determine some theories that we need to consider or implement to our project.

- First of all, the game can be played on the PC platform: We choose PC as the platform for the project based on the ease they can be interacted with by players, and it is easy for computers to switch from creating a feature to testing them right on that device.
- The game should have friendly designs: Our project is focused on tower defense, not on the combat scene. We need to specify the limit to the content, or image that we bring into our game.
- The game must have at least three scenes: The menu, the adventure and the tower defense.
  - + The menu: Place in the beginning of the game. It has some options such as start the game, view character details or view inventory,...
  - + The adventure: After starting the game, a map appears with a lot of tiles, players can choose which tile to move. Each tile has a random event on it that requires the player to draw the route in their mind to optimize their benefit without being punished too hard and lost to the main game: Tower Defense.
  - + The tower defense: Players control the team member to push back enemies that come to the tower. If the tower is out of health, the game is over.
- Each character in the game should be fun to play: We do not choose the option that player just spawn the machine or some character that does only one thing like buff the team or attacking. We want each character to have a strength at some point and have an ability kit to use in particular situations. For instance, the damage dealer has an ability to deal damage to all enemies in range or the defender (tanker) has an ability to shield them and allies or basically can hold a huge wave of enemies for them to make an attack hit multiple enemies at once.
- The play must be different from game to game: An adventure never appears the same in two attempts. To do that, we need to generate the map by random tile, or each tile has more than one possible outcome to make sure that players can not be bored by playing that map again, or go to the same tile.
- The beneficial object can be easily managed, can be working well together, and give a variety of buffs: Some objects that players can obtain during the adventure need a place to display their effects, each one can be distributed to the addition of

some stat. For instance, if something gives 4% attack damage and another thing gives 6% attack damage, there is something that needs to calculate the total bonus of the stat. Beside that, we do not want to give the character buff that only deals more damage, we want a different kind of buff like attack speed, health, regenerate health, mana faster,...

- There is encouragement from the game if the player fails to reach the end of the adventure: Failed in our game is not over, we want to give the player something to power-up their team members if they encounter combat and fail to protect the tower. Players can use it or not, but it can give a small boost to their team to make a second attempt easier than the first.
- And the last thing is the most important: We put the player experience into the most priority. These are some easter eggs or events that have a little chance to appear to do silly things, like give a massive buff, or if they satisfy some hard mission, they can have access to an extremely rare thing that can make the game much more easier.

## 2.2 Technologies and Tools Used

### 2.2.1 Unity



Figure 5: Unity

#### 2.2.1.1 What is Unity

Unity is a cross-platform game engine developed by Unity Technologies, first announced and released in June 2005, initial release version 1.0 on June 8, 2005. Nearly 20 years of development, Unity gradually extended to support for a variety of platforms, such as desktop, mobile, console,...

It is particularly popular for mobile development, especially iOS and Android devices, can be considered as an easy engine for beginner developers, and become a popular choice for developing some independent projects.

This engine can both be used to create three-dimensional and two-dimensional games (as known as 2D and 3D). Beside that, interactive simulations or film, automotive, architecture, engineering, construction,... can be well adopted by Unity.

Unity supports more than 20 end-user platforms to run Unity creations. The application made with Unity gets 3.6 billion downloads per month and in the top 100 games including 82 games that grew by using Unity.

For games, Unity can be used to create and grow amazing games across 20+ platforms and billions of devices with our end-to-end tools and services for creation, launch, and beyond.

For industry, they can get the creation tools and enterprise support to transform CAD and 3D data into immersive apps and experiences for any device, anywhere.

Developers can grow their apps from the first day with Unity's complete set of powerful tools, services and expertise to turn it into a successful business.

This can be known as a developing tool for some spotlight brand games that leave to players the innovating and inspiring experience.

#### 2.2.1.2 History

The Unity game engine launched in 2005, aiming to "democratize" game development by making it accessible to more developers. It was shown at Worldwide Developers Conference 2005 by Scott Forstall on Mac OS X. The next year, Unity was named runner-up in the Best Use of Mac OS X Graphics category in Apple Inc.'s Apple Design Awards. Unity was initially released for Mac OS X, later adding support for Microsoft Windows and Web browsers.

#### 2.2.1.3 Advantages of Unity

Unity is cross-platform, in which developers can target multiple platforms such as Windows, macOS, Linux, iOS, Android, WebGL and various game consoles with minimal additional effort.

The core functionality is diverse and includes: providing a rendering engine (graphics rendering) for 2D or 3D images, a physics engine (computation and collision detection), sound, source code, animation, artificial intelligence, and more

## *2.2.2 Programming language C#*



*Figure 6: C# Language*

### 2.2.2.1 C# Overview

C# is a modern, general-purpose programming language that can be used to perform a wide range of tasks and objectives that span over a variety of professions. C# is primarily used on the Windows .NET framework, although it can be applied to an open source platform.

### 2.2.2.2 Familiar C# feature

C# is accessible to beginners, yet delivers advanced features for experienced developers writing specialised applications. You can be productive quickly. You can learn more specialised techniques as you need them for your applications.

C# applications benefit from the automatic memory management of the .NET runtime. C# applications also use the rich runtime libraries provided by the .NET SDK. Some components are cross-platform, such as file system libraries, data collections, and math libraries. Others are specific to a single workload, such as the ASP.NET Core Web libraries or the .NET MAUI UI library. A rich open source ecosystem on NuGet complements the libraries that are part of the runtime. These libraries provide even more components for you to use.

### 2.2.2.3 Benefits of C#

C# has several advantageous features that help make it a popular programming language. While it's comparatively easy to learn, especially if you're familiar with other C languages, C# can be used to develop many different types of applications, software, and platforms. Here are a few factors that make C# a popular programming language:

- Faster development. C# has features that help shorten your development time, with efficient and simple code that isn't challenging to read to help limit time spent debugging.

For example, type safety and garbage collection for memory management and leak protection.

- Large community. C# is used worldwide, and C# developers are ready to help if you're having trouble with your code.

- High scalability. This makes it easier for you to maintain and expand your projects.

#### 2.2.2.4 What is C# use for

##### **Web development:**

Web developers use C# to build dynamic web pages and applications. When pursuing a career in web development, you generally have three options: front-end, back-end, and full-stack development. Front-end developers ensure websites are easy to use for end users, while back-end developers handle the server side of web applications, such as a website's databases. Full-stack developers perform the duties of both front and back-end developers.

##### **Game development**

C# is a popular programming language in game development due to its overall efficiency and compatibility with the Unity game engine.

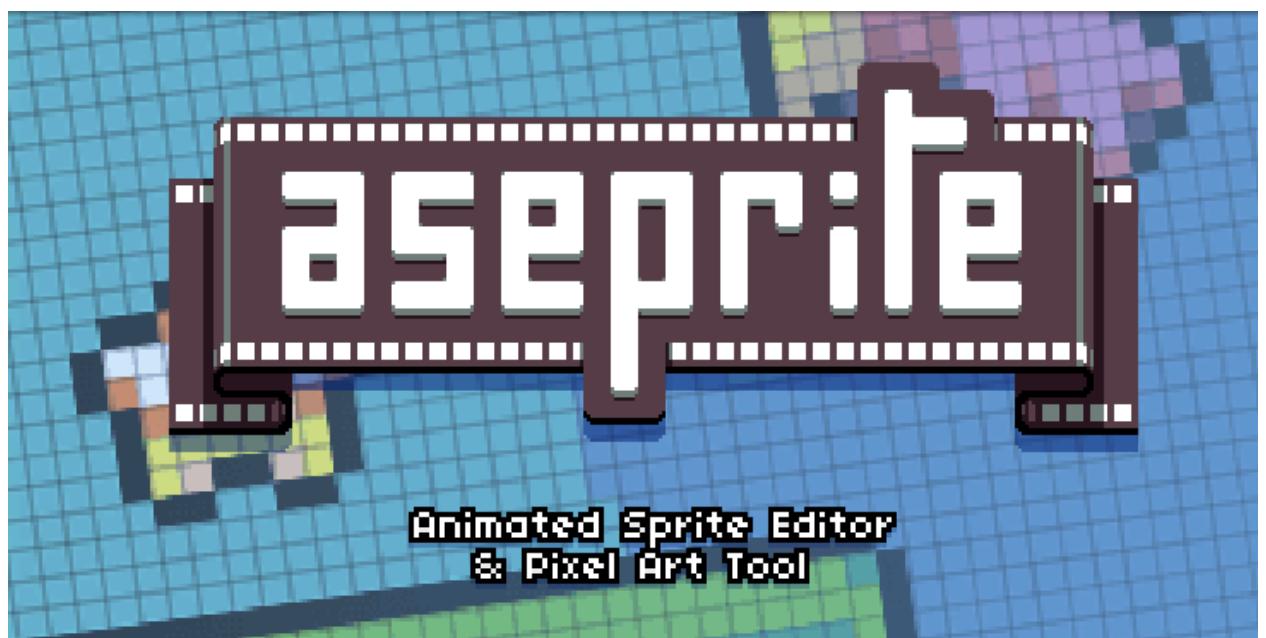
##### **Game developers:**

build the software that makes video games, including the different visuals, sounds, and artificial intelligence (AI) needed for non-character players. As a video game developer, it's your job to take the vision and ideas of video game designers and make them real using programming skills.

##### **Windows application development**

As a programming language originally developed by Microsoft, C# can be used to build all kinds of different Windows applications. For example, this means you can develop applications designed specifically for Windows platforms, such as Microsoft Office.

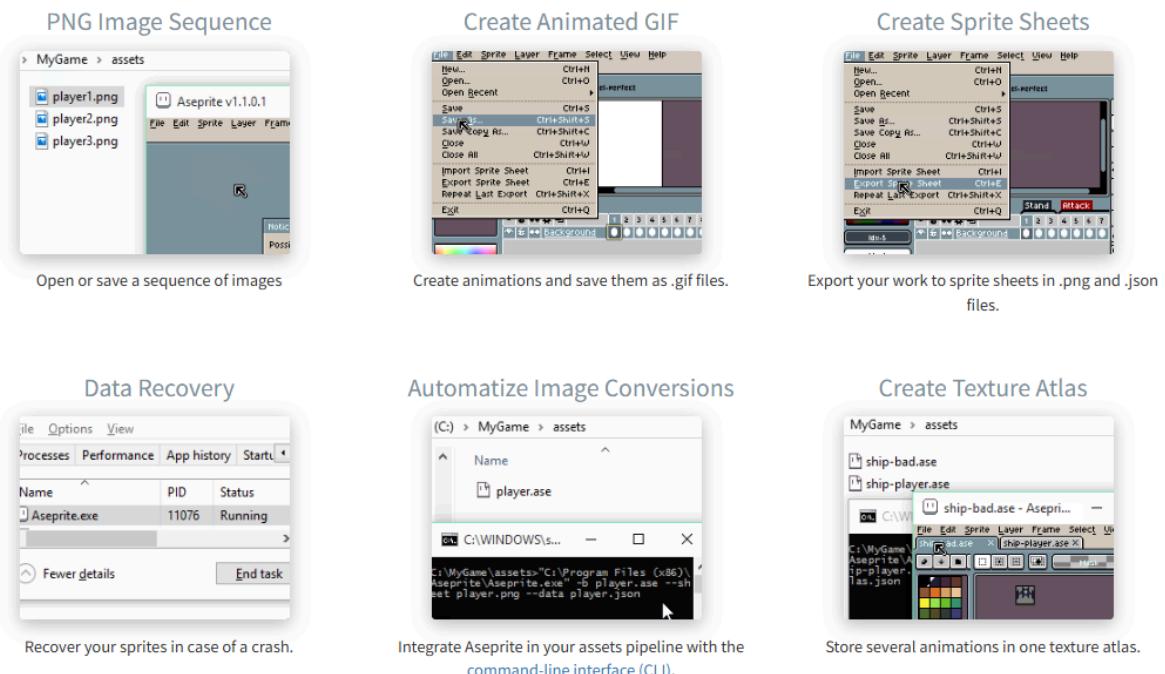
#### *2.2.3 Aseprite*



*Figure 7: Aseprite - Animated sprite editor*

Aseprite is a pixel art tool and animation software that allows users to create retro-style sprites, animations, and even entire scenes. It's incredibly versatile and user-friendly, with features like a timeline for managing frames, layers for organizing elements, and a palette system to keep colors consistent.

It runs on Windows, macOS, and Linux, and features different tools for image and animation editing such as layers, frames, tilemap support, command-line interface, Lua scripting, among others. It is developed by Igara Studio S.A. and led by the developers David, Gaspar, and Martín Capello. Aseprite can be downloaded as freeware, (albeit it does not have the ability to save sprites) or purchased on Steam or Itch.io. Aseprite source code and binaries are distributed under EULA, educational, and Steam proprietary licenses.



### Organize Layers



Create, copy, move, drag & drop layers.

### Animate



Create, copy, move, link, drag & drop frames or cels.

### Tag Frames



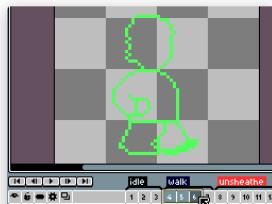
Include several animations in the same file tagging sections.

### Playback Modes



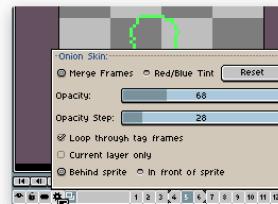
Loop a section in forward, reverse, ping-pong modes. Change preview speed.

### Onion Skin



See other frames as reference to animate.

### Red/Blue Mode



Choose different onion skin modes.

### Palette Control



Copy & paste. Drag & drop. Resize palette.

### Control Alpha Channel



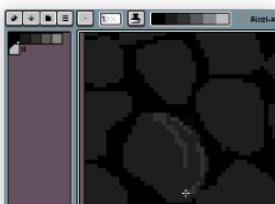
Palette entries with alpha value.

### Color Wheel



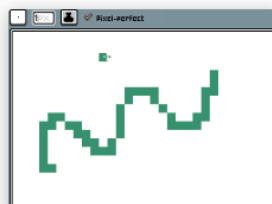
Select color harmonies.

### Shading Mode



Create light and shadows with the shading ink.

### Pixel Perfect Stroke



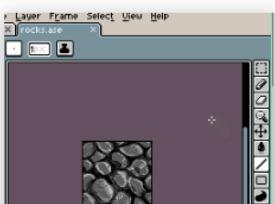
Create perfect strokes for pixel-art.

### RotSprite Rotation



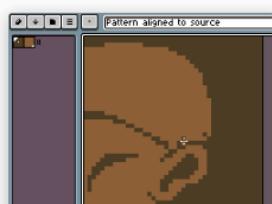
Avoid extreme pixel distortions when rotating tiny sprites.

### Tiled Mode



Create patterns repeating the image in a 3x3 grid.

### Custom Brushes



Create custom brushes for dithering.

### Blend Modes



Composite layers to create color effects.

Figure 8: The ability that Aseprite can provide to the designer.

Aseprite is the powerful tool to create 2D assets and animation, with a lot of advanced tools to make pixel sprites. In our project, this is the main tool to create some colorful effects like collider, icon, adjust the assets, button, background and more.

#### 2.2.4. League of Legend model - Khada Website



Figure 9: League of Legends

League of Legends is a team-based strategy game where two teams of five powerful champions face off to destroy the other's base. Choose from over 140 champions to make epic plays, secure kills, and take down towers as you battle your way to victory.

For the variety of champions, they have a lot of models for some specialized themes and characteristics we can use for our project. As long as the project does not make any profits, this action does not break the Riot Games' "Legal Jibber Jabber" policy, so that we can use it for some academic use and learn to use it in Unity.

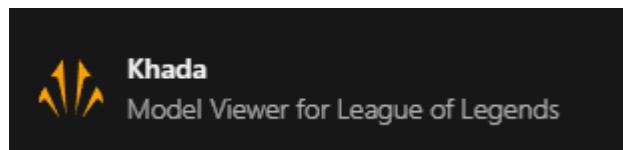


Figure 10: Khada - Model Viewer for League of Legends

The Khada website is a fan-made 3D model viewer for League of Legends. Khada was developed under Riot Games' "Legal Jibber Jabber" policy.

- Unrestrictive

Download 3D models for 3D printing, or even export them with textures and animations, for free.

- Up to date

See the latest skins and champions before they officially launch in-game, as we update them in sync with the PBE.

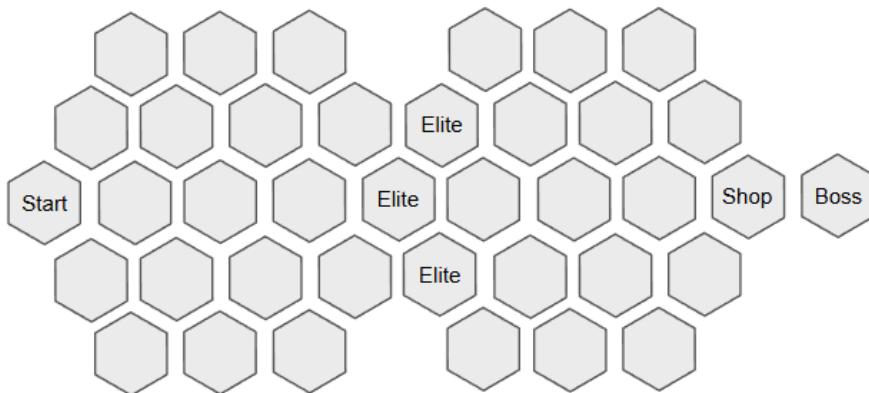
- Adaptive

Capture high quality images for use in thumbnails, cosplay and drawing references, or even creative stickers!

## 2.3 Game mechanic and design patterns

### 2.3.1. Adventure mechanic

- After choosing the level to start, players recruit a team with at least 2 members to start the adventure. The members can inherit the stat they already have in their level.
- The game starts with the Gift from the Beginning, players can choose the first start bonus that fits their play style.
- The map will generated randomly



*Figure 11: The map concept. Except 6 tiles are unchanged from game to game, the remaining tiles will randomly generate whenever the player starts a new adventure.*

Player movement: Players can choose a tile that is next to the current tile and trigger that tile effect. In the game calculated the map will be placed on the coordinate with x and y axis.

The start position is (0, 0), each tile that on the main line connects the Start and Boss tile is the x axis, which is increased by 10 each tile. So the Elite in x-axis is (40,0), Shop is (80, 0) and Boss is (90,0).

The other two next tiles to the start position have the x increase by 5, and y increase or decrease by 5. That means two adjacent tiles of start position are (5, 5) and (5, -5).

That coordinate rule applies to all tiles in the map.

The map will have a total of 38 tiles including 6 const tiles and 32 normal tiles.

### Normal Tile:

Initial quantity: When generating a map, there is a required number of initial tiles to make sure that at least an acceptable number of tiles is generated. This can prevent the random go too far if the beneficial tile does not appear or fill the entire map.

The rest of the tile will have a weight value that decides the chance of its appearance.

For instance: If the weight value of combat tile is as 6 times as reward tile, that means the combat tile has 6 times more chance to appear compared to reward tile.

Tile name	Image	Weight value	Initial quantity	Effects
Event		20	3	Random event trigger.  Players may get a reward from this tile.
Combat		30	3	Start a defense!  Protect the tower through 3 waves of enemies to pass.  Players will get a reward if they defend successfully.
Shop		10	2	Players spend in-game currency to buy some item that can provide strength and utility.
Incognito		10	2	Each movement costs a player some system points.  Incognito can help them restore system points. Players also have an ability to exchange different kinds of reward if they do not need it.
Forge		10	2	Some items can be upgraded to the perfected version - That is curio.

				Forge can enhance the curio to increase the completion rate. At 100%, curio becomes a perfected curio and gives the players perfected bonus!
Abnormal Event		10	1	<p>Random events trigger that change the player map.</p> <p>Players can spend currency to make some advantages change more likely to appear.</p>
Reward		5	1	<p>Random events trigger.</p> <p>Unlike events, these tiles guarantee players some good stuff.</p>
Gaming Event		5	1	Encounter a little fun game. If lucky enough, players can get a completed curio for free!

Table 1. Tiles

### Const tile

In a map, some tiles will be preset coordinates and numbers of each type.

Tile name	Image	Initial quantity	Effects
Start		1	Every adventure starts with a start position.
Shop(before entering boss)		1	Players spend in-game currency to buy some item that can provide strength and utility.
Elite		3	<p>Start a defense!</p> <p>Protect the tower through 3 waves of enemies to pass.</p>

			Players will get a reward if they defend successfully.  This version of combat features an elite enemy that is harder to defeat.
Boss		1	Start a defense!  This is the last fight to gain a victory if the player successfully defends the tower.  This version of combat has 4 waves of enemies with outstanding difficulty.

*Table 2. Const tile*

The reason why we need to preset some tile above except the beginning and boss:

- The elite encounter reminds the player to balance the strength and the wealth throughout the game. If players only find ways to optimize their currency, they may lose this defense.
- The shop appears before the Boss to give the player the last chance to spend all their currency. It is too bad if players gain a lot of currency during their adventure but have nowhere to use it.

### *2.3.2. Adventure resources*

#### 2.3.2.1. Electric chip



*Figure 12: Electric Chip image*

The main currency for adventure. Electric chip (Echip) can obtain by

- Gift of the Beginning.

- After a successful defense.
- Some random events, rewards
- Incognito
- Gaming event (if all curio is obtained)

Electric chip can be used for:

- Make a purchase in Shop.
- Enhance curio in Forge.
- Motivate or spend on some events or rewards.

### 2.3.2.2. System point

The game puts the player into a virtual adventure, so it can harm the in-game system device. Each movement cost a player 10 system points, from the original value of 100. If a player returns to an adventure with a system point that is below or equal 0, 2 “errors” appear and the player must choose 1 from 2 to continue the exploration. A second error will appear if the system point continues to decrease to -50 or lower, as the min capacity is -100, and max is 100.

There are 5 difference errors with variety of negative effect that leave player a strategic choices:

Error ID	Effect
error1	Critical rate reduced by 5%. Critical damage reduced by 50%.
error2	Mana regeneration reduced by 40%. Entire team lose 50 health per second
error3	Damage dealt from entire team reduced by 40%
error4	Reduce 20 armor and 8% resistance
error5	Reduce 30% attack speed

*Table 3. System Error*

(Max number of errors player can have on the same time is 2)

System point can obtain by:

- The Gift of Beginning (give you an item to restore 40 system point)
- Some events or rewards.
- Incognito (if the player do not exchange over bonus)

System point can be decreased by:

- Movement on map.
- Exchange more than the bonus on Incognito tile.
- Some events.

If the players manage to restore more than the system break point (-50 or 0), players can choose an existing error to remove.

#### 2.3.2.3. Tower current health

On some events, players can exchange some of the tower health to motivate some events or get another kind of currency.

The tower health is not naturally increased after a defense, and can be stored throughout an adventure, so that will make players do a risky exchange that can result in the failure.

#### *2.3.3. Adventure items*

##### 2.3.3.1. Curio

There are two ways to increase character strength and utility. First of them is curio.

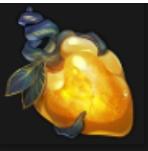
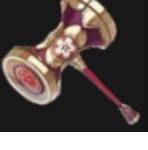
Curio is a type of item that give player a specified bonus. There are 10 curios with variety type of bonuses.

Each curio has a completion progress with the range of 60% - 100%. The bonus from curio increases based on the completion. If the curio reaches 100% completion rate, it becomes Perfected Curio with the additional Perfected Effect.

The main reason for this design is to make the players alway make a strategy choice to each curio selection: If the player considers the bonus from this curio better than another bonus, the completion will make the choice harder. If that curio is around the Perfected state, that will make players make a decision again. This type of problem does not always have the right answer, just based on the player's thought and comparison.

There are 10 curios that can appear in this game.

(C: completeness, range from 60 to 100 based on the completion)

<b>Curio name</b>	<b>Image</b>	<b>Weighted</b>	<b>Effect</b>	<b>Completeness</b>	<b>Completeness reward</b>
Abnormal fruit		4	Every members in the team heal $[10 + 0.2 * C]$ per second.	60-100	Gain 12% damage resistance
Society members pass.		4	In the shop area, the store will discount $[0.25 * C]$ .	60-100	When moving to a new tile, gain 12% of the current EChip.
Mutated dictionary		2	For each Curio you have, increase Damage by $0.01 * C$ . Increases by 5 times if it reaches a Perfected state.	60-100	When forging Curio, Completeness will increase by at least 5%
Hammer of the old		4	Increases team attack speed by $[0.2 * C] \%$	60-100	Mana regeneration increase by 30%
Handheld lottery machine No. 777		2	Reduce $[100 - 1 * C]$ damage deal of the team members.	60-100	Damage from the team gains 30% resistance penetration.
Corally snail shells		4	- Increase $[3000 + 20 * C]$ tower max health - The tower heal $[3000 + 20 * C]$ health when entering combat	60-100	All team members gain 1000 health.

Solid material		4	Increase [0.2 * C] armor to all the team members	60-100	All members gain 8% damage resistance.
The Fire		4	Increase [0.3 * C] damage deal from team members.	60-100	<p>Gain 10% resistance penetration.</p> <p>If both "The Fire" and "The Bait" reach the Perfect state, there is a small chance to see "The Legendary Fish".</p>
The Bait		2	Increase [0.3 * C] critical rate	60-100	<p>Increase 15% critical rate.</p> <p>If both "The Fire" and "The Bait" reach the Perfect state, there is a small chance to see "The Legendary Fish".</p>
The Legendary Fish		0	This fish is always Perfect	Only appear in 100 completion	Increase 77% critical rate, 77% critical damage and 77% resistance penetration

Table 4. Curio

The last curio - The Legendary Fish weighted value is only adjusted to 1 if the player could find The Fire and The Bait. This Legendary Fish cannot appear in shops and games.

There are many ways to obtain curio:

- Gift of the Beginning.
- After a successful defense.
- Some events and rewards

- Incognito
- Game
- Purchase in shop.

There are also some way to increase curio completion:

- Forge
- Some events

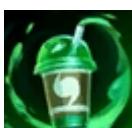
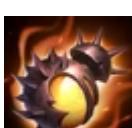
If all the curios are obtained, the player will get a small different currency amount if they have a chance to choose another curio.

### 2.3.3.2. Potion

Potion is the second way to increase player strength. Unlike curio, potions can stack as many times as the player can afford.

There are 11 potions, each potion has a bonus power to one stat, divided by 2 types: normal potions and limited potions.

Limited potions have 5 times less chance to appear compared to normal potions. The limited potion provides bonus to the strong stat which are damage boost, damage resistance and damage resistance penetration.

Potion name	Potion image	Weighted value	Effect
Potion of Rageness		5	Increase 15 attack damage
Potion of Toughness		5	Increase 5 armor
Potion of Protector		1	Increase 6% damage resistance
Potion of Regeneration		5	Heal 6 per second

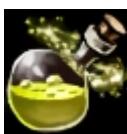
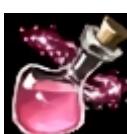
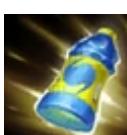
Potion of Aggression		5	Increase 6% critical damage
Potion of Chance		5	Increase 3% critical rate
Potion of Vitality		5	Gain 150 health
Potion of Effervescent		1	Increase 12% damage deal
Potion of Abundant		5	Increase 6% mana regeneration
Potion of Acceleration		5	Increase 3% attack speed
Potion of Penetration		1	Increase 6% resistance penetration

Table 5. Potion

The are some way to obtain potions:

- Shop
- Incognito
- Some rewards.

Potion provides the bonus power to the player. At the end of Adventure, purchasing a potion can give a better benefit than curio, because players can not increase the curio completion.

The limited potion price is 2 more times than normal potion price.

#### 2.3.3.3. Consumable item

The consumable item that can be used on the Adventure. It can stack and be used whenever the player wants.

Consumable item name	Item image	Effect
Contingency Upgrade		Restore 40 system point (Cannot exceed 100)

Table 6. Consumable Item

There is only one way to get the Consumable item above: through the Gift of The Beginning.

#### 2.3.4. Character power statistic (stat).

We have 13 the power stats that we use to calculated:

Stat name	Stat image	Effect
Health		The damage this object can take before entering down state
Health regeneration		The health gains every second.
Armor		Reduce the amount of damage taken by the formula. The more armor object has, the less damage taken from the original amount.
Attack damage		Calculated the initial damage based on the multiplier in object attack.
Critical damage		The damage multiplier when dealing a critical hit
Critical rate		Chance to deal critical hit
Damage boost		Increase overall damage output
Attack speed		The speed of attack animation and cooldown between each attack.
Movement speed		How fast character move on the ground

Mana regeneration		When restore mana, gain an addition multiplier amount
Mana		The mana required to trigger Ultimate ability
Damage resistance		Reduce overall damage taken
Resistance penetration		Bypass the resistance of the enemy.

*Table 7. Stats in game*

#### 2.3.4.1. Base stat:

Base stat is the power statistic of a character without any adjustment by the adventure. This is the first power that players have in the character itself, and can be raised by level up through the character detail.

The max level of character is 36, so the base stat can store the stat from level 1 to level 36. There are only 3 stats that increase if the character level up: Attack, Health and Health Regen.

#### 2.3.4.2. In-game stat:

In-game stat is the power statistic of the character that is calculated by all the positive or negative effects. In-game stat is also the final stat that the game will extract data from it to calculate the damage that character dealt, the attack speed, health, ...

In-game stat is the sum of the below:

- Base stat: The stat before entering the Adventure.
- Curio stat: The stat bonus from Curio.
- Potion stat: The stat bonus from Potion.
- Error stat: The stat that is affected by system error.
- Converted stat: The stat above max range is automatically transferred to the other stat. For instance, foreach 1% critical rate above 100% will be converted into 2% critical damage. If the player has 110% critical rate, that means converted critical rate is -10% and converted critical damage is 20%.

Stat	Max capacity	Convert to other stat
------	--------------	-----------------------

Critical rate	100%	For each 1% critical rate exceeds 100%, convert to 2% critical damage.
Damage Resistance	50%	For each 1% exceed 50%, convert to 2 armor.
Attack speed	5.0	Cannot convert to other stat

Table 8. Max capacity of stat table and convert method.

## 2.4 Conceptual framework

### 2.4.1 Scene Manager

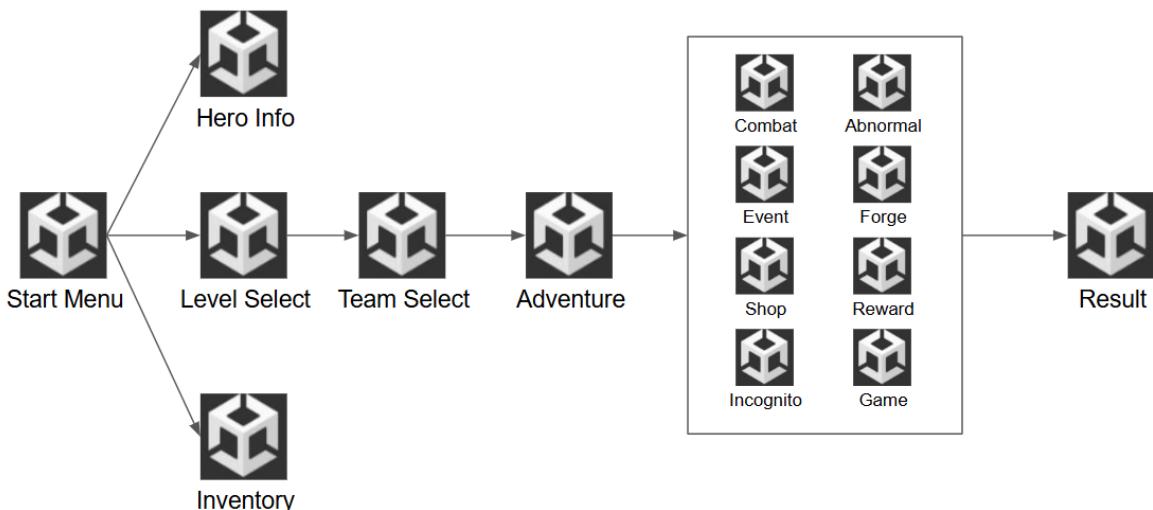


Figure 13: Scene Flowchart

When the game opens, this starts with the Start Menu scene, in which they can view details of characters or manage their inventory. If the player wants to start an Adventure, they choose the level and recruit a team to explore.

The Adventure starts and generates a random map. Based on the target tile of each player movement, an appropriate scene will be loaded. If they do not encounter a combat tile or succeed a defense, the game will send the player back to Adventure scene until the player failed to protect the tower or defeat a boss, which will redirect player to the Result Scene.

There is also an option to leave an adventure without ending the game or just ending the game to start a new Adventure.

After the Adventure end and Result screen appear, the player can move back to the Start menu.

## 2.4.2 Data storing method and adjust data through the game.

### 2.4.2.1. Data storing method

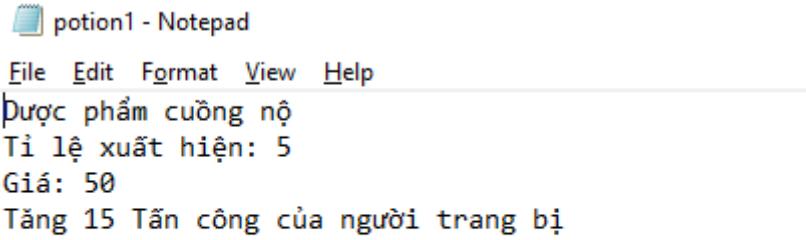
In this project, .txt files are used to store data because they're simple and lightweight. The idea is that they're easy to set up, access them easily, and are able to manage small to moderate amounts of data without having to rely on more complex databases or external systems.

curio_sprite	13/12/2024 4:30 CH	File folder
Hero Equipments	13/12/2024 4:44 CH	File folder
hero_select	15/12/2024 2:58 CH	File folder
hero_sprite	13/12/2024 4:30 CH	File folder
Hero_start	13/12/2024 8:27 CH	File folder
Hero_stat	15/12/2024 2:11 CH	File folder
InventoryData	15/12/2024 2:11 CH	File folder
ingame_data	13/12/2024 4:30 CH	File folder
Item_info	13/12/2024 4:30 CH	File folder
item_sprite	13/12/2024 4:30 CH	File folder
Library	04/12/2024 12:41 CH	File folder
Library_ChronoCard	13/12/2024 4:44 CH	File folder
Library_data	13/12/2024 4:30 CH	File folder
LibraryData	15/12/2024 2:12 CH	File folder
receive	13/12/2024 4:30 CH	File folder

Figure 14: The Data folder in the Assets to manage the text storing a data

potion1	10/12/2024 10:03 SA	Text Document	1 KB
potion2	10/12/2024 10:03 SA	Text Document	1 KB
potion3	10/12/2024 10:03 SA	Text Document	1 KB
potion4	10/12/2024 10:04 SA	Text Document	1 KB
potion5	10/12/2024 10:04 SA	Text Document	1 KB
potion6	10/12/2024 10:04 SA	Text Document	1 KB
potion7	10/12/2024 10:04 SA	Text Document	1 KB
potion8	10/12/2024 10:04 SA	Text Document	1 KB
potion9	10/12/2024 10:04 SA	Text Document	1 KB
potion10	10/12/2024 10:04 SA	Text Document	1 KB
potion11	10/12/2024 10:04 SA	Text Document	1 KB

Figure 15: 11 potion information is 11 text file in the potion folder



```

File Edit Format View Help
Được phẩm cuồng nộ
Tỉ lệ xuất hiện: 5
Giá: 50
Tăng 15 Tấn công của người trang bị

```

*Figure 16: Each potion text file includes name, weight value, price and effect.*

For the project, a text file is the easiest method to store game data, team developers can access it and check for accuracy quickly. They are also easy to make some small adjustments without refreshing the whole database.

#### 2.4.2.2. Adjust data

##### **2.4.2.1.1 Write data from text file**

Data is written into file using System.IO namespace. The purpose of writing data is to save progress and get stats, information across different scenes.

```

public void SaveCurrentHp()
{
    string path =
"Assets/Data/Hero_stat/Ingame_stat/tower/TowerCurrentHealth.txt";
    try
    {
        int roundedHp = (int)Math.Round(currentHpBuff);
        string hpString =
roundedHp.ToString(CultureInfo.InvariantCulture).Replace('.', ',');
        File.WriteAllText(path, hpString);
    }
    catch (Exception ex)
    {
        Debug.LogError("Error saving current HP: " + ex.Message);
    }
}

```

##### **2.4.2.1.2 Read data from text file**

After write data into text file, other scenes are able to get data from that file and use it

```

private float GetCurrentHp()
{
    string path =
"Assets/Data/Hero_stat/Ingame_stat/tower/TowerCurrentHealth.txt";
    if (File.Exists(path))
    {

```

```

        string fileContent = File.ReadAllText(path);
        fileContent = fileContent.Replace(',', '.');
        float.TryParse(fileContent,
            NumberStyles.Float, CultureInfo.InvariantCulture, out currentHpBuff));
    }
    else
    {
        Debug.LogError("Path not found");
    }
    return currentHpBuff;
}

```

## 2.5 Definition and terminology

### 2.5.1 Views in Unity

- **Scene view:** Scene view is where user visualize and interact with the world you create in the Editor. In the Scene view, user can select, manipulate, and modify GameObjects that act as scenery.

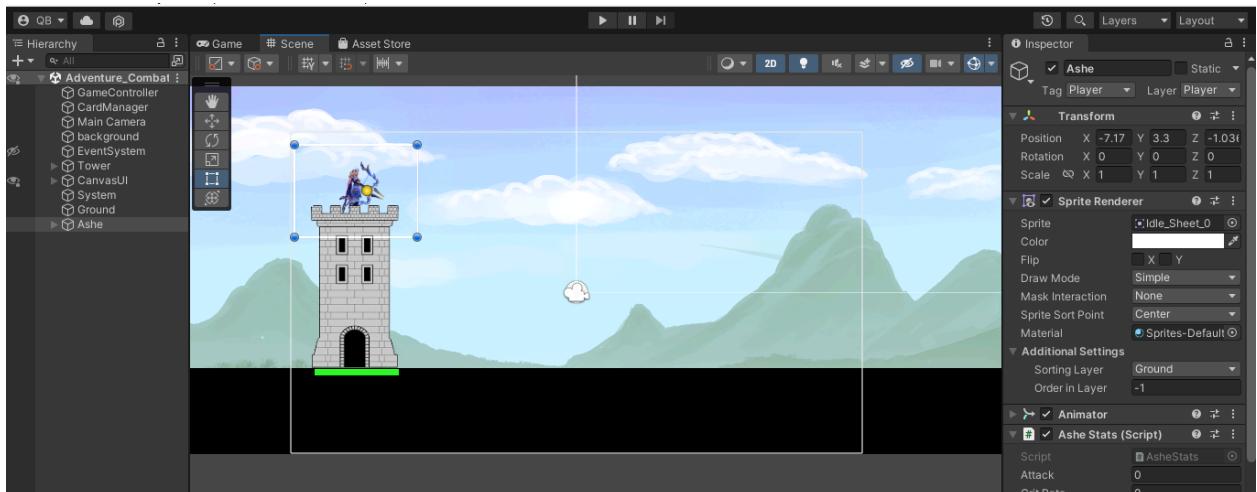


Figure 17: Scene View

- **Game view:** The Game view is rendered from the Camera in the application. The Game view displays how the final, built application looks. Game window will be called when the Play button is pressed. The window allows options for screen settings, which reflect the range of the Scene that the player can see with each corresponding screen ratio. After pressing the Play button, the game application will be in Testing mode, at this time any changes to the properties, Components, ... of the object will be temporary.

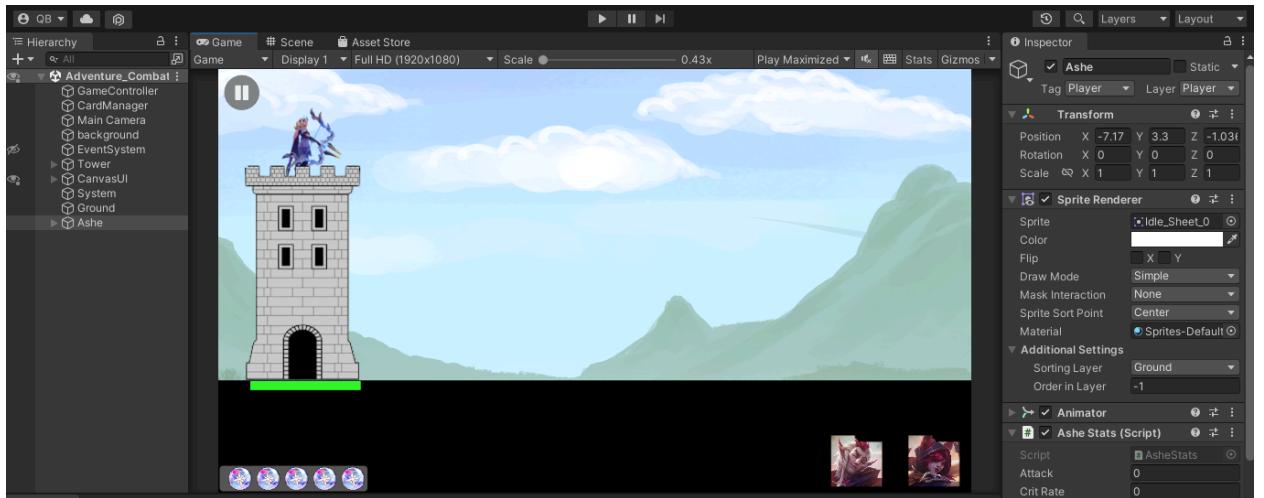


Figure 18: Game View

- Hierarchy view: Includes the GameObjects in the current Scene. It includes resources such as 3D models, prefabs, and custom objects that contribute to the creation of a complete game. Objects can be selected in the Hierarchy tab and dragged to another object to create a parent-child relationship for the object. When an object is added or removed in the scene, it will appear or disappear in the Hierarchy tab.

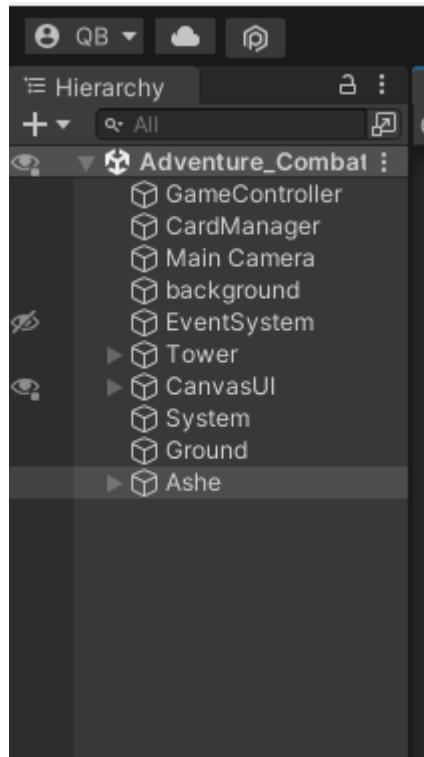


Figure 19: Hierarchy View

- Inspector view: The Inspector will display all information about the object you are working on in detail, including attached Components and their properties. This also is used to change the values of object properties.

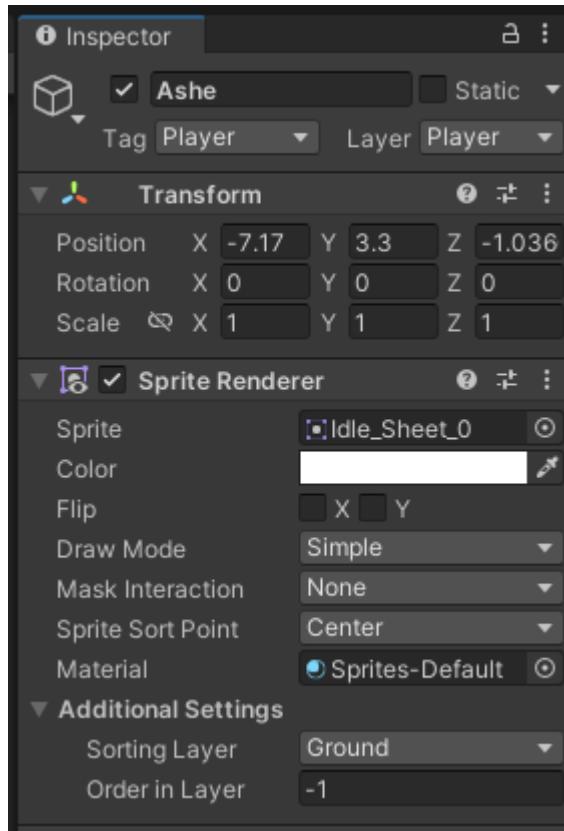


Figure 20: Inspector View

- Project view: Project is a place to access and manage the assets

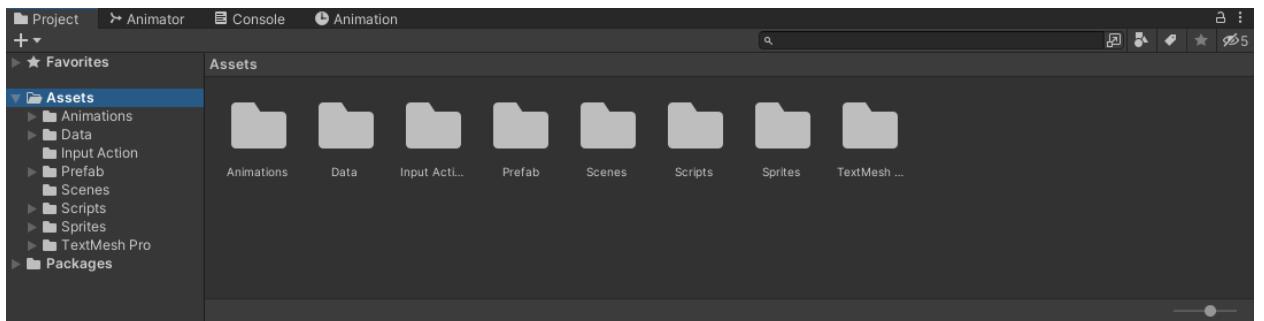


Figure 21: Project View

### 2.5.2 Unity Game concepts

- GameObject: Unity's GameObject class represents anything that can exist in a Scene. GameObjects are the building blocks for scenes in Unity and act as a container for functional components which determine how the GameObject looks and what it does.
- Components: Components are the functional pieces of every GameObject. Components contain properties which you can edit to define the behavior of a GameObject.
- Sprite: Sprites are 2D graphics objects used for characters, props, bullets, and other components of a 2D game. The graphics are derived from bitmap images – Texture2D . The Sprite class essentially defines the image components that should be used for a

particular image. This information can then be used by a SpriteRenderer component on the GameObject to execute the graphics.

- Prefab: Prefabs are a special type of component that allows fully configured GameObjects to be saved in the Project for reuse. These assets can then be shared between scenes, or even other projects without having to be configured again
- Script: Scripts are behavior components that can be applied to GameObjects and modified in the Unity Inspector. A script is made up of C# code that is executed during the "play" state. Scripts can also be used to create tools in Unity to modify the development process.

# Chapter 3: Experimental Results

## 3.1 Introduction to Experiments:

Project Alpha: Guardian is a tower defense game, the objective is protecting the tower from waves of enemies

Players have to manage and use resources wisely in order to make characters stronger and easily push back the enemy wave of attack.

## 3.2 Methodology:

We separate the data folder into 3 small groups: First is the sprite to load the image to the game, second is the Library to get the unchanged information like game rule, random weight value or item description, and the third one to store the in-game data that is different for each Adventure run.

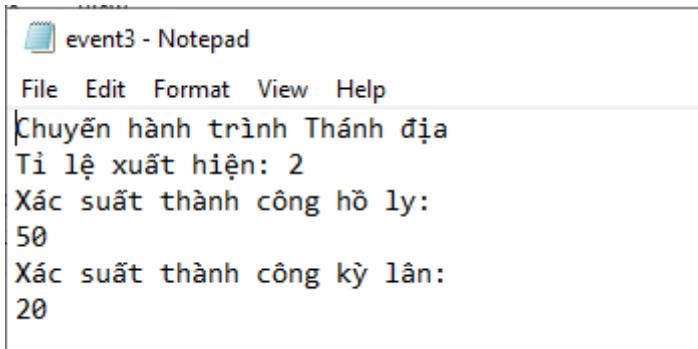
curio_sprite	13/12/2024 4:30 CH	File folder
Hero Equipments	13/12/2024 4:44 CH	File folder
hero_select	15/12/2024 2:58 CH	File folder
hero_sprite	13/12/2024 4:30 CH	File folder
Hero_start	13/12/2024 8:27 CH	File folder
Hero_stat	15/12/2024 2:11 CH	File folder
InventoryData	15/12/2024 2:11 CH	File folder
ingame_data	13/12/2024 4:30 CH	File folder
Item_info	13/12/2024 4:30 CH	File folder
item_sprite	13/12/2024 4:30 CH	File folder
Library	04/12/2024 12:41 CH	File folder
Library_ChronoCard	13/12/2024 4:44 CH	File folder
Library_data	13/12/2024 4:30 CH	File folder
LibraryData	15/12/2024 2:12 CH	File folder
receive	13/12/2024 4:30 CH	File folder

Figure 22: Data folder

Const_Tile	13/12/2024 4:30 CH	File folder
Curio_lib	13/12/2024 4:30 CH	File folder
Description	13/12/2024 4:30 CH	File folder
Error_lib	13/12/2024 4:30 CH	File folder
Event_lib	13/12/2024 4:30 CH	File folder
Potion_lib	13/12/2024 4:30 CH	File folder
Potion_sprite	13/12/2024 4:30 CH	File folder
Tile_Info	13/12/2024 4:30 CH	File folder
Tile_lib	13/12/2024 4:30 CH	File folder

Figure 23: Library\_data to storing unchanged data

event1	13/12/2024 6:07 CH	Text Document	1 KB
event1.txt.meta	04/12/2024 11:05 CH	META File	1 KB
event2	13/12/2024 10:42 CH	Text Document	1 KB
event2.txt.meta	04/12/2024 11:05 CH	META File	1 KB
event3	14/12/2024 1:49 CH	Text Document	1 KB
event3.txt.meta	04/12/2024 11:05 CH	META File	1 KB



The screenshot shows a Notepad window titled "event3 - Notepad". The menu bar includes File, Edit, Format, View, and Help. The content of the document is as follows:

```

Chuyển hành trình Thánh địa
Tỉ lệ xuất hiện: 2
Xác suất thành công hồi ly:
50
Xác suất thành công kỳ lân:
20

```

Figure 24: The initial data that decides the title, the game chance. Except the rule update based on player choice, this is almost not changed for much.

base_start_lv1	14/12/2024 12:27 SA	File folder
base_stat	13/12/2024 4:30 CH	File folder
converted_stat	13/12/2024 4:30 CH	File folder
curio_stat	13/12/2024 4:30 CH	File folder
error_stat	13/12/2024 4:30 CH	File folder
hero_lv	15/12/2024 2:11 CH	File folder
ingame_stat	13/12/2024 4:30 CH	File folder
potion_stat	13/12/2024 4:30 CH	File folder

Figure 25: The in-game data that decides the stat of character and update based on the player Adventure. This is usually adjusted and removed after finishing an Adventure.

### 3.3. Experimental Procedure:

#### 3.3.1 Menu Start scene

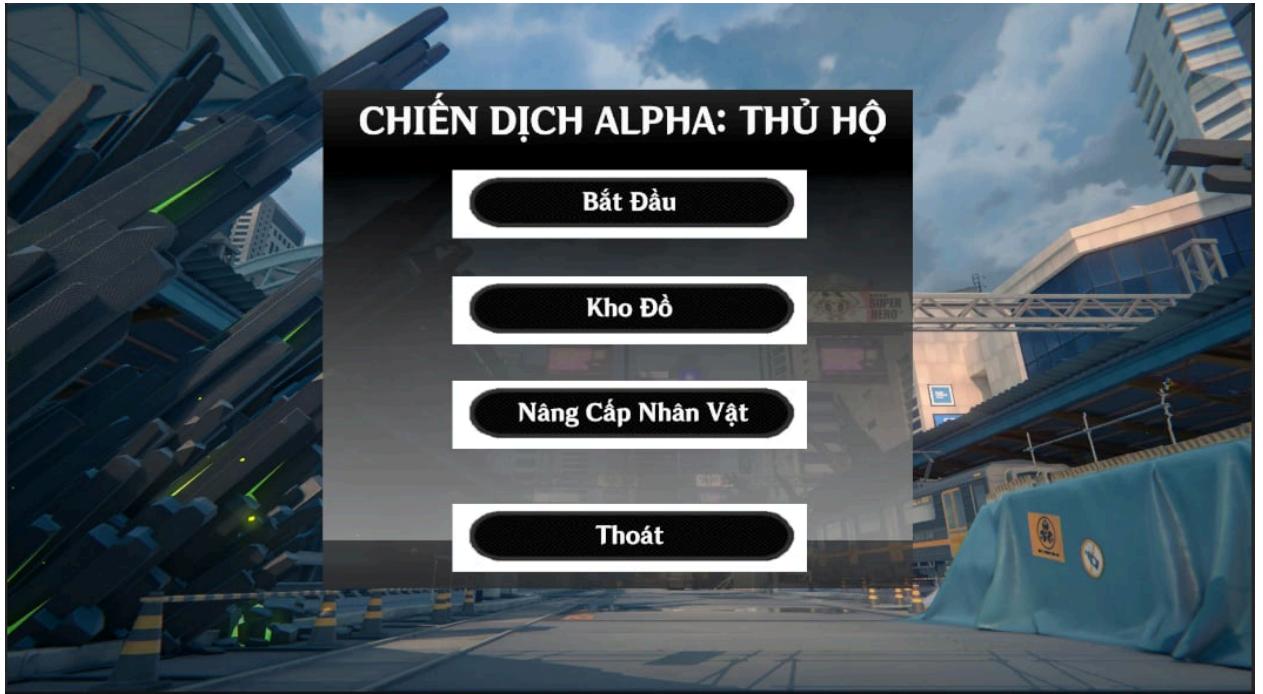


Figure 26: Menu Scene

Here we have the start button to enter the game and inventory, character information, and the exit button.

### 3.3.2. Inventory scene

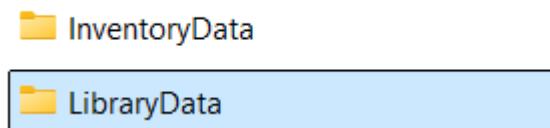


Figure 27: Data file

We divide 2 folders LibraryData will be used to store item information and InventoryData will be used to store quantity

Below is the file structure that stores the quantity and information of the item.

```
File Edit View

Huy chương vinh dự
Chứng nhận của một chỉ huy xuất sắc.
<i>“Lời nói của một chỉ huy xuất sắc đáng giá hơn tất cả những công trạng mà họ nhận được.”</i>
5
```

Figure 28: File information

The file name will be saved as a numeric code, for example: item00000.txt

line 1 is the name of the item  
line 2 + 3 is the description of the item

line 4 is the rank (rarity) of the item



Figure 29: File Quantity - This file will contain a number of items owned.

The interface in the picture is the game's item management screen, providing complete information and functions for players to easily track and manipulate their items. The interface components include item lists, detailed information, filters, and interactive functions such as combining items or accessing the store. This interface helps players manage resources efficiently and quickly.

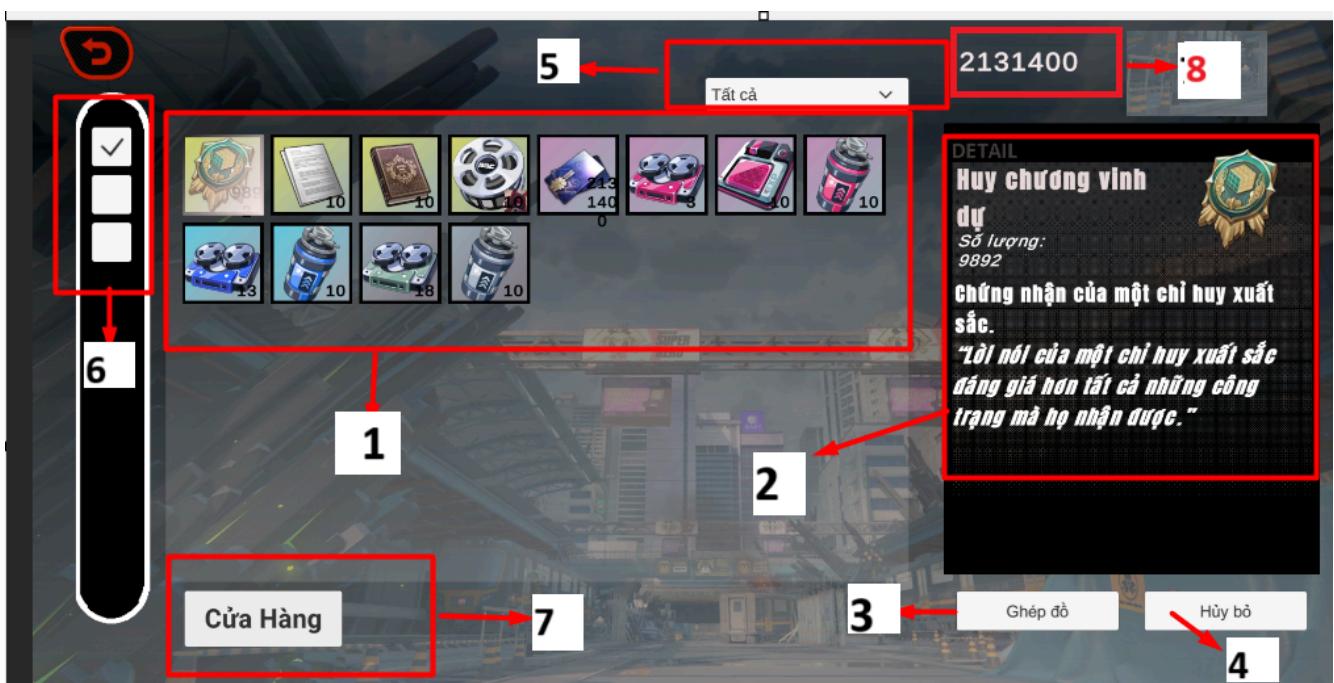
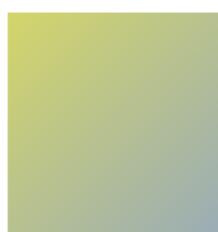


Figure 30: Inventory Scene overview

Number 1: The screen displays the items that the player owns. In this section, the items will be automatically arranged by rarity from 5 to 1 star.



5 star



4 star



3 star



2 star

Figure 31: Item rarity

```
InventoryController.instance.LoadView(InventoryController.instance.inventoryFilterLists.OrderByDescending(f=> f.rank).ToList());
```

Figure 32: This is the code that sorts the items in the list according to the rank of each item

Number 2 : Display the detailed description and quantity of the item player own.

```
        public void ShowDetail()
    {
        ItemSelectedImage.sprite = GetComponent<Toggle>()..isOn ? SelectedSprite : UnselectedSprite;
        InventoryController.instance.idItemSelected = id;
        DetailPanelController.instance.ShowDetails(_itemSprite, _itemName, _itemDes, _quan);
    }
```

Figure 33

This function will check if the button is selected or not, when selected it will load the information.

When the player clicks on the item, information such as the image, quantity and description will be displayed here.

Number 3: This screen is used to merge items.



Figure 34: Merge Item

This screen will display the name, image and quantity of the item. On the left is the item used to combine into the item on the right.

```

Ghi chép Anh hùng - Loại nhỏ
Khi sử dụng có thể tăng 10 điểm Kinh nghiệm cho Anh hùng.
<i>“Một người chỉ huy tốt phải nắm được lối chiến đấu chủ đạo của Anh hùng, và những yếu tố liên
2
item10001
10

```

Figure 35: Text file information

For the items that can be combined, we add a 5th line to store the id of the item that will be combined and the 6th line is the quantity used to combine (in this example, 10 items Hero Recorded - Small size will combine to make 1 item10001).

Merge Function: Call the item that can be merged as item 1 and item2 as the item to be merged. This function will check if the selected item is eligible to be merged (there are lines 5 and 6 and enough quantity to merge) then subtract the quantity of item 1 increase the quantity of item 2 finally update the new quantity to the file and reload the ui

#### Number 4: Destroy

This function will get rid of the item slot and set their quantity to 0 and delete on the UI interface.

#### Number 5+6: Sort item

Number 5 is the filter by item rank. Number 6 is the filter by item attributes (in this game we divide items into 2 types: materials and resources)

#### Number 7: Shop Items

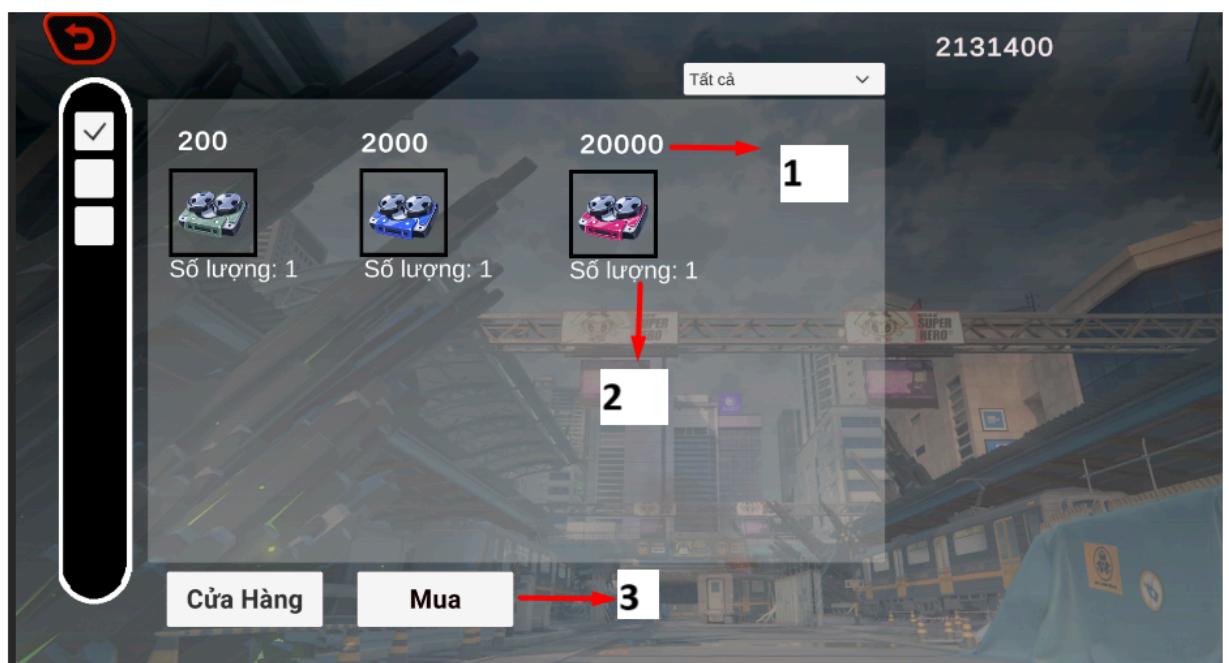


Figure 36: Shop Scene

#### Number 1: Price of item

Number 2: number of items the player will purchase

Number 3: Purchase button

### 3.3.3. Hero Detail scene

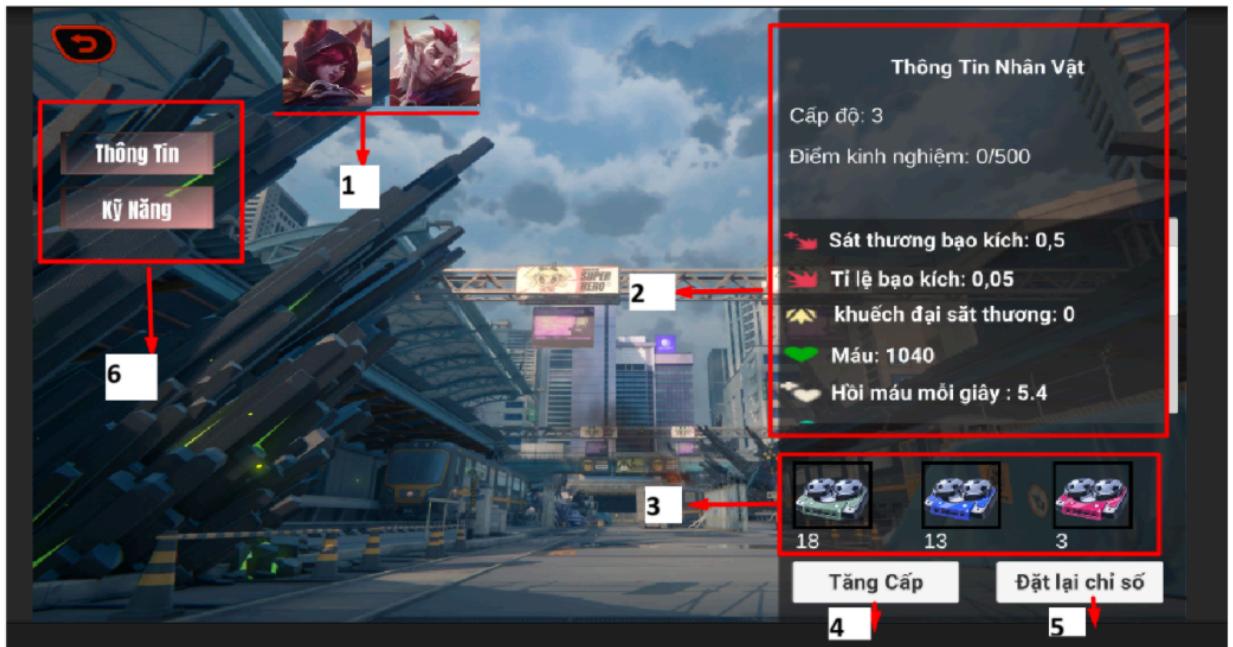


Figure 37: The character base stat and information

Number 1: Hero in the team, select to show their information.

Number 2: The base stat of the hero increases when the character levels up.

Number 3: Upgrade character by using item.

Number 4: Use the button to confirm the upgrade.

Number 5: An option to set character level to 1. This will help the player to start the game again without the help of level stat.

Number 6: Select to appear stat panel or ability panel.

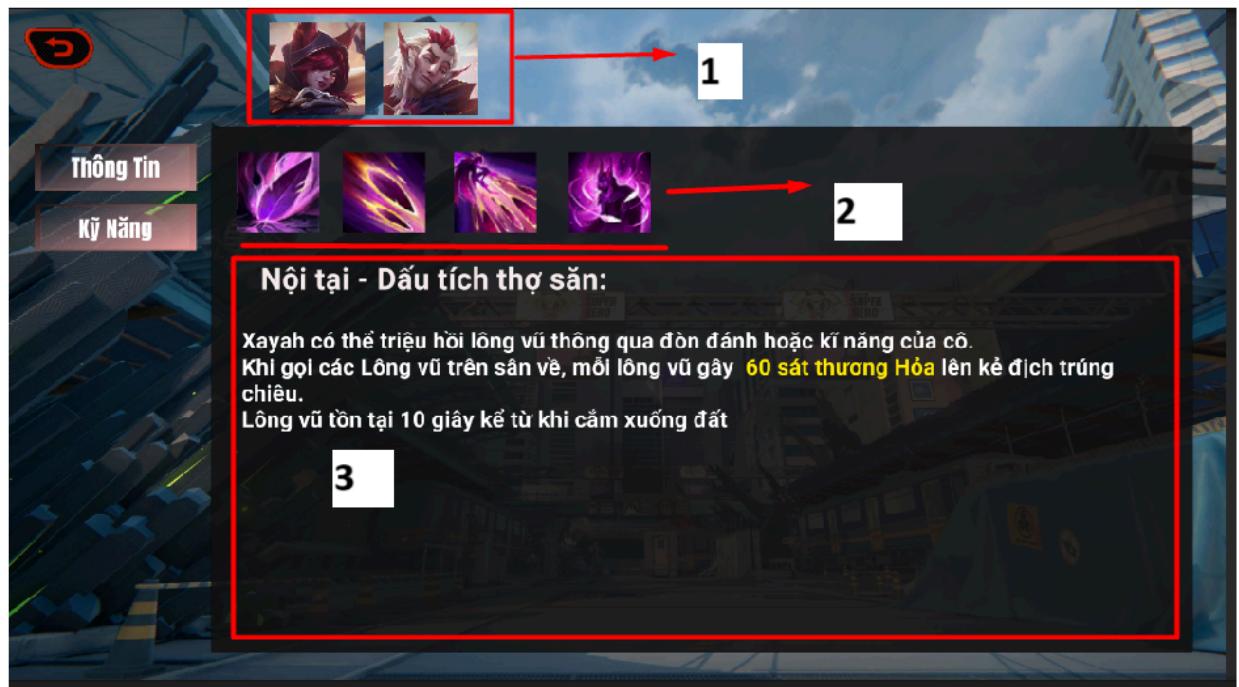


Figure 38: The character ability information

Number 1: Hero in the team, select to show their information.

Number 2: The ability button with ability image.

Number 3: Ability detail.

### 3.3.4. Level Select scene

This is a scene that introduces an exploration gamemode that is called “Intergalactic video game”. This scene is used for select a level before entering the Adventure.



Figure 39: Level Select scene

After selecting a level and going to the next step, the system will check the in-game data folder. If there are data of the previous play, that mean the last game is not over and player will have an option to start the game at the position where they left.



Figure 40: Continue and Finish game options

### 3.3.5. Team Select scene

The Team Select scene displays reward for the level and a box where players select characters.



Figure 41: First level team select screen

When clicking on the select character box, a panel will appear on the left that shows a list of available characters. To select a character, click on the character avatar, then that avatar will be placed at the select character box.



Figure 42: Xayah selected

After the player confirms the team planner. They can start the Adventure.

### 3.3.6. Adventure

#### 3.3.6.1 Gift from the Beginning

If this is the Adventure initiating and map generation, The Gift from The Beginning will appear with 3 options:

- Obtain some EChip
- Open a Curio Selection canvas.
- Select Consumable items that can allow the player restore system point.

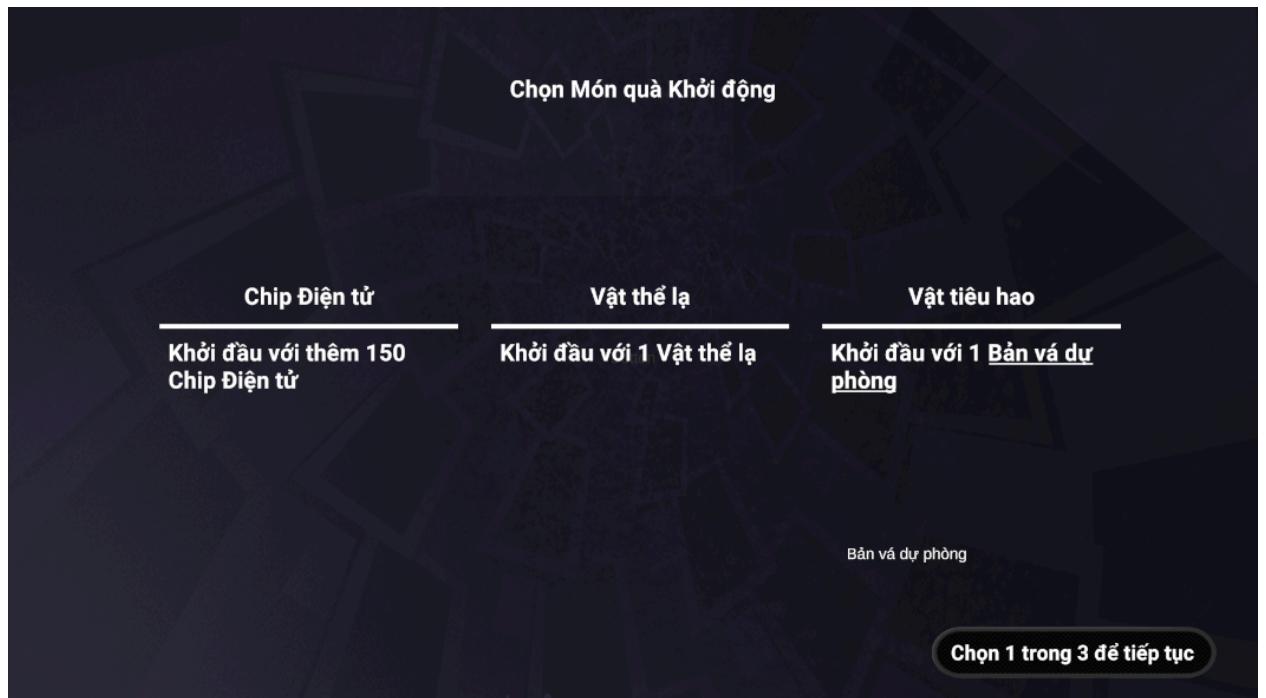


Figure 43: The Gift from The Beginning

After choosing one option, the system will send the reward respectively:

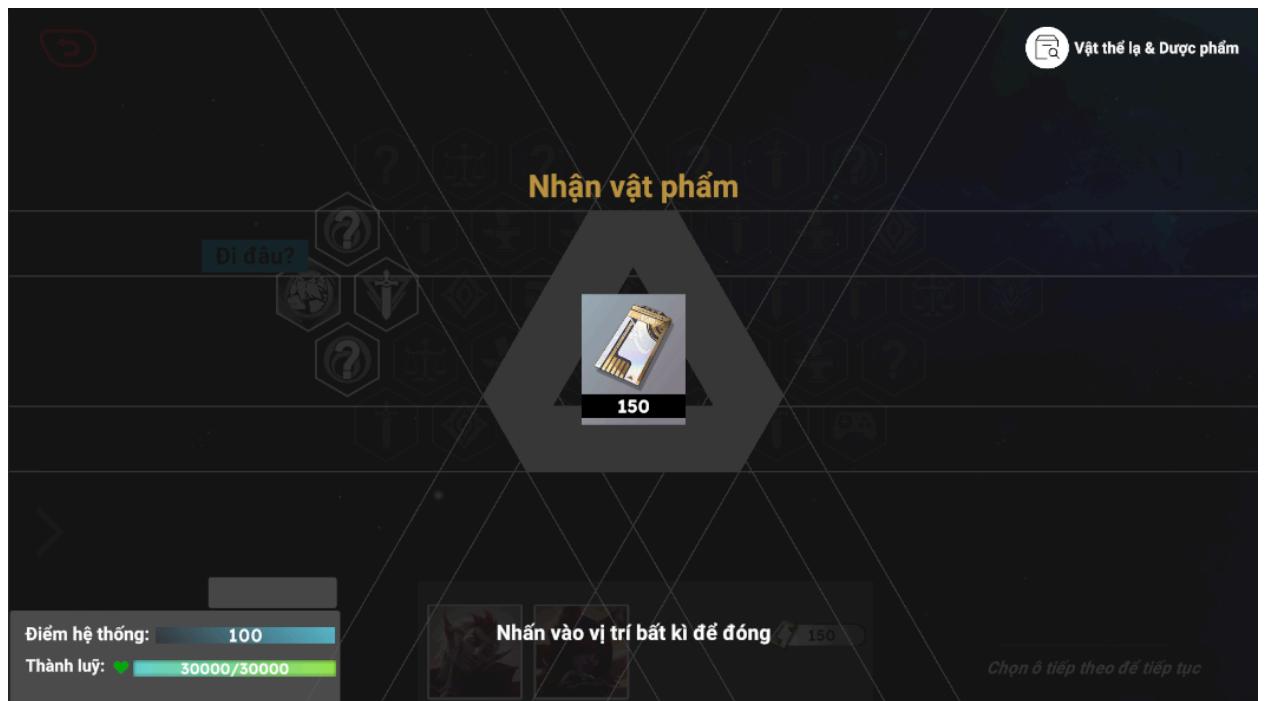


Figure 44: ElectricChip option



Figure 45: Curio selection canvas

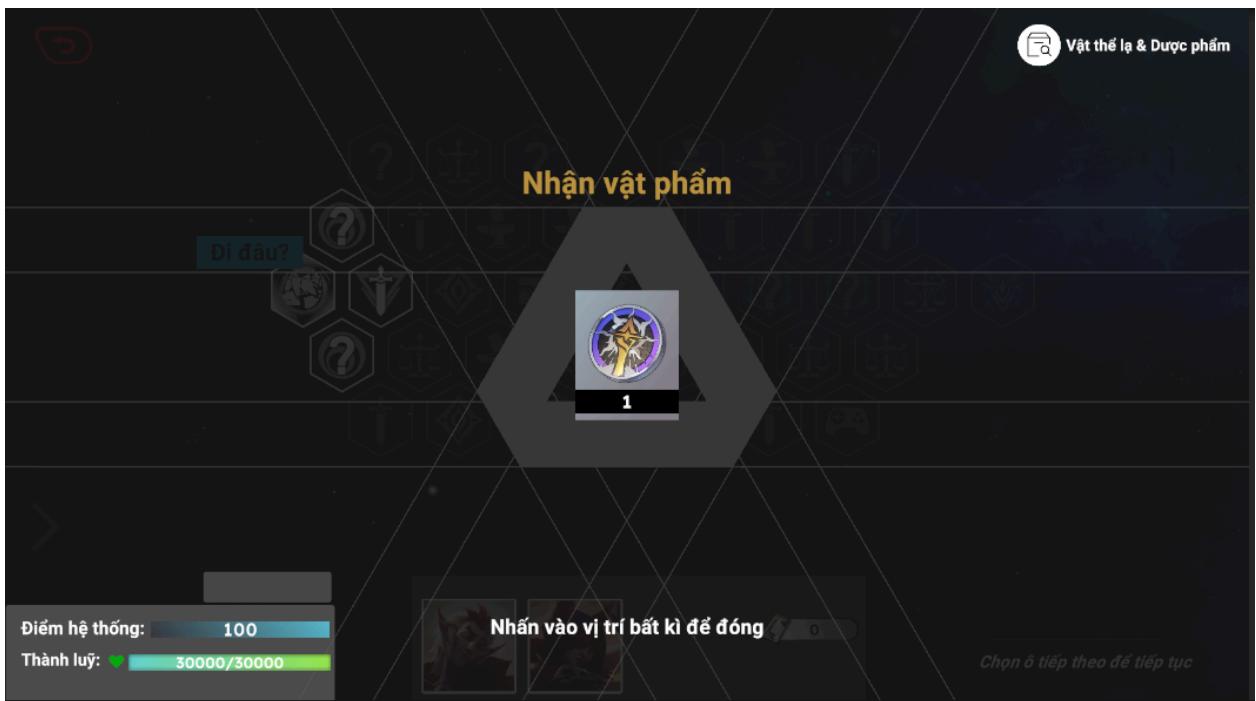


Figure 46: Contingency Upgrade that grant the player 40 system point

### 3.3.6.2 Map and Tile selection

After getting “Gift from the Beginning”, an Adventure scene is displayed which shows information about system points, tower’s health, character’s stats, and tiles. There are 38 tiles on the map which include 12 types. Players can select a tile that is adjacent to the current tile in order to move.

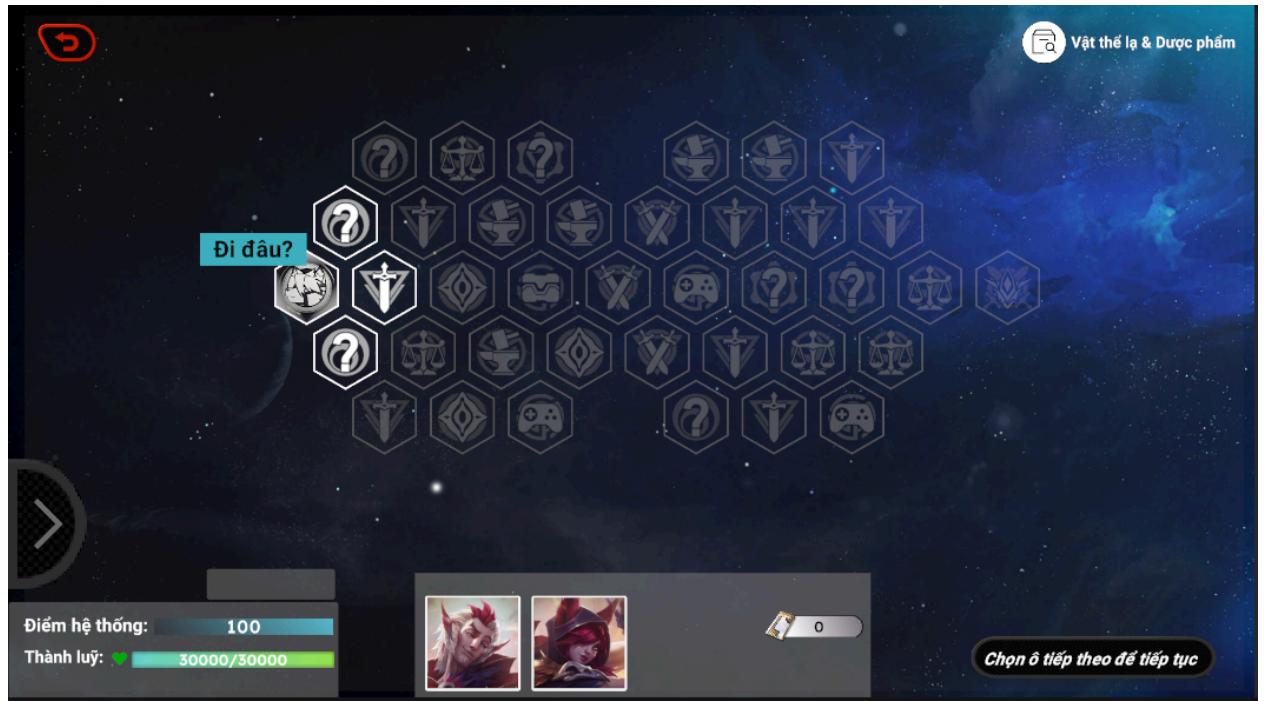


Figure 47: Adventure map

In this scene, the player can see the character detail, the curio and potion obtained, current system point, current health, Echip amount, Error, consumable item and all tiles in the map.

Based on the current position of the player, the adjacent tiles are highlighted, inform player that these tiles are available.

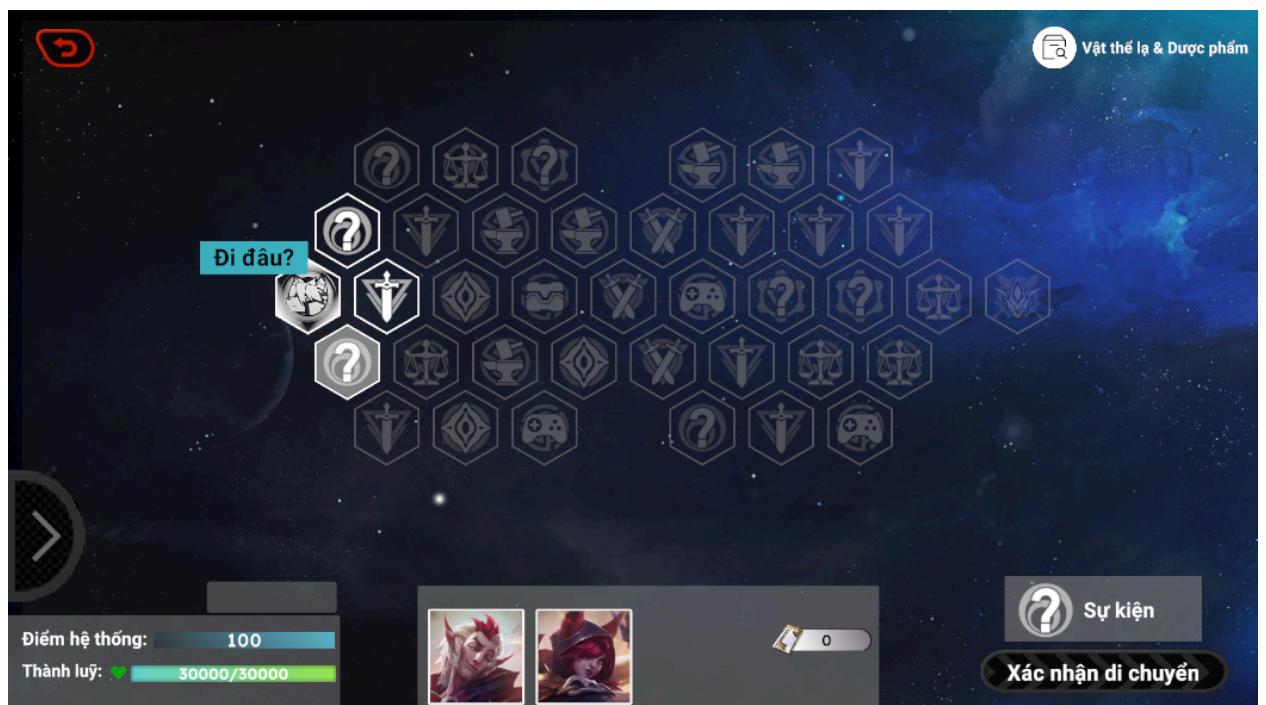


Figure 48: After select a tile, confirm player movement to set the current tile to the target position

After the player confirms the selection, based on the type of destination tile, they move to the appropriate scene.

### 3.3.7 Adventure: Event

There are 3 types of event, these will open when the player decides to move to the event tile on the Adventure map.

The events include:

- Desert Bank
- Paint the town blue
- A Journey to the Wonderland

For instance, the Desert bank is the event that player can invest their currency for the future.

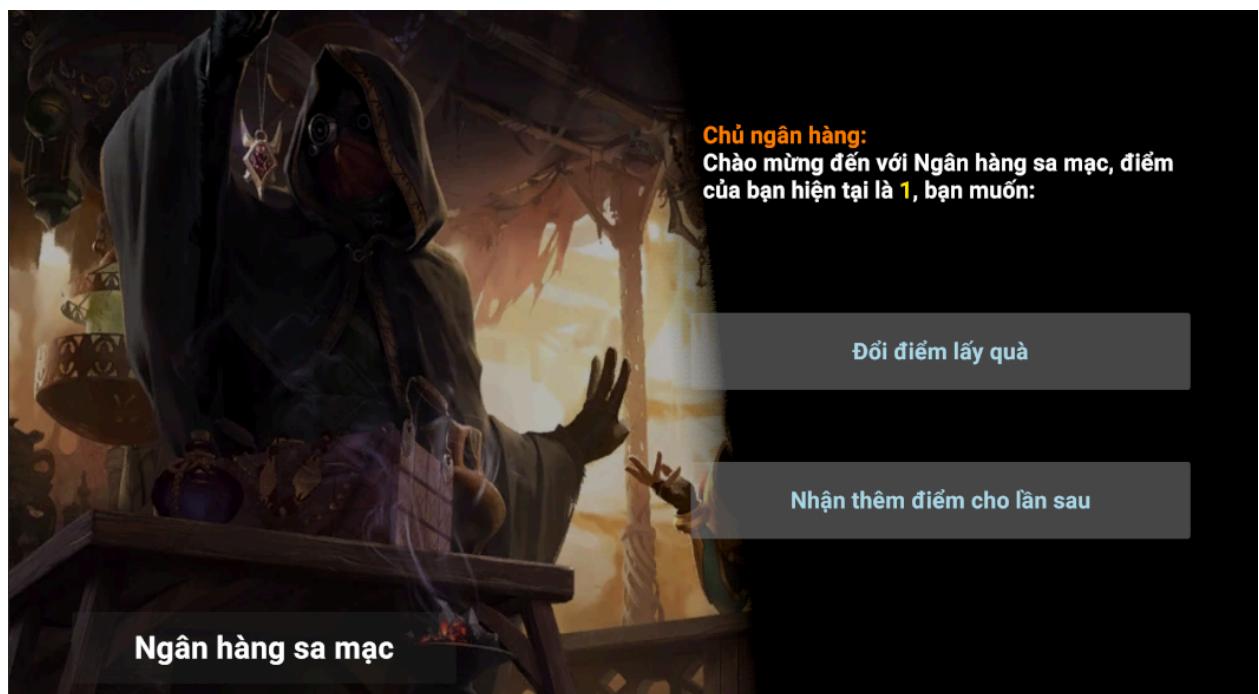


Figure 49: Desert Bank

The player has two options: Exchange points for rewards or exchange their current stuff to get points for the next Desert Bank.

There are some notes:

- The first option cannot be selected if player do not have point
- The point is not reset after the Adventure is over and can carry through every Adventure.
- The player can give nothing and leave.
- Players cannot do both things in one encounter.



Figure 50: Desert Bank - exchange point to rewards.

### 3.3.8 Adventure: Incognito

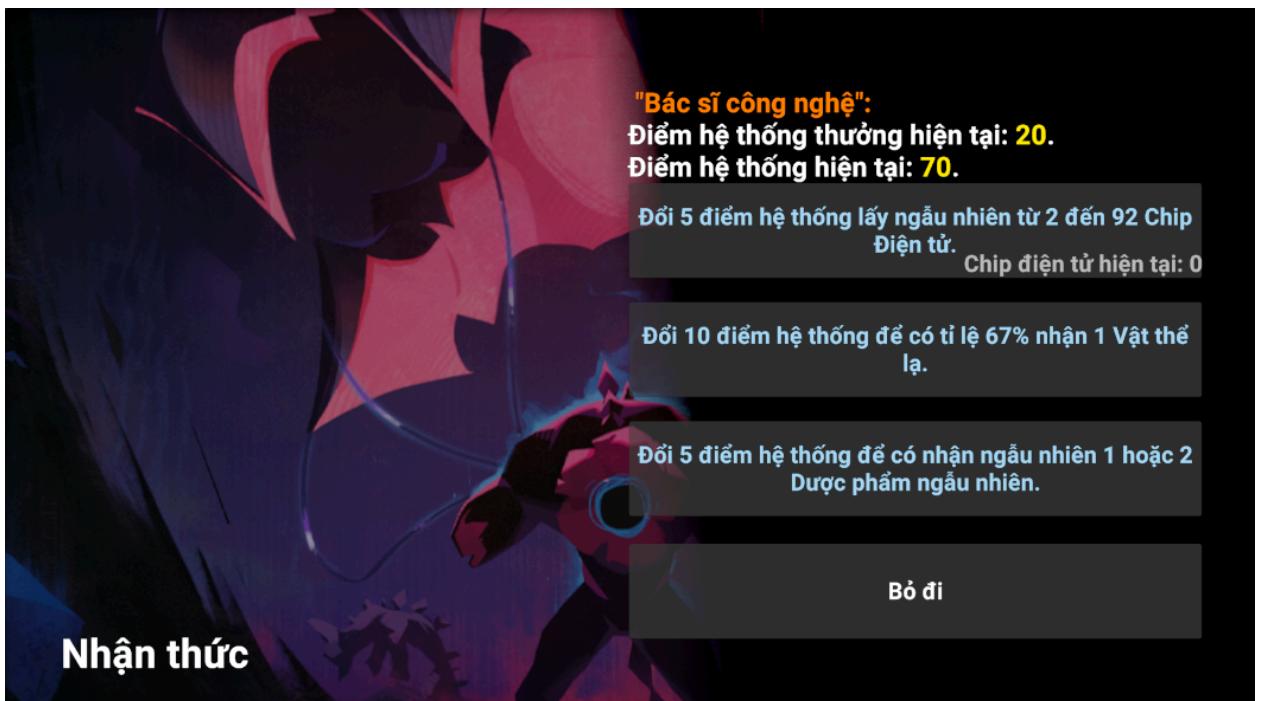


Figure 51: Incognito event

This can be known as the event but with the guaranteed reward first.

When the player enters an Incognito event, they can get 20 system points for free, but it is not all of the event. Player can reduce their system point they get to additional reward, including:

- An option for EChip.

- An option for a chance to get a curio.
- An option for random amount potion.

The cost and the reward of each option is randomized. It is not the same for each time they enter an Incognito. The player should choose it wisely in order to maximize their rewards. Or just simply that they can enter this tile to restore some system point when it is low.

### 3.3.9 Adventure: Shop

This is a place for players to use their Electric Chip to buy Curio and Potion, there are 6 shop slots with items to sell.

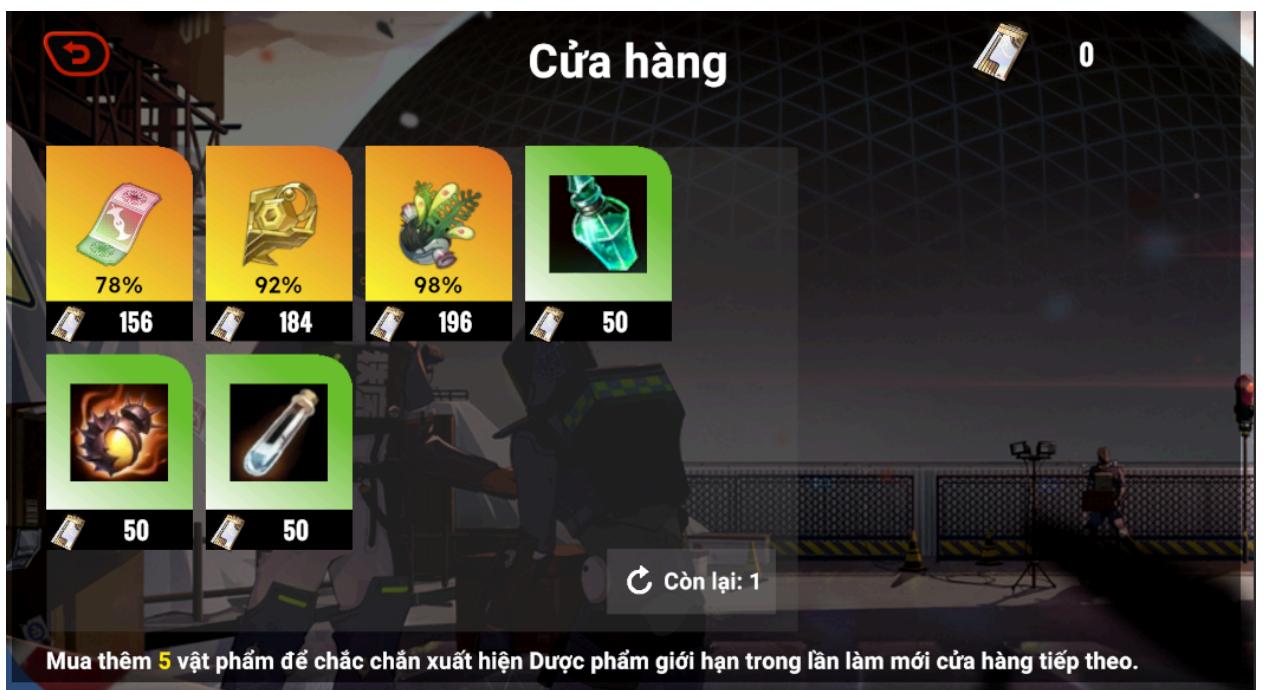


Figure 52: Shop

There are some specialities of this shop:

- The shop always tries to get 3 curios from the list that the player has not obtained yet, except The Legendary Fish.
- For the remaining slot, the shop fills by random potions. Each potion has a chance to appear, the limited potions having a smaller chance than the normal one.
- The cost for each curio is based on its completion ( $2 \times$  completion). If the selling curio is at the Perfected state, it will be sold for 300 EChip.
- The cost of potion is based on its rarity. Normal potion is sold for 50 EChip and Limited potion is sold for the double price, 100 EChip.

- The Limited Potion is guaranteed to appear in every shop if the player totally purchases 5 items sold by the shop throughout the Adventure. This count is subtract by 5 for every limited potion purchased, but cannot go below 0.
- Each shop the player has one chance to refresh the shop for free.

There is always a shop before the final Boss tile.

### 3.3.10. Adventure: Forge

Forge is a place to increase completion of Curios.



Figure 53: Forge

There are some specialities of this Forge:

- The forge only forge curio. If the player comes with no curio available for forge or does not have enough EChip, this place is useless.
- The price for forging is 25 for the first time, and increases by 15 for each Forging time.
- For each time player Forging a curio, its completion will be random again from the current completion to 100%. This is guaranteed to not reduce the completion of the curio. If the curio reaches 100% completion, it becomes a Perfected Curio.

Forge is the easiest way to obtain the Perfected Curio. This will be the player's strategic tile.

### 3.3.11. Adventure: Game

Game is a tile that gives player Curio, with its completion based on their performance of this game.

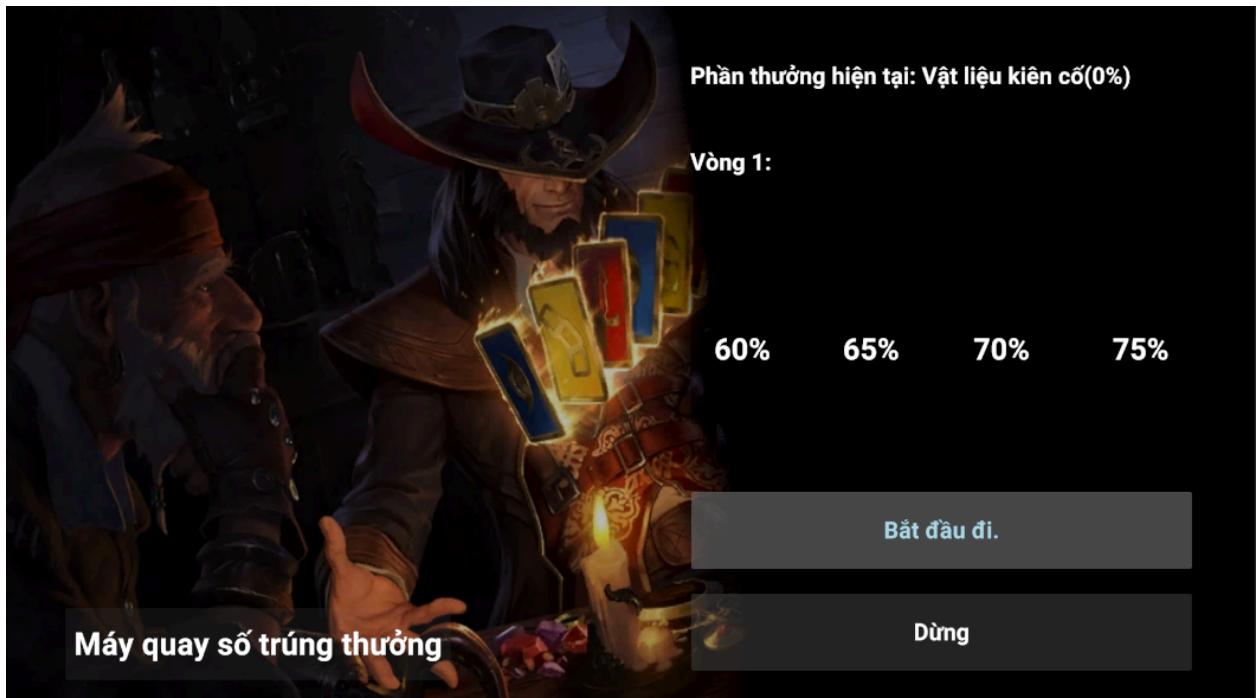


Figure 54: Players can see the possible outcome of 4 options.

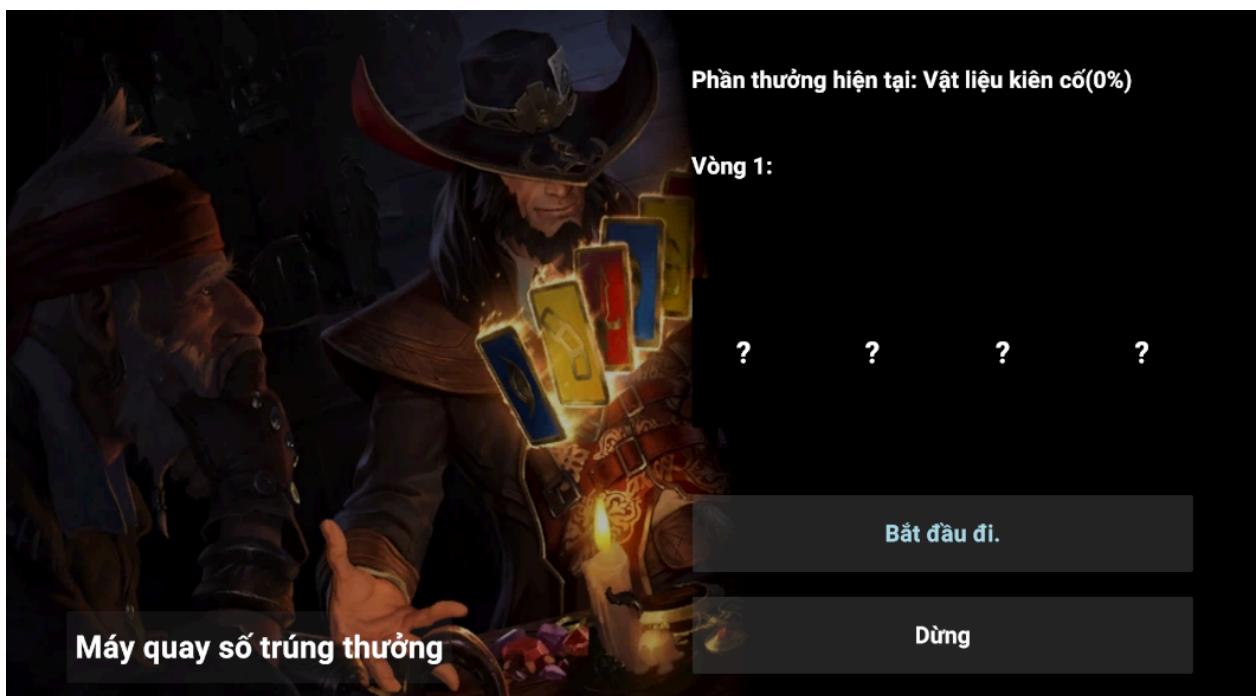


Figure 55: When the player starts the round, all the options are randomized, and the player will choose one of them.

There are some specialities of Game tile:

- The game always chooses the reward for the player first based on their current curio. The game cannot choose The Legendary Fish and if all the available curios are obtained by the player, the game reward will be converted to EChip.

- The game has 4 rounds in total. Except the first round, player can stop the game and get the Curio with its current completion
- The first round is completely risk-free, which sets the initial completion of the reward. If the player wants something guaranteed, they can play for the first round and end the game to get the reward curio.
- The second and the third round enhance the curio completion. There are 3 levels of enhancement and 1 risk option to reset its completion to 60%.
- The last round is the riskiest with 4 options: One of them is to fully enhance curio to 100%, one is to give a small enhancement of 10%, one is to set the curio completion to 60% and the last one is to completely delete a reward.
- After 4 rounds, the current state of curio is the reward for the player.

This is the place that can give players a free curio, but players need to consider when to stop and get their reward.

### *3.3.12. Adventure: Reward*

This random reward event comes with the guaranteed prize for the player. This is the best-tile to visit of the player strategy.

There are 3 random Reward events that can appear:

- Machine S-lottery
- The Legend Chest in a Bubble Deep Town
- Treasure covered by the time.

For instance, the Machine S-lottery is the reward event that gives players a huge amount of EChip.

The player has 3 chances to spin the machine for free. Based on the result of the machine, they can get that amount of EChip.

Each slot of the machine can be random in range from 1 to 3. That theoretically means the possible outcome of each spin is between 111 to 333.

In addition, if the player can Spin for the same number for 3 positions (111, 222 or 333), they will gain a Jackpot, which increases the EChip wins to 400.

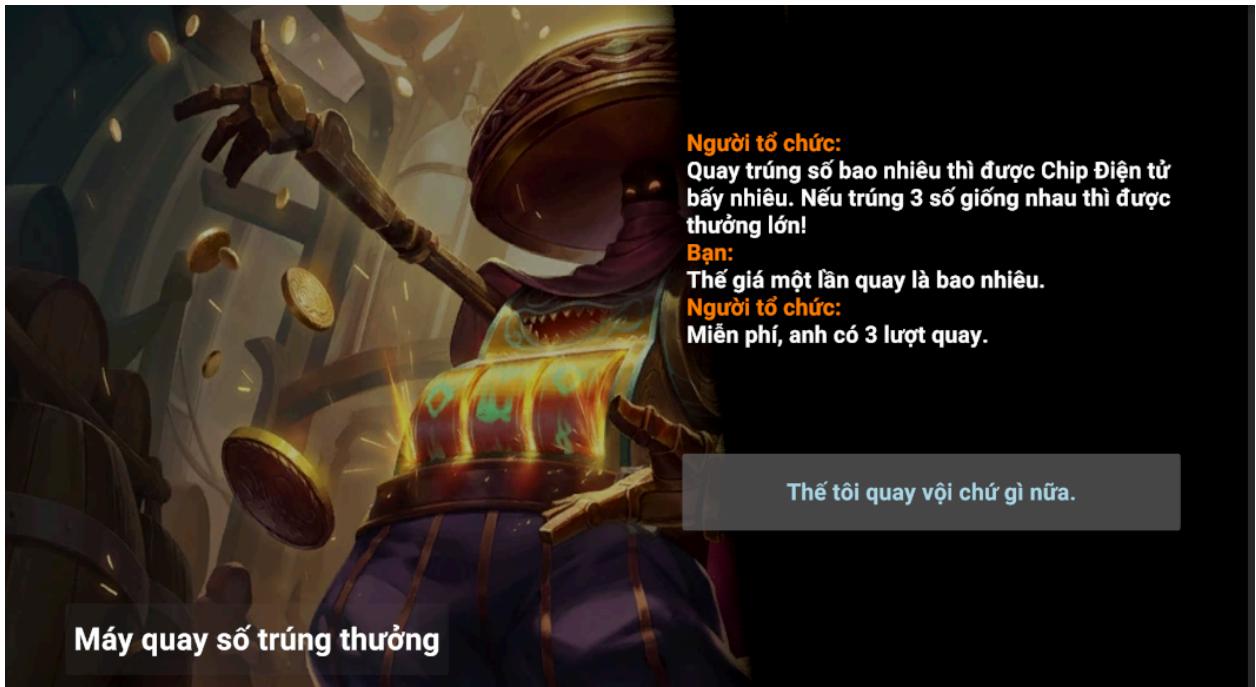


Figure 56: Event Introduction

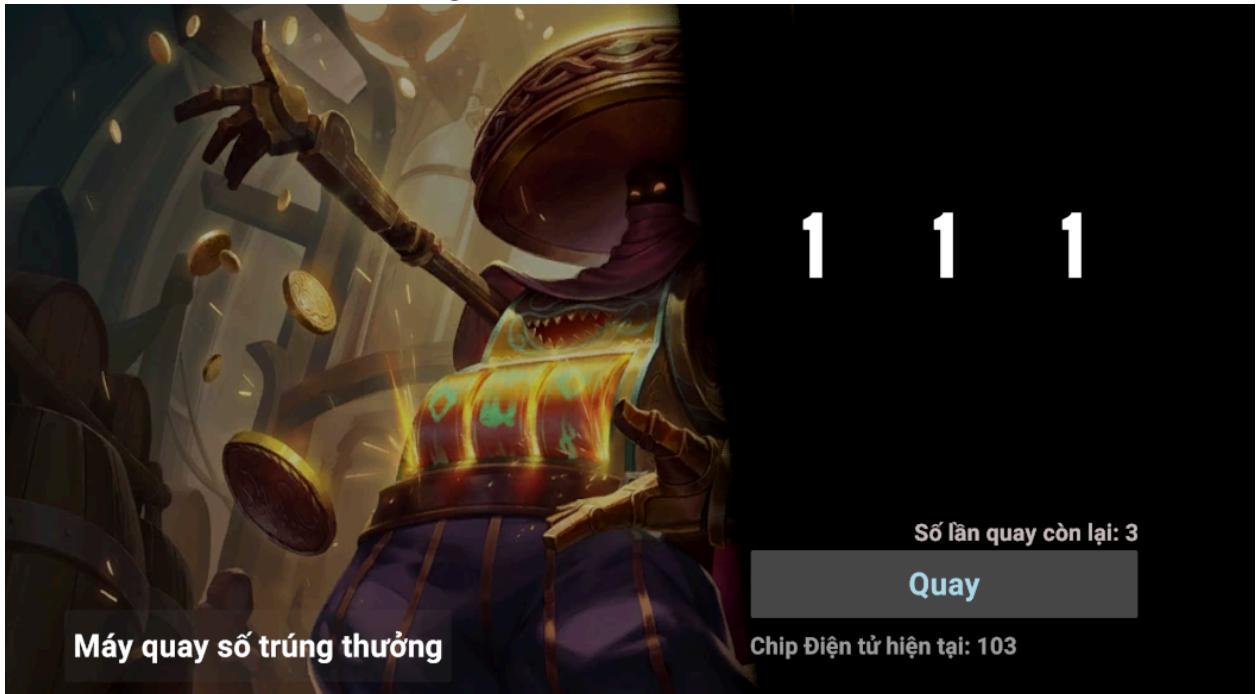


Figure 57: Event Spin screen.

### 3.3.13. Adventure: Abnormal

This tile is the only way for players to interact with the Adventure map.

When the player comes to this tile, there will be something affecting the map. The guard in here can offer for the player to guide the way out. There are 4 options for players to choose. Based on the player selection, they also decide the random pool of abnormal can appear.



Figure 58: 4 event options for player to choose

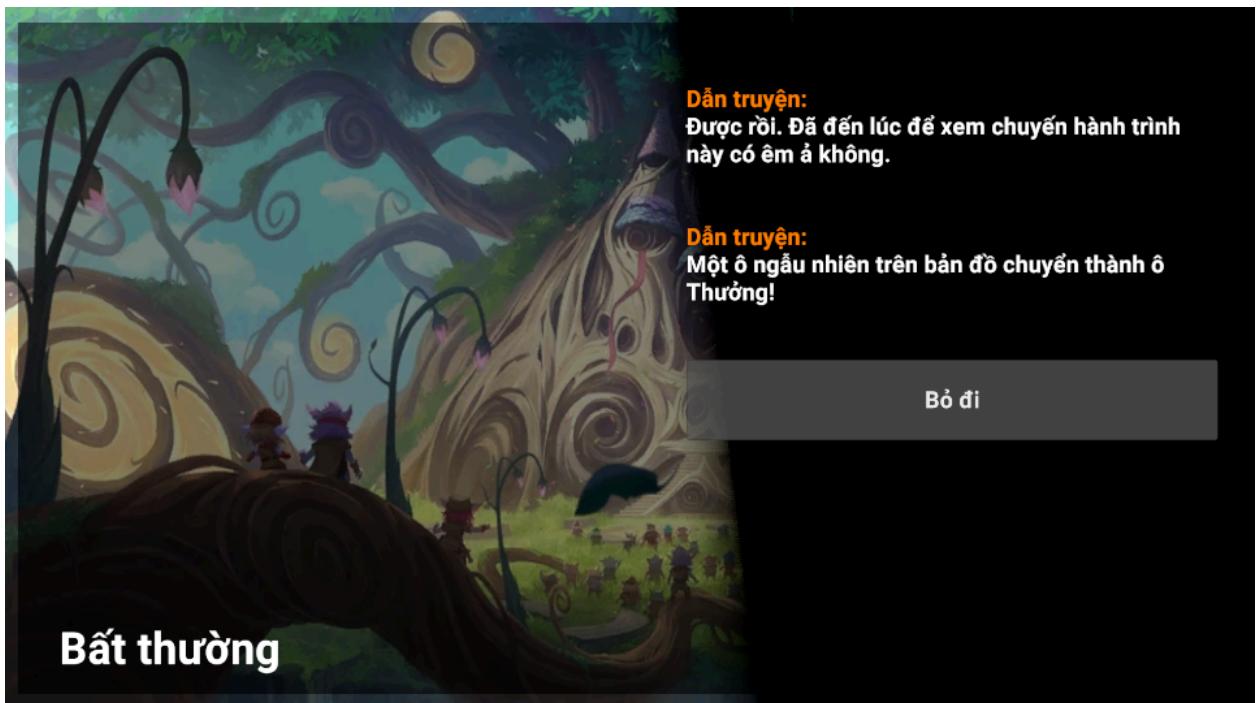


Figure 59: After choosing, a random abnormal from the pool will be selected and affected to the Adventure map.

There are 9 possible abnormal outcomes of this event, the luckiest is “Make all adjacent tiles of the current potion change to Reward tile” and the worst is “All the tiles on the map have 30% to become a Blank tile”, which will narrow the player in tile selection.

### 3.3.14. Adventure: Combat

If players select on the combat, Elite or Boss tile, they will get to the Adventure: Combat scene.

### 3.3.14.1 Environment

In the Adventure\_Combat scene, the player starts with a 2D platformer map that contains only one path, from where enemies spawn on the right edge of the screen to the left, where the player must prevent the tower from being attacked by enemies.



Figure 60: Scene overview

### 3.3.14.2 Win - Lose condition

A Tower will be placed on the left side. Player's objective is to defeat all the enemy and protect the tower.

If the Tower's health is less or equal to 0, the match will be stopped and the player will have a chance to start a rematch. If the player leaves, the Adventure is over and redirects the player to the Result screen.

When all enemies in that stage are defeated, that means the player has won and receives Adventure reward afterward. If this is the Boss stage, the player completes the Adventure and redirects them to the Result Screen.

### 3.3.14.3 List of characters

#### **Playable characters:**

- Xayah
- Rakan
- Ashe (this character is always on player team and cannot be controlled by player)

**Enemies:**

- Melee minion
- Ranged minion
- Siege minion
- Super minion

**3.3.14.4 Character detail****3.3.14.4.1 Xayah****Stats:**

Attack: 340 (+10 / level)  
Health: 580 (+20 / level)  
Armor: 24  
Health regeneration: 5.8 / second (+0.2 / level)  
Attack speed: 1.0  
Movement speed: 1.0  
Mana: 90  
Mana regeneration: 1.0  
Critical rate: 5%  
Critical damage: 50%  
Damage boost: 0%  
Resistance: 0%  
Resistance Penetration: 0%  
Attack range: 400

**Xayah Ability Overview:****Passive - Hunter's Traces**

Xayah can summon Feathers by attacking or using one of her abilities. When she calls feathers from the field back, each feather deals 60% Fire damage to enemies it hits.

Feathers last 10 seconds after being planted.

**Normal attack - Feather Pierce:**

Xayah normal attack throws a feather every 1.2 seconds, dealing 90% fire damage to the first enemy she hits and 45% fire damage to the remaining enemies.



*Figure 61*

### Skill - Double Daggers:

Instantly throws 2 feathers forward, dealing 60 fire damage per feather. After that, call all feathers back to xayah.



Figure 62

### Ultimate - Feather Storm:

Gain 1 energy every 2 seconds and normal attack. When energy reaches 90, Xayah is able to use the ultimate.

Xayah jumps into the air, immune to damage and crowd control, and releases 7 feathers forward, each dealing 60% Fire damage to all enemies it hits. She then calls the feathers back.



Figure 63

### Animation:

Xayah has 10 animations: a1 (attack 1), a2 (attack 2), Death, Idle, Run, Skill, Skill\_end, Spawn, Ult (ultimate), Ult\_end.

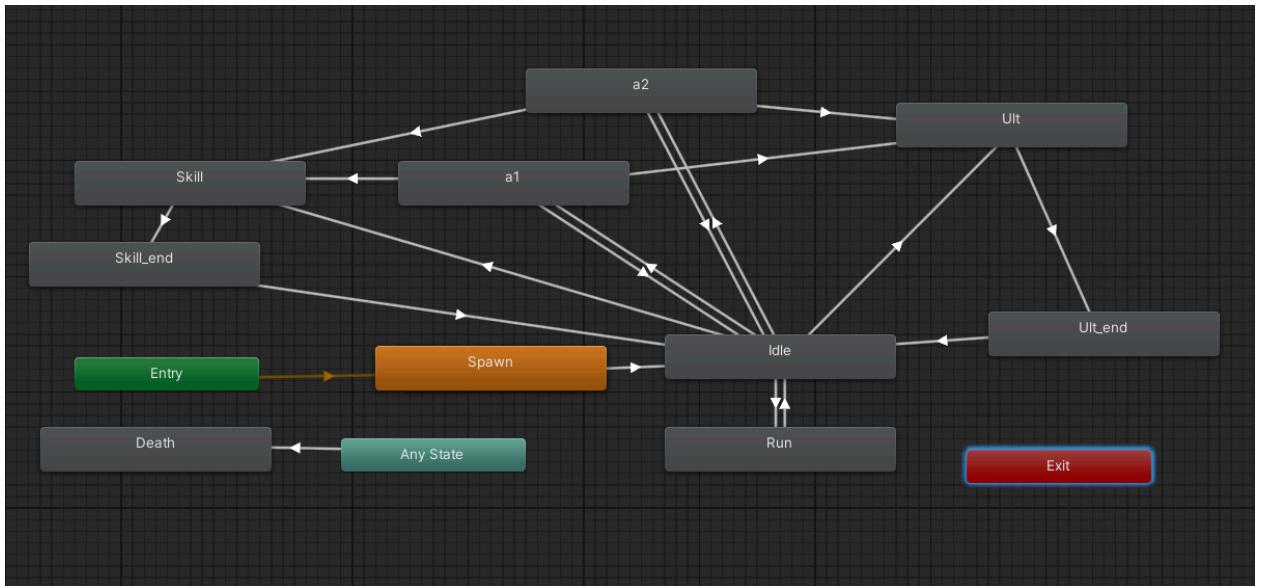


Figure 64 Xayah animator

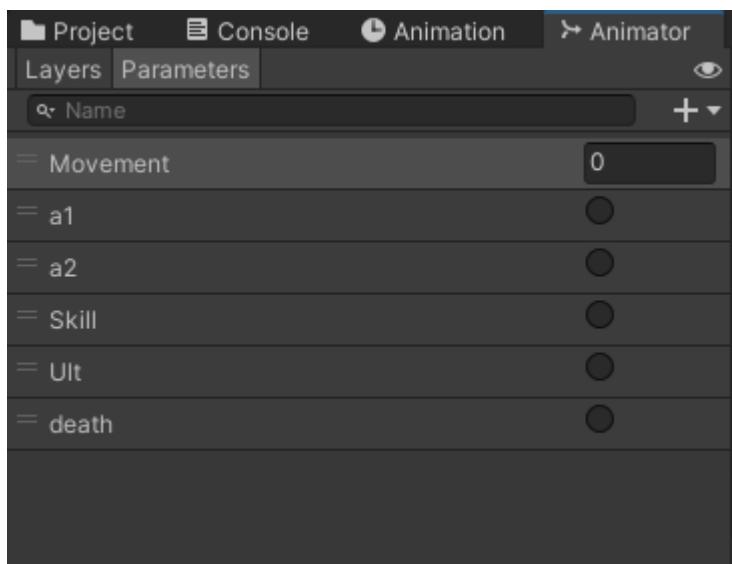


Figure 65 Parameter used to call Xayah animation

### 3.3.14.4.2 Rakan

#### Stats:

Attack: 250 (+7 / level)

Health: 740 (+28 / level)

Armor: 35

Health regeneration: 7.4 / second(+0.28 / level)

Attack speed: 1.0

Movement speed: 1.0

Mana: 100

Mana regeneration: 1.0

Critical rate: 5%

Critical damage: 50%

Damage boost: 0%

Resistance: 0%

Resistance Penetration: 0%

Attack range: 50

### Rakan Ability Overview:

Passive - Natural Shield:

When Rakan receives a shield, Xayah also obtains one equal to 50% of Rakan shield.

After entering battle for every 40 seconds, Rakan grants himself a shield equal to 18% of his max health + 150. Rakan shields can be stacked and lasts until it broken.

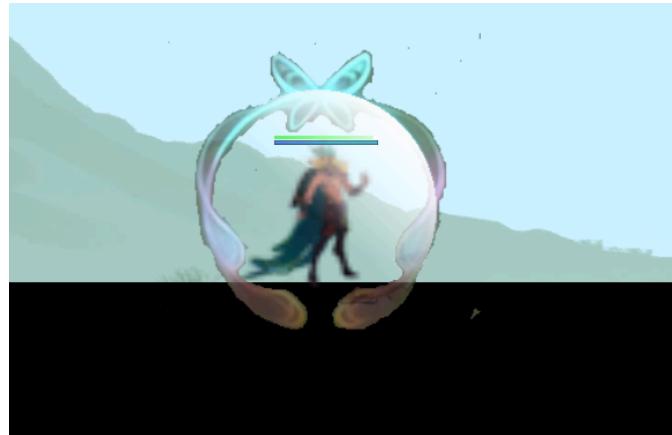


Figure 66

Normal attack - Feather Cloak:

Attack enemies every 1 second, dealing 90% Wind damage to all enemies hit.



Figure 67

Skill - Epic Assault:

Dashes in the target direction, knocking back all enemies he hits and dealing 160% Wind damage. Each enemy hit grants Rakan a shield equal to 6% of his maximum health + 75. Mana regeneration: 4 + 2 for each enemy hit.

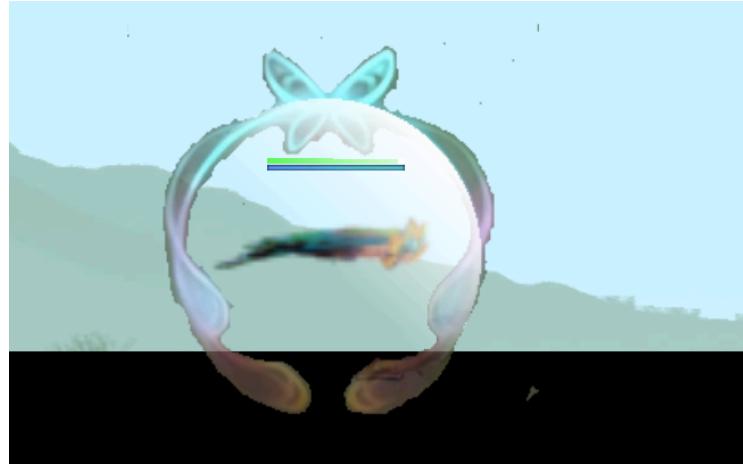


Figure 68

### Ultimate - Ethereal Waltz:

Gain 1 Energy every 2 seconds, every time Rakan gets attacked or uses a normal attack.  
The ultimate is ready when current mana at 100:

Enter the "Agitated" state for 12 seconds, while "Agitated":

Rakan receives 50% movement speed and creates a zone around himself. This zone grants Rakan 30% damage resistance, deals 150% wind damage to nearby enemies every second, and gains a shield equal to 4% of maximum health every second + 50 for each enemy hit.

While in "the Agitated" state, Rakan cannot gain Energy, use normal attacks, or use combat techniques until this state ends.



Figure 69

### Animation

Rakan has 12 animations: a1 (attack 1), a2 (attack 2), death, idle, run, skill\_into, skill\_end, spawn, ult (ultimate), ult\_idle, ult\_run, ult\_run\_to\_idle.

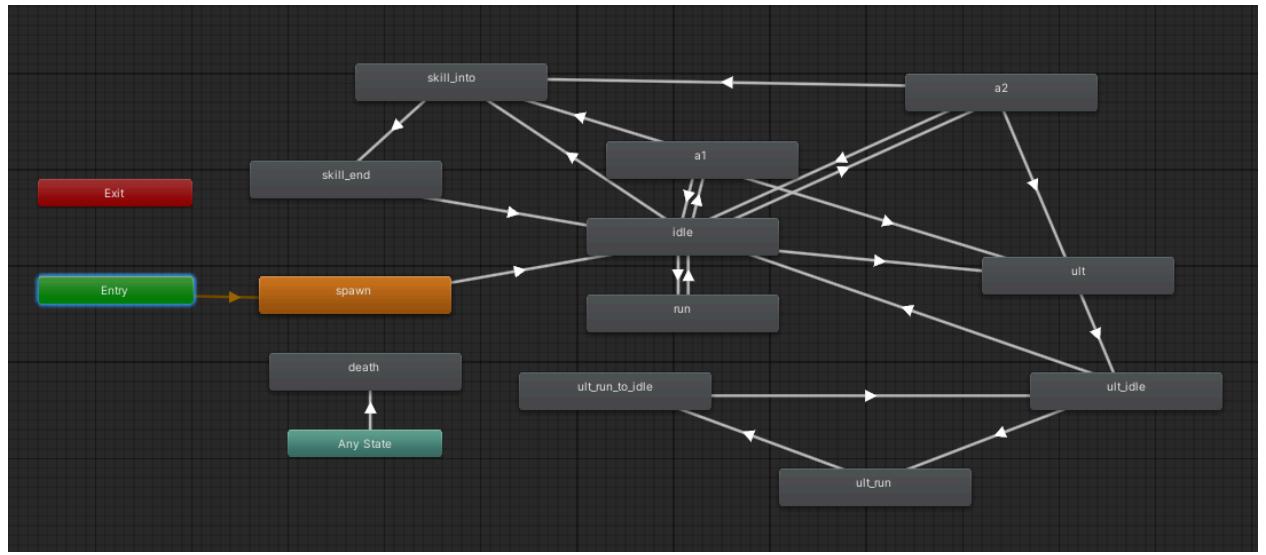


Figure 70: Rakan animator

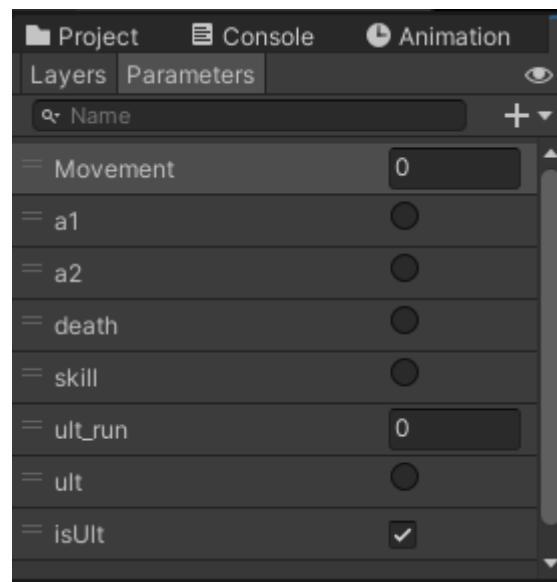


Figure 71: Rakan parameter

### 3.3.14.4.3 Ashe

Ashe is a support character who stands on the tower and has a shooting range that covers almost the whole map.

Ashe is the character that can deal significant damage, especially if the main character is at the low level.

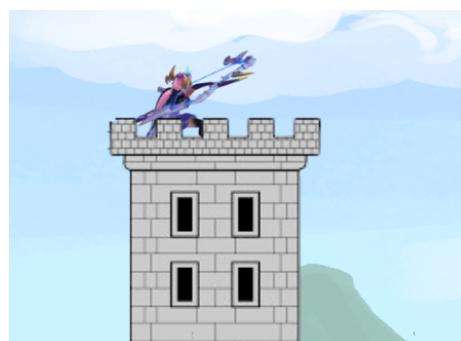


Figure 72

### Animation:

Ashe has 3 animations: attack, idle, idle\_to\_attack

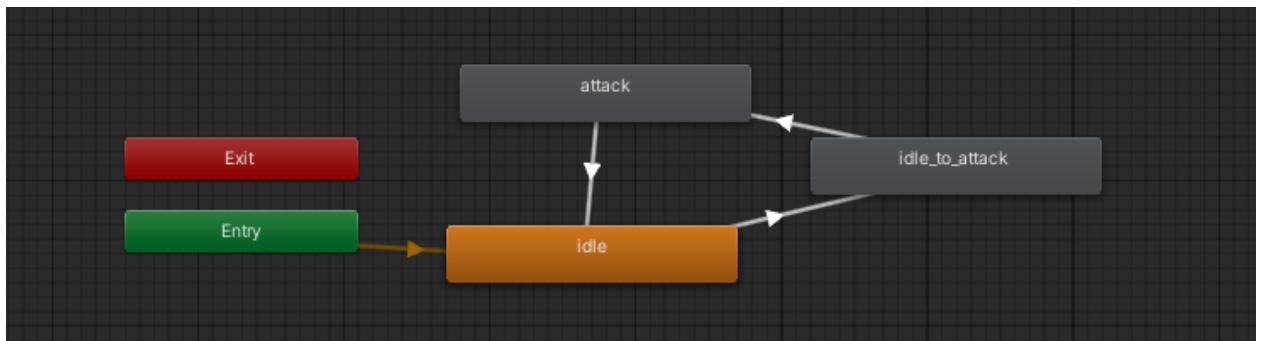


Figure 73: Ashe animator

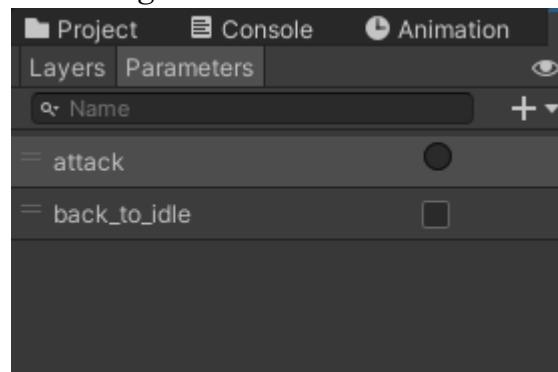


Figure 74: Ashe parameter

#### 3.3.14.4.4 Melee minion

##### Stats

Health: 4000

Attack: 120

Armor: 48

Resistance: 0%

Attack range: 100

Normal Attack - Hammer Strike: Every 1.2 seconds deals 100% damage to enemies.

### Animation:

Melee minion has 6 animations: attack\_1, attack\_2, attack\_3, death, idle, run

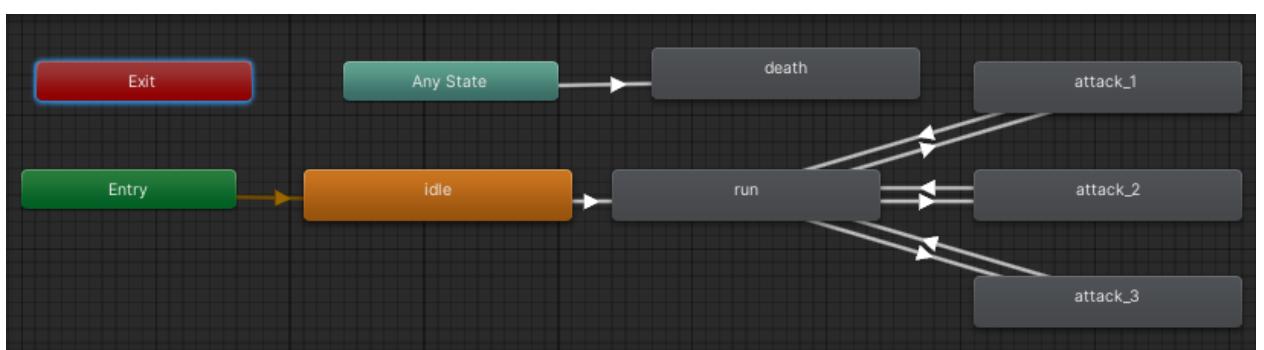


Figure 75: Melee minion animator

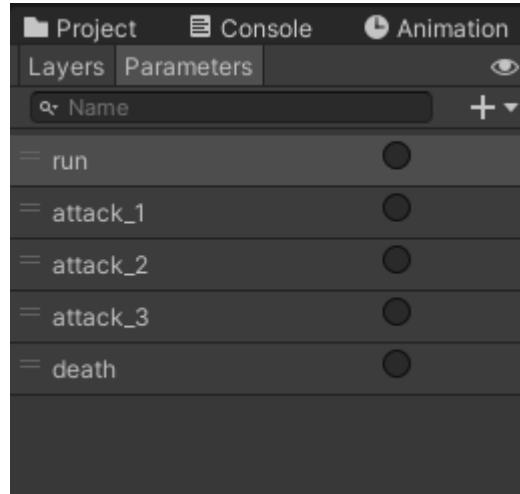


Figure 76: Melee minion parameter

### 3.3.14.4.5 Ranged minion

Stats

Health: 3200

Attack: 120

Armor: 32

Resistance: 0%

Attack range: 400

Normal Attack - Magic beam: Deal 100% damage to enemies every 1.5 seconds

#### Animation:

Ranged minion has 6 animations: a1 (attack 1), a2 (attack 2), death, idle, run

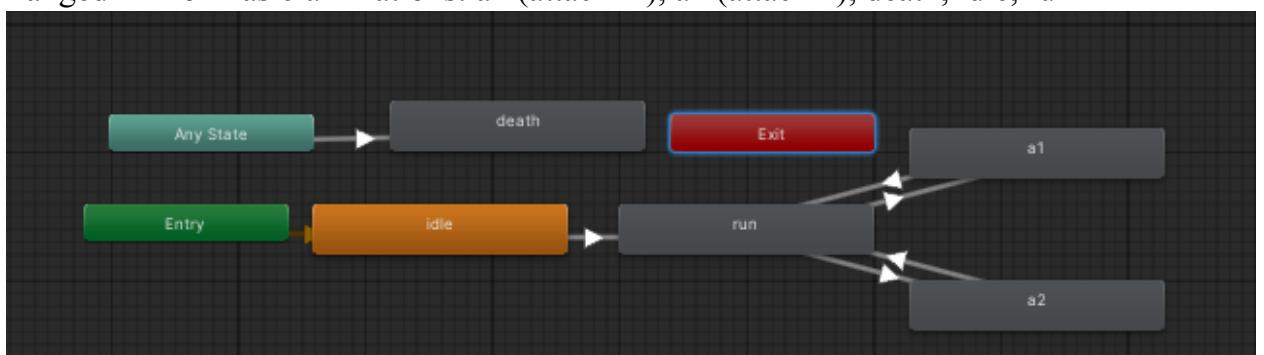


Figure 77: Ranged minion animator

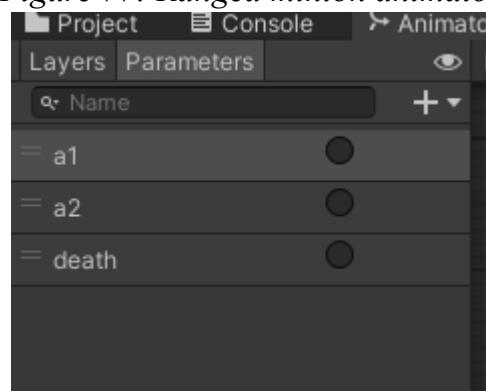


Figure 78: Ranged minion parameter

### 3.3.14.4.6 Siege minion

#### Stats:

Health: 7200

Attack: 240

Armor: 48

Resistance: 0%

Attack range: 450

Normal attack - Heavy Cannon: Deals 100% damage to enemies every 2.4 seconds.

#### Animation:

Siege minion has 6 animations: a1 (attack 1), a2 (attack 2), death, idle, run

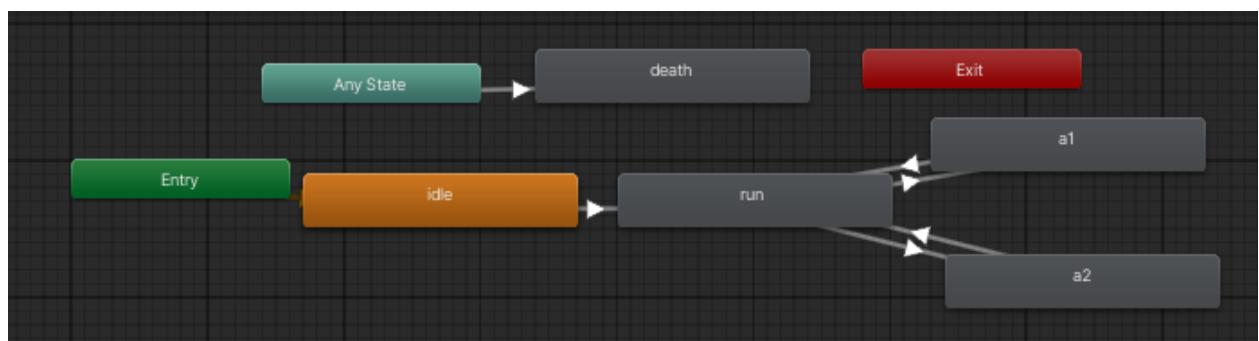


Figure 79: Siege minion animator

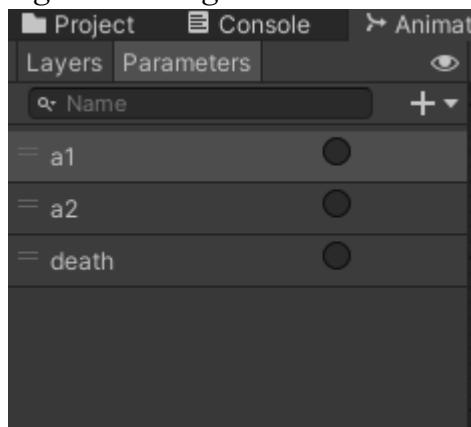


Figure 80: Siege minion parameter

### 3.3.15.4.7 Super minion

#### Stats:

Health: 10800

Attack: 320

Armor: 72

Resistance: 30%

Attack range: 100

Passive - Energy Field: Gain 3200 shields when summoned, when attacking every 5 times, or when below 30% health. Shields do not stack and attack stacks do not activate while shielded.

Normal attack - Glamorous slam: Deals 100% damage to enemies every 2 seconds.

### **Animation:**

Super minion has 6 animations: a1 (attack 1), a2 (attack 2), death, idle, run.

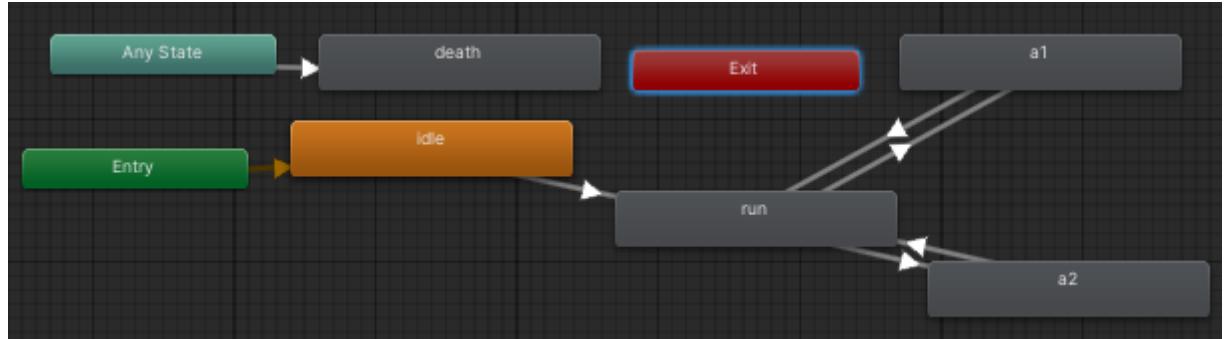


Figure 81: Super minion animator

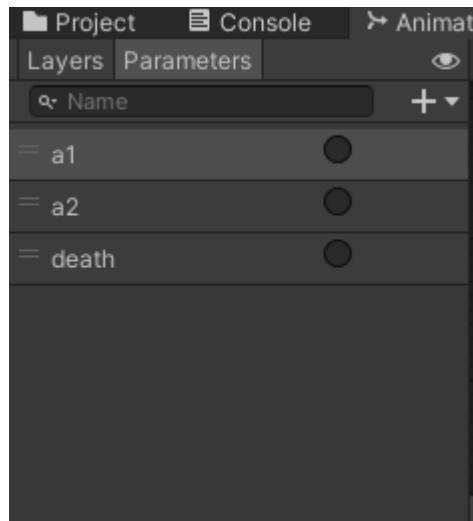


Figure 82: Super minion parameter

#### 3.3.14.5 Spawn

- Playable character: In the beginning of the battle, the character will spawn near the tower. Players can control the character to defeat the enemies.

- Enemies: Minions spawn on the right side of the screen and move to the tower.

#### 3.3.14.6 Character selection and character movement

### **Playable characters:**

On the screen, there are avatars of characters, when the player clicks on the border, it will show a bright border which means the character is currently selected.

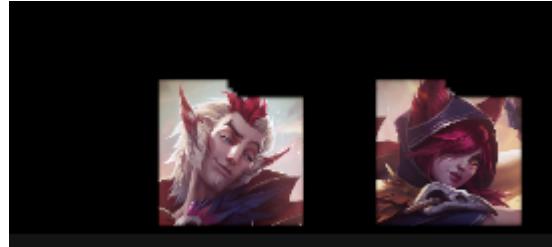


Figure 83: Unselected character

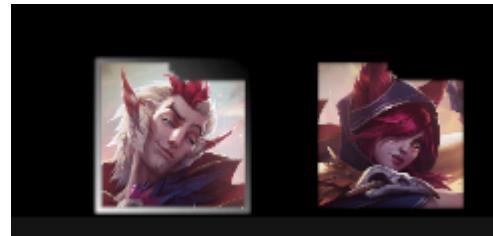


Figure 84: Selected character

When a character is selected, players are able to move the character by right-clicking on the screen. Only one character is able to be selected at the time.

#### **Enemies:**

They move to the tower and will attack anything that appears to block their path.

##### 3.3.14.7 Detect collider

A collider is a shape of a GameObject, in this case those are character and tower for the purposes of physical collisions.

When characters collide with each other, they can trigger some sort of things for example: animation. This allows characters to attack, throw weapons or shoot bullets in order to deal damage to enemies.

Each character will have a Box collider component assigned inside the inspector in order for the detector to work. In addition, the character must set “Tag” or “Layer” so that they will know what character to trigger the attack.



Figure 85: Box collider of Xayah (green box)

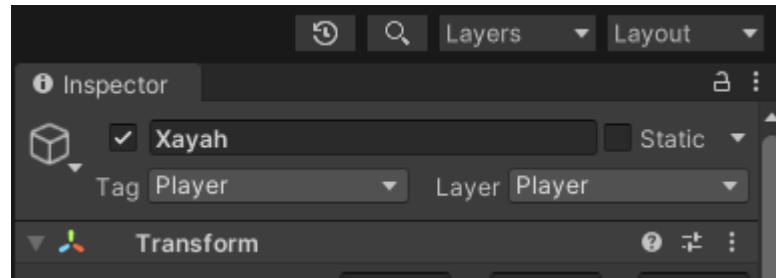


Figure 86: Tag and Layer in Inspector

Example code to detect enemy:

```
RaycastHit2D hit = Physics2D.Raycast(raycast.transform.position,
direction, raycastDistance, DetectEnemy);
if (hit.collider != null)
{
    if (hit.collider.CompareTag("Enemy"))
    {
        //Detected
        Debug.DrawRay(raycast.transform.position,
direction * hit.distance, Color.red);
        if (!isAttacking && timeCoolDown <= 0)
        {
            isAttacking = true;
            Attack();
        }
    }
}
```

### 3.3.14.8 Skill Point

All the character abilities have a skill. Using a skill requires a skill point.

Skill point is a point manager that is used for all the members. For each 24 second, a skill point is generated and can be used.

The max skill point player can hold at the time is 5.



Figure 87: Skill point system

In order to use a skill point, players need to select a character by clicking on the character's avatar, then press E to activate the character's skill.

#### 3.3.14.9 Get stats and show stats

The assets folder of the game contains a folder called “Data”, which stores information about the game. The path to access the path is: “Assets/Data/Hero\_stat/ingame\_stat”, here will store the stat of Xayah, Rakan, Ashe and Tower.

Name	Date modified	Type	Size
rakan	13/12/2024 4:30 CH	File folder	
tower	13/12/2024 6:30 CH	File folder	
xayah	13/12/2024 4:30 CH	File folder	
rakan.meta	04/12/2024 11:05 CH	META File	1 KB
tower.meta	04/12/2024 11:05 CH	META File	1 KB
xayah.meta	04/12/2024 11:05 CH	META File	1 KB

Figure 88: Folder of character stat

Inside folder rakan and xayah, there are text file that store stats of the character, here are the stats:

Res	15/12/2024 3:02 CH	Text Document	1 KB
ManaRegen	15/12/2024 3:02 CH	Text Document	1 KB
Mana	15/12/2024 3:02 CH	Text Document	1 KB
IgnoreRes	15/12/2024 3:02 CH	Text Document	1 KB
HealthRegen	15/12/2024 3:02 CH	Text Document	1 KB
Health	15/12/2024 3:02 CH	Text Document	1 KB
DmgBoost	15/12/2024 3:02 CH	Text Document	1 KB
CritRate	15/12/2024 3:02 CH	Text Document	1 KB
CritDmg	15/12/2024 3:02 CH	Text Document	1 KB
AttackSpd	15/12/2024 3:02 CH	Text Document	1 KB
Attack	15/12/2024 3:02 CH	Text Document	1 KB
Armor	15/12/2024 3:02 CH	Text Document	1 KB

Figure 89: Text file to store character stats

For minion cases, their stats will be preset via Inspector view, and can be modified only by that way.

In order to show stats of characters, players need to left-click on the character collider, then a panel of stats will display at the top of the screen.



Figure 90: UI panel for display playable character stats

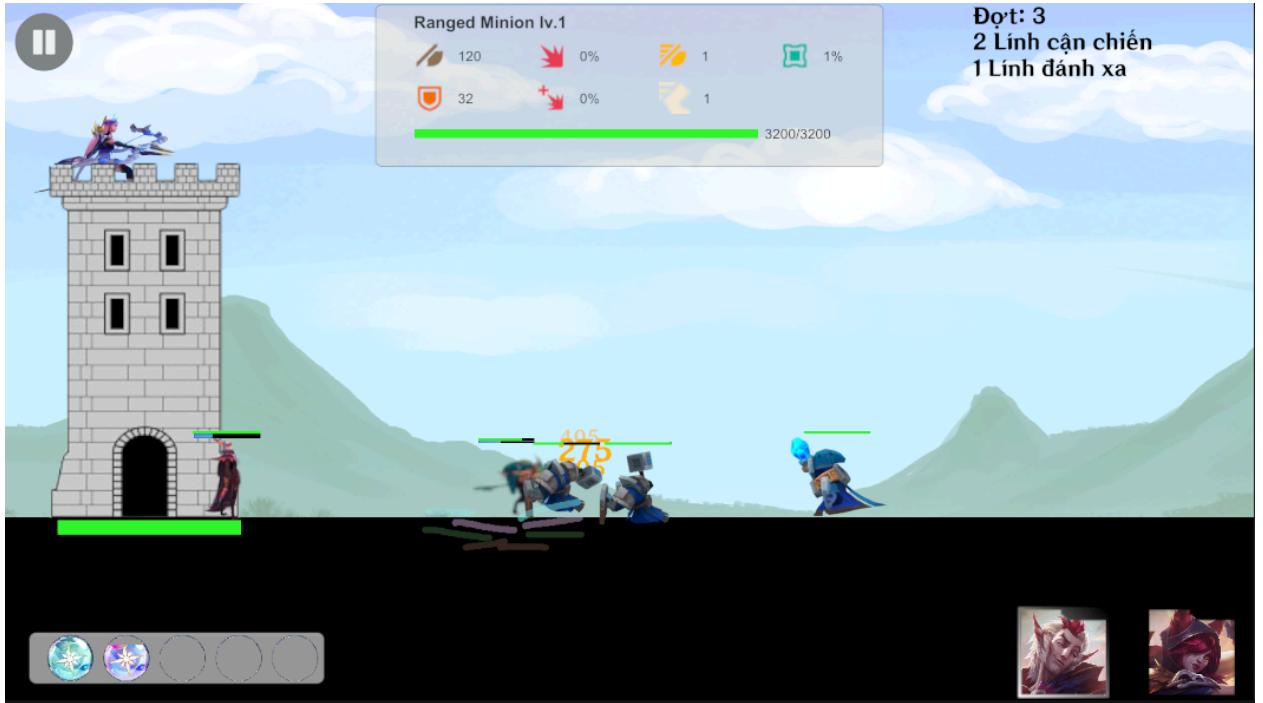


Figure 91: UI panel for display minion stats

### 3.3.14.10 Character down and respawn

If a character's health is 0, that means that character is in a down state. During this time, there is a respawn timer before the character is revived again on that character.

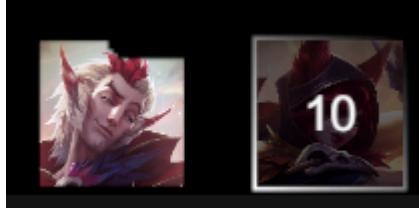


Figure 92: Xayah is currently down

### 3.3.14.11 Difficulty, wave and level of minions

There are a total of 17 difficulties and 20 waves , each difficulty has 3 waves of enemies, except the last difficulty will have 4 waves.

The time between each wave is based on the difficulty, harder level will extend this duration, and the time between each minion of the same wave to spawn is 3 seconds.

Minions will have their level from 1 to 36, each level will increase 1% of their max health, armor and damage resistance.

The player can see the enemies of the current wave in the top right corner.

### 3.3.14.12 Damage calculation

Formula to calculate damage dealt:

Base damage = Attack \* %Multiplier \* CritDamage (if critical strike)

Actual damage = Base damage \* \_ReduceDmgByArmor \* DamageBoost \* (1 - (IgnoreResistance - Resistance)).

Formula to calculate the Reduce damage from Armor:  $_ReduceDmgByArmor = 1 - (\text{armor} / (\text{armor} + 100))$ .

#### 3.3.14.13 Pause panel

On the top left of the screen, there is a button that allows players to pause the game. When the panel shows up, there are 3 buttons: Exit, Restart and Continue.



Figure 93: Pause panel

#### 3.3.14.14 Win and Lose UI



Figure 94: Lose panel



Figure 95: Win panel

### 3.3.15 Adventure: Result

When players decide to quit during the exploration or they go through all the way to the boss and defeat all enemies, the Result screen will show up.

It summarizes the number of tiles moved; ElectricChip, System Point left; number of Curios and Potions; Tower health, System Error and team selected.



Figure 96: Result

After the player decides to go back to the main menu of Adventure, all the current data will be deleted and ready for a new Adventure.

## **Chapter 4: Conclusion and Recommendations**

### **4.1. Objective achieved through the project**

During the project, we explore on variety of thing and create a lot of amazing stuffs:

- New knowledge:
  - + Before the project, we just imagine the way video games are created and developed. This project is the first time we enter a complete production of a game from the idea sketch to the game application. We have to be game developers, imagine the way players play our game and try to add the appropriate element that makes the game more attractive.
  - + We explore brand new tools and environments: This is our first project with Unity, we have to learn how to use the new things from the scene, the hierarchy, the scripts to the assets, create sprite, make animation, calculate damage, resource, ... This is not only our new exciting knowledge but also a new way to apply our Information Technology knowledge into something we have not met before.
- Improve our knowledge:
  - + We have to work as a team for this exploration. We improve our team-work skills during this project: Our communication skill to provide our work to the right person, our planning skill to make everything in our control, our critical skill to make a better decision for the project,...
  - + Improve our skills: We have a chance to make a C# script and connect with the Unity inspector to show player data, or trigger animation, set game object state, calculate number, adjust position, ...

### **4.2. Project optimization**

There is still have place for us to make some adjustments:

- Animation: Some animations do not switch smoothly.
- Quality: There are some scripts that we need to improve performance.
- In-game graphic: There are some images or backgrounds that we need to change to match the game atmosphere.

### **4.3. Future orientation**

At the end of the project, we are happy with what we have today.

Even though the time of the project is over, our project still can be improved in the future. There are some features that we want to add:

- Improvement: We want to optimize all the adjustments in the list above.
- Language: We want to support more than one Language.
- Level: We will create some level with different shapes of map.
- Event and Item: We want to create more Random items in Random list, including curios, events, potions,...
- More character: We want to add some new characters to our project. For instance, someone can provide buff for the team.
- More character empowerment: Currently it only increases in level, we have a plan to make the player have an unlocked trail of power, or a gear system.

#### **4.4. Conclusion**

After 3 months of our project, we have an experiment with the Unity project about a Tower Defense game. We gain a lot of knowledge during this time and this is our valuable experience that will be our advantages in the future.

All the comments and feedback to our current project is the foundation to the next opportunity for us to continue to improve and bring the better player experience for everyone.

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