

Development and Commercialization of Mobile Game in Tower Defense genre

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Resumo

Os jogos móveis constituem o maior segmento do mercado global de jogos. Estima-se que mais de 2,8 mil milhões de pessoas joguem jogos móveis[1]. Este projeto é dedicado ao desenvolvimento e à comercialização de um jogo móvel no género Tower Defense, utilizando Unity, com foco na plataforma Android. Neste género, os jogadores defendem uma base construindo torres para impedir ondas de inimigos. O projeto também analisa métodos de integração de estratégias de monetização, como anúncios no jogo e compras.

O principal objetivo foi criar um jogo móvel 2D de alta qualidade, otimizado para Android, com ferramentas de monetização integradas. As tarefas incluíram a análise de plataformas de desenvolvimento, a pesquisa de modelos de monetização e a avaliação da eficiência económica de várias ferramentas.

O desenvolvimento foi realizado com Unity, com a monetização integrada através de compras na aplicação e publicidade. O Unity In-App Purchases Plugin garante transações seguras, enquanto o plugin IronSource otimiza a receita ao integrar várias redes de anúncios. O Firebase Analytics foi utilizado para monitorizar o envolvimento dos utilizadores e apoiar decisões orientadas por dados.

Os dados recolhidos incluíram relatórios de desempenho do IronSource, taxas de retenção do Firebase, análises gerais do jogo, envolvimento dos utilizadores e tendências de receita publicitária nos primeiros três meses após o lançamento. Além disso, foram usados dados sobre a atividade dos utilizadores, comparações com outro projeto e popularidade dos sistemas operativos móveis.

Em conclusão, o projeto destacou os desafios do crescimento orgânico num mercado competitivo e a mudança das preferências dos jogadores em direção a jogos híbridos. As lições aprendidas sublinham a necessidade de estratégias de marketing flexíveis e de um foco mais profundo na aquisição de utilizadores para alcançar sucesso a longo prazo no sector dos jogos móveis.

Palavras-Chave: TECNOLOGIAS DE DESENVOLVIMENTO, FERRAMENTAS DE DESENVOLVIMENTO, MONETIZAÇÃO, APLICAÇÃO MÓVEL, JOGOS MÓVEIS.

Abstract

Mobile games comprise the single largest segment of the global games market. Estimates have indicated that over 2.8bn people play mobile games[1].

This project is dedicated to the development and commercialization of a mobile game in the Tower Defense genre, using Unity, with a focus on the Android platform. In this genre, players defend a base by building towers to stop waves of enemies. The project also analyzes methods of integrating monetization strategies, such as in-game ads and purchases.

The main objective was to create a high-quality 2D mobile game optimized for Android, with integrated monetization tools. The tasks included analyzing development platforms, researching monetization models, and evaluating the economic efficiency of various tools.

Development was carried out using Unity, with monetization integrated through in-app purchases and advertising. The Unity In-App Purchases Plugin ensures secure transactions, while the IronSource plugin optimizes revenue by integrating multiple ad networks. Firebase Analytics was used to track user engagement and support data-driven decisions.

Collected data included performance reports from IronSource, retention rates from Firebase, general game analysis, user engagement, and advertising revenue trends in the first three months post-launch. Additionally, data on user activity, comparisons with another project, and mobile operating system popularity were used.

In conclusion, the project highlighted the challenges of organic growth in a competitive market and the shift in player preferences toward hybrid games. The lessons learned emphasize the need for flexible marketing strategies and a deeper focus on user acquisition to achieve long-term success in the mobile gaming sector.

Keywords: DEVELOPMENT TECHNOLOGIES, DEVELOPMENT TOOLS, MONETIZATION, MOBILE APPLICATION, MOBILE GAMES

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1. Introduction

The Tower Defense genre is one of the most popular and captivating in the world of mobile games, attracting millions of players with its unique features and engaging gameplay. This genre stands out for its simple rules and intuitive gameplay: players don't need to carefully study the plot or deeply immerse themselves in the game world. Instead, players must strategically place defensive towers to withstand waves of enemies and protect their territory.

Despite its apparent simplicity, Tower Defense games require players to think strategically and plan ahead. They must choose the right towers for different types of enemies and manage their resources effectively to survive during attacks. Every decision made matters and can determine success or defeat.

One of the key aspects of the appeal of Tower Defense is their engaging and replayable experience. Games in this genre often offer diverse levels that can be replayed multiple times, aiming to improve results and overcome increasingly difficult challenges. This creates a sense of achievement and encourages players to replay.

Another attractive aspect of Tower Defense is the tower upgrade and improvement system. Many games in this genre allow players to upgrade their defensive towers, adding new abilities and making them more effective in battling enemies. This progression element adds depth to the game and motivates players to play in the long term.

Finally, in the Tower Defense genre, there is a wide variety of gameplay mechanics and styles, from classic defensive strategies to fantasy and science fiction settings. This allows players to choose games that match their preferences and interests and enjoy a variety of gaming experiences.

Overall, the Tower Defense genre continues to attract players with its engaging mechanics, strategic depth, and upgradeability, making it one of the most beloved and successful genres of mobile games.

1.1. Objectives

Goal: To develop a mobile 2D Tower Defense game using the Unity game engine and integrating built-in monetization and advertising mechanisms. Additionally, subsequent analysis and improvement of monetization methods are envisaged.

To achieve this goal, the following tasks need to be addressed:

- Analyze the means of implementing mobile applications and games.
- Develop a mobile game and application based on the Android operating system, tailored for commercial applications.
- Conduct an analysis of monetization models and tools to determine those suitable for application in mobile applications.
- Study and integrate monetization tools considering the product's specifics.
- Investigate the economic efficiency.

2. Context and Technologies

Mobile games and applications have surged in popularity, offering lucrative opportunities for monetization. The multifaceted nature of gaming applications contributes significantly to their potential for recouping investments. Several factors underscore the effectiveness of using games as applications for monetization:

- **Broad Audience Appeal:** Games cater to a diverse demographic, attracting both adults and children alike. This broad appeal maximizes the reach of gaming applications, thereby increasing the potential user base and revenue opportunities.
- **Versatile Monetization Methods:** Gaming applications offer a plethora of monetization options, ranging from in-app purchases and subscriptions to advertisements and sponsorships. This versatility allows developers to tailor their monetization strategy to align with their target audience and maximize revenue streams.

2.1. SWOT analysis

During the design phase of the project, a SWOT analysis (Table 1) was conducted to assess the current situation from four perspectives: strengths, weaknesses, opportunities, and threats. In the business context, strengths were evaluated based on the following parameters:

- **Uniqueness of the Offering:** The project's ability to offer something distinct and innovative compared to existing solutions enhances its competitive advantage. This uniqueness can attract customers and differentiate the project in the market.
- **Management and Human Resources:** The competence and experience of the staff play a crucial role in the success of the project. A skilled and knowledgeable team can effectively execute tasks, overcome challenges, and drive the project towards its objectives.
- **Clear System Presence:** A well-defined business structure with clearly outlined processes and employee roles fosters efficiency and productivity. When everyone understands their responsibilities and how they contribute to the project's goals, it streamlines operations and minimizes confusion.
- **Financial Resources and Access to Funds:** Sufficient financial resources and access to funds are essential for project sustainability and growth. Adequate funding ensures smooth operations, investment in development, and adaptation to market changes.
- **Well-Organized Sales Department:** A well-functioning sales department is critical for generating revenue and achieving success in the market. Effective sales strategies, customer relationship management, and market penetration rely on the capabilities of this department.
- **Well-Thought-Out Marketing Policies:** Strategic marketing policies contribute to brand visibility, customer acquisition, and market expansion. A comprehensive marketing plan tailored to the project's objectives can drive awareness and demand, ultimately leading to increased sales and profitability.
- **Production Costs:** Efficient management of production costs is essential for maintaining profitability and competitiveness. Controlling expenses while ensuring quality and efficiency in production processes is vital for the project's financial health.

Opportunities and threats in business are primarily assessed based on the following parameters:

1. Market trends: changes in demand.

2. Economic conditions in the country: business growth correlates with economic growth.
3. Competition: the emergence of new competitors can reshape the industry.
4. Infrastructure changes: significant changes can bring both opportunities and challenges.
5. Legislation and political trends: legal changes can impact businesses significantly.
6. Technological advancements: progress can both disrupt existing industries and create new ones.

Table 1: SWOT analysis

	Strengths	Weaknesses
Internal Factors	Generating Profit: Developer Promotion through the Application	Multiple improvements: Expenses on developer account purchase
External Factors	Due to the growth of the gaming market, now is the most favorable time to enter this industry. Opportunities for adding functionality	Costs in the initial phase for advertising the application within other applications: Numerous competitors

2.2. Platform Selection

To implement the mobile application, it was necessary to determine the mobile operating system:

1. Android OS.
2. Symbian OS.

3. Windows Mobile.
4. Palm OS.
5. iPhone OS.
6. BlackBerry OS.

The StatCounter Global Stats chart displays the mobile operating system market share worldwide from October 2023 to October 2024 (Figure 1) [2]. Android consistently leads the market with a stable share around the 70-80% range, followed by iOS, which maintains a second position with a share close to 20-30%. Other operating systems, including Samsung's proprietary OS, KaiOS, Windows, and Linux, have minimal market shares, almost negligible in comparison to Android and iOS. The chart illustrates the dominance of Android and iOS in the global mobile OS landscape, highlighting a highly stable and concentrated market share distribution over the year.

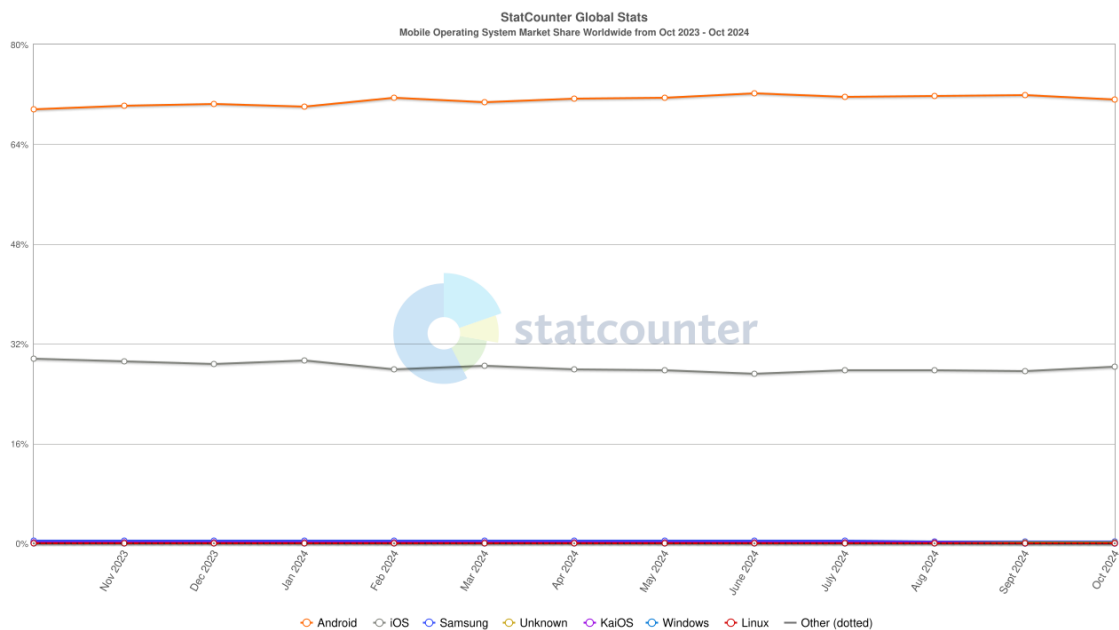


Figure 1: mobile operating system popularity

The widespread adoption of the Android operating system has cemented its position as the leading platform for mobile devices globally. With over 2 billion monthly active users, Android has surpassed significant milestones, underscoring its dominance in the market. This popularity can be attributed to several factors, including its open-source nature, robust functionality, and extensive ecosystem of apps and services.

Central to the Android experience is the Google Play app store, which serves as the primary source of software for Android devices. With a vast library of over 300 thousand programs, Google Play offers users access to a diverse array of apps, ranging from productivity tools to entertainment content. The platform caters to both free and paid apps, providing developers with various monetization options and opportunities to reach a broad audience.

In addition to the app store, Android users benefit from seamless integration with Google's suite of services, including Gmail, Maps, Search, and YouTube. These widely-used applications further enhance the Android experience, offering users convenient access to essential tools and content.

Overall, the Android operating system's popularity and versatility have made it a preferred choice for both developers and consumers alike. Its robust ecosystem, coupled with a user-friendly interface and extensive app selection, continues to drive its widespread adoption and ongoing success in the mobile market.

The most sought-after tasks addressed by developing applications for Android smartphones include:

- Providing users with timely news updates.
- Offering additional value to users of your service.
- Expanding the user base.
- Increasing brand loyalty and recognition through promotional applications.
- Generating revenue through the sale of goods/services via the mobile application.

2.3. Mobile Application Development Tools selection

There are several different development tools for mobile applications, and the three most popular platforms will be considered:

- Corona SDK
- Unreal Engine
- Unity

Corona SDK: Known for its ease of use, Corona SDK is a cross-platform game development engine tailored for 2D games on iOS and Android. With a Lua-based API, it allows developers to quickly create complex game functionalities while benefiting from a streamlined learning curve. A major highlight of Corona SDK is its real-time testing, which enables instant previews of changes on actual devices, allowing for an efficient workflow. Corona SDK supports monetization through its built-in Corona Ads, making it a valuable choice for indie developers or small studios. For added convenience, it integrates with Corona Editor, a Sublime Text plugin, which aids in writing and managing Lua code. Moreover, on OS X, developers can access the Composer GUI, a visual tool that simplifies level design by enabling drag-and-drop functionality for objects and the ability to preview object physics interactions. Corona SDK, a cross-platform mobile development framework that builds native apps for iOS, Android, Amazon Kindle, Windows Phone, tvOS, Android TV, and Mac and Windows desktops from a single code base.[2][4][3] Corona products use the programming language Lua[3].

Unreal Engine: is the fourth version of Unreal Engine developed by Epic Games. UE4 began development in 2003 and was released in March 2014, with the first game using UE4 being released in April 2014. UE4 introduced support for physically based materials and a new visual programming language called "Blueprints". It was succeeded by Unreal Engine 5[4]. This engine has an open-source codebase, encouraging a vibrant and engaged community that contributes to its ongoing improvement and support. With a pricing model that includes a free base version and a Pro upgrade, UE4 makes it easy for new developers to start without upfront costs and provides scalability as projects grow. The C++ foundation supports high-performance builds for both iOS and Android, making it a preferred choice for games demanding detailed environments, complex lighting, and custom shader effects. Unreal's editor, known for its top-tier visualization tools, provides advanced rendering options to fine-tune lighting, shadow quality, and shader complexity, catering to developers aiming for photorealistic graphics and immersive environments.

Unity: is a cross-platform game engine developed by Unity Technologies, first announced and released in June 2005 at Apple Worldwide Developers Conference as a Mac OS X game engine. The engine has since been gradually extended to support a variety of desktop, mobile, console, augmented reality, and virtual reality platforms. It is particularly popular for iOS and Android mobile game development, is considered easy to use for beginner developers, and is popular for indie game development[5]. Unity is unique in its support for scripting in C#, modified JavaScript, and Boo (a Python dialect), giving developers flexibility in programming language preference. The engine is known for its highly customizable Drag & Drop interface, which consists of various modular windows that can be arranged to suit individual workflows. Developers can debug games in real-time directly in the editor, which streamlines the process of identifying and solving issues as they arise. Unity organizes content into “scenes” (representing levels), each stored as a separate file that contains everything necessary for that level: objects, scripts, and configuration settings. This organized structure supports efficient project management, as developers can create and test individual levels independently before integrating them into the final game.

After analyzing these platforms (Table 2), it can be concluded that they are very similar, with the main differences lying in the programming languages used. The Unity platform was chosen as the development environment based on the following criteria:

- Clarity and ease of use of the interface.
- Familiar programming language.
- Availability of a free version for development.
- Free and built-in capabilities for monetizing the created application.

Table 2: Example of using caption for a table

	Condora SDK	Unreal Engine	Unity
Languages	Lua	C++,Moduls	C#,JavaScript(mods)
Platforms	Android,IOS	Android,IOS, Desktop	Android,IOS, VR,Desktop, Consoles,WEB
Free Version	YES	YES	YES
Interface	3/5	4/5	5/5

3. Development of requirements specification

Developing a mobile game or application is always a complex technological process. At the first stage of work, it is necessary to develop a technical specification. To do this, you need to clearly define what kind of game it will be. It is also necessary to draw up a task plan. It should be described in detail so as not to have to redo it again. These insights reflect both traditional aspects of Tower Defense gameplay and recent shifts in player expectations within the mobile market. Industry reports such as Newzoo's provide essential context by analyzing trends in mobile game spending and highlighting regions where mobile Tower Defense games are especially popular [6].

The second stage of development is design. At this stage, the functionality and interface of the game are implemented. It is important to determine the placement of interface buttons, levels, and assess the complexity of the gameplay to avoid creating impassable areas, but also to avoid using overly simple routes.

The third stage involves designing the visual design, characters, locations, objects, and other elements. This is an important step, as the appearance of the game can greatly influence its attractiveness to users.

The next stage is development, implementing all the previous developments. After implementation, it is necessary to test the resulting product and fix any errors.

Next, create a page for the game or application in the Google Play Console, set its rating and price, write a game description, create documentation for monetization, create items that will be sold in the game (they need to be created both in the game and in the

Google Play Console, and they must match). After that, you can upload the game archive and submit it for approval. This process usually takes about a week.

After the game is published, it will be available on the Google Play Market, and anyone interested will be able to download it.

3.1. Analysis of features of well-known implementations

This table (Table 3) provides a comparative analysis of the strengths and weaknesses of three well-known game implementations:

- Clash Royale
- Grow Castle
- Kingdom Rush

Table 3: Analysis of features

Feature	Clash Royale	Grow Castle	Kingdom Rush
Animations, Sounds	yes	yes	yes
Online	yes	no	no
Friends List	yes	yes	no
Subscription	no	no	yes
In-app Purchasing	yes	yes	no

Advertisement	yes	yes	no
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The features analyzed include animations and sounds, online capability, friends list, subscription options, in-app purchasing, and advertisements. Clash Royale and Grow Castle excel in providing animations, sounds, and online features, whereas Kingdom Rush lacks online capability and a friends list but offers subscription options. Both Clash Royale and Grow Castle include in-app purchasing and advertisements, while Kingdom Rush does not. I analyzed these games from a profitability perspective to determine which elements would be beneficial to implement in my own game.

3.2. Gameplay analysis

This chapter provides an analysis of the gameplay in the Tower Defense genre, which is crucial for understanding how the game mechanics work and what makes the game engaging and balanced. The title of the chapter, "Gameplay Analysis," reflects the goal of the study, which is to examine the key elements that make up the gameplay. This includes analyzing the game's objectives, construction mechanics, interactions with enemies, and decision-making throughout the game.

Each of these aspects plays an important role in creating an engaging and balanced gaming experience. Understanding how different mechanics work—from tower placement to selecting tactics for dealing with enemy waves—allows developers and players to approach game challenges more consciously. Analyzing these elements also helps to identify key factors that influence the game's enjoyment, difficulty, and balance, which are the foundation of a successful Tower Defense project. Gameplay analysis in Tower Defence games involves several key aspects:

- **Game Objective:** The main goal in Tower Defence games is to defend a specific point on the map (often called a base or crystal) from incoming enemies. Players must build defensive towers and use various strategies to prevent enemy incursions.

- **Tower Construction:** Players have access to different types of towers with varying characteristics and abilities. By analyzing the strengths and weaknesses of each tower, players must choose the best locations to build them to effectively control the flow of enemies.
- **Tower Upgrades:** Players often have the option to upgrade towers, increasing their power, attack speed, range, and other parameters. This allows players to adapt their tactics to changing conditions and enemy forces.
- **Resources and Economy:** In most Tower Defense games, players earn resources for destroying enemies or at the end of each wave. These resources are used for building and upgrading towers. By analyzing available resources and tower costs, players must effectively manage the game's economy.
- **Enemy Waves:** Enemies attack the player's base in waves, each typically becoming stronger and more numerous as the game progresses. By analyzing the composition of each wave and their abilities, players must build defenses capable of handling an increasing challenge.
- **Tactics and Strategies:** Key to gameplay analysis is the selection of optimal tactics and strategies. This includes the strategic placement of towers, choice of upgrades, efficient resource utilization, and the use of special abilities or character skills (if present).
- **Progression and Balance:** To keep the game engaging, it's important for the difficulty levels and available features to gradually expand. Analyzing the balance between game difficulty and player capabilities helps create an engaging and balanced gameplay experience.
- **Player Units:** In Tower Defense games, players may create various units that can help delay enemies or support defense. These units may include characters such as fighters, mages, engineers, or mechanisms capable of obstructing enemy movement or directly attacking them.
- **Player Special Abilities:** For additional control over the battle, players may possess special abilities or skills. These abilities may include freezing enemies for a period, calling down a meteor shower that damages an area, placing mines along enemy paths, or activating a protective shield area to defend the base or towers from damage.

3.3. Design

To enhance the visual aspect of the game and ensure it captures the attention and imagination of players, two high-quality assets were invested in. These assets will not only elevate the overall aesthetic of the game but also contribute to a more immersive and engaging experience for users.

3.3.1. Tower Defense 2D game kit

This kit is an extensive collection of graphics for creating a 2D Tower Defense game (Figure 2). It includes tiles for level design, monster sprites for use as enemies, various combat and support towers, magic elements, and interface components. With this kit, create a full-fledged fantasy game. All graphic elements are created in Adobe Illustrator and are provided in vector format, allowing for easy resizing without loss of quality.



Figure 2: TOWER DEFENSE 2D GAME KIT listing image

3.3.2. GUI Pro - Fantasy RPG

This asset includes a GUI skin (Figure 3) with a demonstration scene layout and prefabs, as well as various item icons and pictograms. The elements are available in 1920x1080 resolution and are provided in PNG format. The assortment comprises over 1200 resources, including 361 pictograms and 90 unique item icons of various sizes.



Figure 3 : GUI Pro - Fantasy RPG listing image

3.4. Prototype

This figure (Figure 4) illustrates a prototype design for a tower defense game.

Key elements:

1. **Enemy Spawn Point:** This is the location on the map where enemy units start their journey. Enemies spawn here and begin moving along a predetermined path towards the finish point.

2. **Finish Point:** This is the endpoint on the map that enemies must reach. If any enemy reaches this point, the player loses one life or receives some damage. The number of lives is usually limited, and if they run out, the player loses.
3. **Enemies:** These are various enemy characters or creatures that move across the maps towards the finish point, attempting to overcome all obstacles and player's towers.
4. **Towers:** These are locations on the map where the player can build defensive structures for coins. Towers can attack enemies, dealing damage or applying other effects to help the player defend their base.
5. **Waves:** This is the number of waves in the current round of the game. Typically, waves increase the game's difficulty, including stronger and more numerous enemies.
6. **Inventory Button:** This is where all special abilities available to the player are located. These can be skills or items that the player can use to aid in battle.
7. **Speed Booster:** This is a feature that allows the player to speed up or slow down time in the game. Speeding up time can help in quickly passing waves or managing the situation on the map.
8. **Lives:** This is the number of lives the player can afford to lose before losing the game. Each time an enemy reaches the finish point, the player loses one life.
9. **Gold:** This is the amount of coins that the player can use to build towers and purchase other upgrades in the game.
10. **Gems:** This is a special currency in the game that can be used to buy special abilities, coins, and unique towers. Typically, gems are used to access special features or to speed up progress in the game.

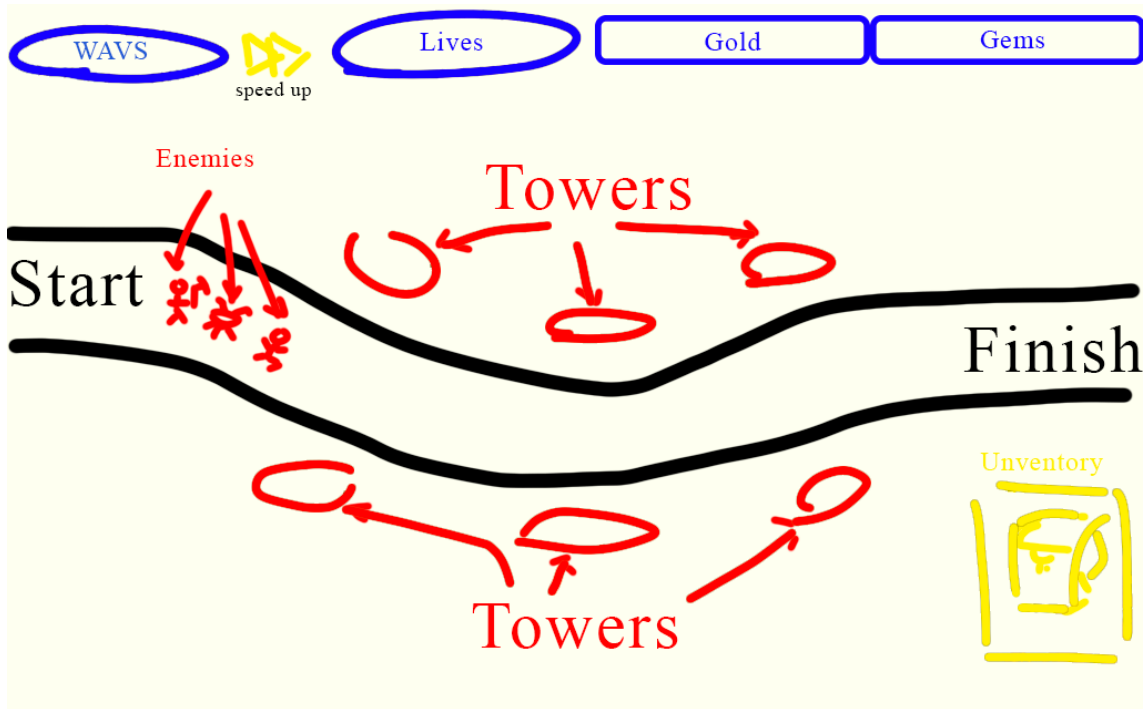


Figure 4 : Prototype

3.5. Artificial Intelligence

In modern strategy games, the integration of an artificial intelligence (AI) system to control enemies is crucial for creating a dynamic and challenging experience for the player. Enemy AI is responsible for managing how various types of enemies behave, move, interact with the player's units, and adapt to changing situations on the battlefield. This chapter explores the principles behind enemy AI management, from following designated paths with flexibility to initiating battles with player-controlled units. By examining the components of a robust AI-driven enemy system, we can gain insights into how it enhances gameplay and provides strategic depth.

Pathfinding and Waypoint System: The AI system in this game directs enemies along a series of waypoints, which are strategically placed across the map. Waypoints serve as guidance markers, helping enemies navigate through complex terrain, avoid obstacles, and follow a specific route toward their target destination. However, the pathfinding system is more than just rigid, point-to-point movement.

The AI includes a degree of flexibility in how enemies move, giving them a radius of freedom around each waypoint. Within this radius, enemies can adjust their movement slightly, resulting in a less predictable and more dynamic path. This prevents enemies from looking too mechanical or following overly rigid paths, adding realism and making it more challenging for the player to predict their exact movements. The AI's pathfinding with flexibility creates the impression of intelligent enemies that adapt to their surroundings and move purposefully across the map.

Encounter and Engagement Mechanics: A defining feature of the AI-driven enemy system is its ability to detect and engage with player units. When enemies encounter player-controlled units within a certain proximity, they stop following their path and initiate combat. This behavior adds a layer of real-time decision-making to the AI system.

The AI must evaluate both distance and priority when deciding whether to engage. For instance, if multiple player units are within range, the AI could prioritize certain types of units over others, perhaps targeting weaker or more vulnerable units first. Alternatively, the AI may opt to focus on high-threat units that pose a significant danger to their advance. By implementing these encounter and engagement mechanics, the AI can dynamically adapt to player actions and create a fluid, interactive battlefield.

Diverse Enemy Types and Unique Traits: To increase the strategic depth, the game includes various enemy types with unique traits that influence gameplay. Each type of enemy requires the player to adapt their strategy and use specific tactics to effectively counter the threats posed. Below are some examples of enemy traits managed by the AI system:

- **Flying Enemies:** Certain enemies possess the ability to fly, making them immune to attacks from ground-based towers or units that only target ground-level enemies. The AI controls these flying enemies differently, allowing them to ignore ground obstacles and move more directly towards their destination. This adds a new level of challenge, as players must invest in specialized anti-air towers or units to counter these threats.
- **Damage Resistance:** Some enemies exhibit resistance to specific attack types, such as melee or elemental attacks. The AI system recognizes these resistances and manages enemy behavior to leverage their strengths, potentially positioning them as front-line units to absorb damage or as decoys to distract the player's

defenses. This trait forces the player to diversify their arsenal and use attacks that can bypass or overcome resistances.

- **High-Speed Enemies:** Certain enemies are faster than others, making them harder to target with slow-firing towers or traps. The AI leverages these high-speed enemies to create a sense of urgency, as they quickly close the gap between the starting point and the destination. Players need to strategize carefully to slow down or control these speedy enemies, using area-of-effect abilities or traps that can impede their progress.
- **Special Abilities:** Some enemies are equipped with special abilities that can alter the flow of battle. For example, some may have the ability to summon additional allies, creating an instant reinforcement of enemy forces. Others may generate force fields that provide temporary immunity to attacks. The AI activates these abilities based on contextual triggers, such as health thresholds or proximity to player units, creating unpredictable and varied encounters that keep the player engaged.

4. Dynamic and Reactive Enemy Behavior

The AI system also incorporates a degree of dynamic behavior, allowing enemies to adjust their actions in response to changes on the battlefield. For instance, if a pathway becomes heavily fortified with player defenses, the AI may route some enemies along alternative paths or use their movement flexibility to avoid heavily guarded areas.

Additionally, the AI can trigger certain behaviors based on the status of nearby enemies. For example, if a unit is heavily damaged, the AI may decide to retreat or seek out reinforcements if such mechanics are part of the game design. This makes the enemies feel more adaptive, and their responses more in line with an intelligent adversary, further challenging the player to anticipate enemy actions.

3.6. Game Elements

Game elements are the building blocks of how the game works, shaping the way players interact with the world around them and with each other. In this section, we'll take a closer look at the key objects you'll encounter while playing, what makes them unique, and how they contribute to a fun gaming experience. We'll cover different types of towers, enemies, skills, levels, and menu interfaces that players use to defend against waves of foes and tackle various challenges.

Every game element is carefully designed to have its own set of traits that can greatly affect the strategies and tactics players use. For example, towers are your main line of defense, each equipped with specific attack types, ranges, and special abilities that you'll need to master. You can pick from a variety of towers, like archers, gunmen, and mages, each adding its flavor to your overall defense. The towers you choose not only determine how you respond to immediate enemy waves but also influence your long-term strategies. As the game progresses, you'll have to adapt to tougher challenges and different types of enemies.

Now, let's talk about the enemies. They are the primary threat to your defenses and come in all shapes and sizes. They vary in speed, health, and abilities, which means you need to constantly evaluate the strengths and weaknesses of your own defenses. Understanding how enemies behave and tweaking your strategies based on that is crucial for surviving and succeeding in the game.

And then there are the supporting structures, like selection maps and menus, which really enhance your overall experience. The selection map lets you pick levels and plan your approach, while the menu interface makes it easy to navigate through different game functions, adjust settings, and track your progress.

In essence, all these game elements work together to create a dynamic and engaging experience. The interplay between towers, enemies, and supportive structures encourages players to think critically and strategize effectively, making every game session a unique adventure.

3.6.1. Towers

Towers are the cornerstone of the game's defensive strategy, serving as the primary means by which players can combat waves of enemies. Each tower type is designed with unique capabilities, strengths, and weaknesses, allowing players to craft a diverse array of strategies based on their individual play styles. Understanding the functionality and tactical applications of each tower is essential for successful gameplay.

1. Archer: The Archer (Figure 5) Towers are the cornerstone of the game's defensive strategy, serving as the primary means by which players can combat waves of enemies. Each tower type is designed with unique capabilities, strengths, and weaknesses, allowing players to craft a diverse array of strategies based on their individual play styles. Understanding the functionality and tactical applications of each tower is essential for successful gameplay.



Figure 5 : Archer tower

1. Gunmen: The Gunmen (Figure 6) are specialized in taking down airborne threats. Their rapid-fire projectiles are highly effective against flying enemies that might bypass other towers. The Gunmen can also provide valuable support against ground enemies, making them a versatile addition to any defensive setup. Players should position Gunmen strategically to maximize their coverage of aerial paths and ensure a balanced defense.



Figure 6 : Gunmen tower

2. Cannoneer: The Cannoneer (Figure 7) is a powerful area-of-effect tower that hurls massive stones at groups of enemies. Its significant damage output makes it particularly effective against tightly clustered foes. However, the Cannoneer has a slower attack rate, requiring careful placement to hit as many enemies as possible before they reach the tower's range. Players can leverage the Cannoneer's area damage to clear out waves of weaker enemies or soften tougher foes before they reach other defenses.



Figure 7 : Cannoneer tower

3. Mage: The Mage (Figure 8) harnesses magical spells to attack both ground and airborne targets from a distance. With abilities that can inflict higher damage and additional effects such as freezing or slowing enemies, the Mage is invaluable for crowd control. Players can enhance the Mage's magical abilities through upgrades, allowing it to deal devastating damage to stronger enemies or provide strategic advantages during critical moments in battle.



Figure 8 : Mage tower

4. Poison Tower: The Poison Tower (Figure 9) excels at dealing damage over time. Its attacks release poisonous trails that linger on the battlefield, continuously

damaging any enemies that pass through. This tower is particularly effective against waves of weaker enemies, as it can weaken them before they reach the frontline defenses. Players should consider combining the Poison Tower with other towers for synergistic effects, as the poison damage can soften enemies for more potent attacks from other towers.



Figure 9 : Poison tower

5. Launcher: The Launcher (Figure 10) is a heavy artillery tower that fires explosive rockets at enemies. This tower becomes available after reaching a certain level and is especially powerful against large groups of enemies. Its ability to deal high area damage makes it an essential asset for clearing out waves. However, players must be mindful of its cooldown period and ensure it is positioned to cover critical paths, maximizing its destructive potential.



Figure 10 : Launcher tower

6. Thunder Tower: The Thunder Tower (Figure 11) is the ultimate defensive structure that unleashes devastating lightning strikes on enemies. With a high damage output and the ability to hit multiple targets, the Thunder Tower can turn

the tide of battle. Its visual spectacle and power make it a favorite among players, but it requires careful resource management and strategic placement to optimize its impact on the battlefield.

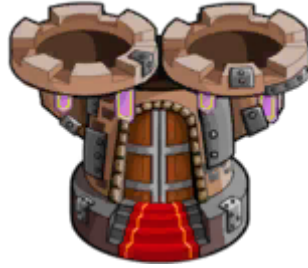


Figure 11 : Thunder tower

3.6.2. Skills

1. Reinforcement: Reinforcement (Figure 12) is the ability to summon two additional units to hold back enemies on a specific part of the map. These units can be used to reinforce defense on vulnerable areas or to create temporary blockades to prevent enemies from advancing towards your base. When activated, the Reinforcement skill can be deployed in any area of the map that is currently under threat. Players must choose wisely where to place these units, as their positioning can significantly impact the effectiveness of the defense. For example, summoning reinforcements at a choke point can create a formidable blockade that slows down the enemy's advance, giving other towers more time to attack and inflict damage. Using the Reinforcement skill effectively requires careful planning and timing. Players need to assess the flow of the battle and anticipate enemy movements to maximize the impact of the additional units. For instance, if a particularly strong wave of enemies approaches, deploying reinforcements just before they arrive can be the difference between a successful defense and a breach of the base.



Figure 12 : Reinforcement Icon

2. Frost Power: Frost Power (Figure 13) is the ability to freeze enemies for a short time. When activated, enemies are surrounded by a layer of ice, slowing them down and temporarily halting their movement. This gives the player extra time to rebuild defenses or focus efforts on other parts of the map. The duration of the freeze effect is an important aspect of this skill. While it may only last a few seconds, this brief window can be pivotal in high-pressure situations. Players can use the time gained to repair or upgrade towers that might be taking heavy damage, deploy reinforcements, or position additional defenses in preparation for incoming waves. The strategic placement of Frost Power can turn the tide of battle by buying players precious time to enhance their defensive setup or redirect their attention where it's needed most. Additionally, the Frost Power skill can be particularly effective when dealing with tougher enemies or bosses. These foes often have higher health and can deal significant damage to defenses. By freezing them temporarily, players can significantly reduce the pressure on their towers, allowing for a more concentrated attack without the immediate threat of being overwhelmed.



Figure 13 : Frost Power Icon

3. **The Lord's Fire:** The Lord's Fire (Figure 14) is a devastating ability that unleashes a powerful fiery blast, striking enemies within a designated small area. When activated, this skill sends forth an intense wave of flames, dealing significant damage to all enemies caught in its radius. This makes it an invaluable tool for players looking to inflict mass damage and weaken or eliminate large groups of foes quickly. The area of effect is a critical aspect of the Lord's Fire skill. While it targets a specific zone, players must carefully consider their positioning and timing when deploying it. Using the skill in areas where multiple enemies converge can maximize its impact, turning the tide of battle in favor of the player. Whether it's a horde of weaker enemies or a cluster of stronger foes, the ability to deal area damage provides players with a strategic advantage against overwhelming odds. Additionally, the Lord's Fire skill can serve as an effective crowd control mechanism. By damaging multiple enemies at once, it can disrupt their momentum and slow their advance, giving players additional time to regroup and reinforce their defenses. This can be particularly beneficial during intense waves, where enemy numbers threaten to overwhelm defenses and create chaos.

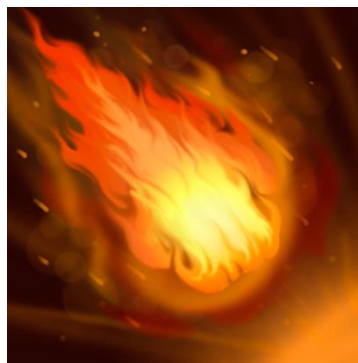


Figure 14 : The Lord's Fire Icon

4. **Mines:** Mines (Figure 15) are devices placed on the map that are activated when enemies approach. Upon detonation, mines deal damage to all enemies within the blast radius, making them an effective means of controlling advancing waves of foes. Mines can be strategically positioned on enemy paths or in vulnerable defense points. Mines represent a unique gameplay element that allows players to set traps capable of significantly altering the course of battle. By strategically placing mines on key routes that enemies are likely to take, players can create areas where foes are subjected to sudden attacks, taking substantial damage before reaching defensive structures. One of the key aspects of utilizing mines is their

activation timing. Players must carefully decide when and where to deploy mines to maximize their effectiveness. If mines are activated too early, enemies may still be too weak to incur serious damage. Conversely, if they are set too late, foes may have already passed, rendering the mines ineffective.



Figure 15 : Mines Icon

5. Toxic Puddle: Toxic Puddle (Figure 16) creates an area on the map contaminated with toxic substances that inflict damage on all enemies within its radius. Upon contact with the toxic puddle, enemies begin to take damage over time, making this ability an effective means of controlling large groups of foes and slowing their progress. The strategic placement of Toxic Puddles is crucial for maximizing their effectiveness. Players can deploy this ability in high-traffic areas where enemies are likely to converge, ensuring that a large number of foes are exposed to its damaging effects. This makes the Toxic Puddle particularly valuable during intense waves of enemies, where controlling the flow of enemies can be the difference between victory and defeat.

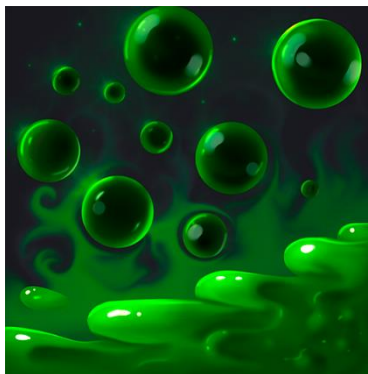


Figure 16 : Toxic Puddle Icon

3.6.3. Enemies

"Enemies" are the opponents trying to breach the player's defensive lines. Enemies vary by type, possessing different characteristics and unique abilities. Some enemies move faster but have lower health, while others are slower but have high armor. The game also features airborne enemies that can only be targeted by specific types of towers. Each type of enemy requires a thoughtful approach and a combination of various towers for effective elimination.

1. Enemy Bone (Figure 17): The **Enemy Bone** is a formidable creature made entirely of bones, which gives it a haunting and intimidating presence. This skeletal adversary attacks the player using its sharp, jagged bones as weapons, inflicting damage and creating a sense of urgency during encounters. It can take on various forms, such as a traditional skeleton or a more grotesque amalgamation of bones. Regardless of its appearance, the Enemy Bone poses a significant challenge due to its resilience and strength, with a higher health pool than many other foes, requiring players to employ strategic thinking and quick reflexes to overcome it effectively.



Figure 17 : Enemy Bone

2. Enemy Bat (Figure 18): fast and maneuverable creature that resembles a bat. It moves swiftly through the air, making it difficult for players to target. Its erratic flight patterns can be disorienting, as it swoops in to attack the player's units. The Bat's speed and agility make it a persistent threat, often overwhelming players who are unprepared. Players must be quick to react and anticipate the Bat's movements to effectively defend against this aerial menace..



Figure 18 : Enemy Bat

3. Enemy Bandit with Axe (Figure 19): ruthless foe armed with a hefty axe. This enemy uses its weapon to deal heavy damage to player units, striking with ferocity. Often found as part of a gang or group of robbers, these bandits are known for their ambush tactics, lurking in the shadows until the right moment to attack. Their brute strength combined with their unpredictable ambush behavior makes them a significant threat on the battlefield.



Figure 19 : Enemy Bandit with Knife

4. Enemy Bandit with Knife (Figure 20): swift and agile adversary that attacks player units with a sharp knife. This enemy relies on speed and cunning, often striking quickly and retreating before players can mount a defense. Their quick, slashing attacks can disrupt the player's strategies, making them dangerous foes in close combat. Players must be vigilant and ready to respond to the Bandit's fast-paced attacks.



Figure 20 : Enemy Bandit with Mace

5. Enemy Bandit with Mace (Figure 21): wields a massive mace, using it to deliver devastating strikes against player units. This enemy is known for its heavy attacks that can knock back or incapacitate weaker units. With its sheer strength and the ability to break through defenses, the Bandit with Mace poses a formidable challenge. Players must find ways to outmaneuver or overwhelm this enemy before it can unleash its powerful attacks.



Figure 21 : Enemy Bandit with Mace

6. Enemy Bandit with Sword (Figure 22): skilled combatant armed with a sharp sword. This enemy utilizes its weapon with precision, executing swift and lethal attacks against player units. With its balanced combination of speed and strength, the Bandit with Sword can engage players effectively in combat. Players need to stay alert and be ready to counter this enemy's strikes, as its skillful swordplay can quickly turn the tide of battle.
- 7.



Figure 22 : Enemy Bandit with Sword

8. Enemy Bug (Figure 23): small but aggressive insect that attacks player units with its sharp fangs or venomous sting. Despite its size, this enemy can overwhelm players through sheer numbers, as they often swarm around their targets. The Bug's quick movements and ability to inflict damage can catch players off guard, making it essential for players to manage these threats quickly to avoid being overrun.



Figure 23 : Enemy Bug

9. Enemy Executioner (Figure 24): grim and powerful warrior equipped with a heavy sword or axe. Known for their brutal efficiency, Executioners deliver heavy blows that can deal significant damage to player units. Their intimidating presence on the battlefield commands respect and fear, forcing players to approach with caution. The Executioner's strength and durability make it one of the more formidable adversaries players will encounter.



Figure 24 : Enemy Executioner

10. Enemy Fat Man (Figure 25): massive opponent with a large health pool, making it challenging to take down. This enemy can absorb a significant amount of damage before being defeated, allowing it to charge into battle with little regard for its safety. The Fat Man's sheer size and strength make it a formidable threat, and players must focus their firepower and coordination to overcome this hulking adversary.



Figure 25 : Enemy Fat Man

11. Enemy Spider Blue (Figure 26): venomous insect that attacks player units with its swift strikes and toxic fangs. This enemy is known for its agility, allowing it to quickly navigate the battlefield and evade attacks. The Spider Blue's venom can deal damage over time, posing a lingering threat to players who underestimate its capabilities. Players need to be wary of this enemy's swift movements and the potential for ongoing damage from its venomous attacks.



Figure 26 : Enemy Spider Blue

12. Enemy Wolf Gray (Figure 27): predatory beast that attacks player units in packs. Known for their teamwork and coordination, these wolves can overwhelm players by flanking and surrounding them. Their keen senses and agility make them dangerous adversaries, as they can quickly close the distance and launch coordinated attacks. Players must develop strategies to deal with multiple wolves simultaneously, utilizing area damage abilities or teamwork to fend off these relentless hunters.



Figure 27 : Enemy Wolf Gray

3.6.4. Level Selection Map

The level selection map (Figure 28) consists of 3 zones: green, desert, and dark.

1. Green Zone: The journey begins in the Green Zone, a charming forest that boasts lush greenery, shimmering lakes, and a serene kingdom. This vibrant area is designed to introduce players to the game's mechanics in a welcoming environment. Here, players can familiarize themselves with basic controls and strategies while enjoying the peaceful scenery. The Green Zone encourages exploration and interaction with friendly NPCs, who provide simple quests to help players learn the game. This initial setting creates a sense of comfort and excitement as players embark on their adventure.

2. Desert Zone: Transitioning from the Green Zone, players find themselves in the Desert Zone, a stark contrast characterized by vast, sun-scorched landscapes and relentless sandstorms. The environment is unforgiving, testing players' resilience and resource management skills. In this zone, players encounter new enemy types and environmental hazards, which require them to adapt their strategies. As they navigate through the harsh terrain, players will discover hidden treasures buried beneath the sands, providing opportunities for exploration and reward. The challenges of the Desert Zone prepare players for more intense battles and resourceful decision-making.

3. Dark Zone: Finally, players enter the Dark Zone, a foreboding realm where danger and evil lurk. This area presents the most formidable challenges yet, demanding players to summon their skills and strategies as they face powerful enemies. The atmosphere is thick with tension, and each step taken requires careful planning. The Dark Zone serves as the climax of the player's journey, where they confront the ultimate antagonist and navigate pivotal moments that will determine the outcome of their adventure. Overcoming the trials of this zone marks significant growth in the player's abilities and deepens their understanding of the game's mechanics.



Figure 28 : Level Selection Map

3.6.5. Menu

Game Menu (Figure 30): The Game Menu is designed to provide players with essential functionalities that enhance their gaming experience. The layout includes several key elements, each serving a specific purpose, as illustrated in the accompanying prototype (Figure 29).

1. **Shop:** The Shop section allows players to purchase in-game items using either in-game currency or real money. The product range encompasses various towers, in-game currency (gems), and gold, giving players the flexibility to expand their gaming capabilities according to their preferences. Players can browse through a selection of items to enhance their gameplay, from powerful towers that defend against enemy waves to essential resources needed for progression. The shop is intuitively organized, making it easy for players to find the items they need to strengthen their strategies.
2. **Upgrades:** In the Upgrades category, players can utilize a special currency known as "stars" to enhance various game elements. This feature allows players to improve tower damage, increase the effectiveness of their units, and unlock additional abilities. The upgrade system encourages players to invest in their gameplay style and adapt their strategies based on their experiences. By spending stars, players can tailor their defenses to better combat the challenges they face as they progress through the game.
3. **About the Game:** The About the Game section provides valuable information regarding towers, skills, and strategic tips available within the game. This resource is designed to assist players in developing their strategic thinking and improving their overall effectiveness in gameplay. By understanding the strengths and weaknesses of different towers and skills, players can formulate more effective strategies and make informed decisions during their battles.
4. **Gems:** Gems represent a special form of in-game currency, allowing players to make various purchases in the shop and spend on upgrades. Gems can be acquired through gameplay or purchased directly, providing players with opportunities to enhance their gaming experience. The use of gems facilitates quick access to essential items, enabling players to respond to immediate challenges more effectively.

5. Stars: Stars are awarded for successfully completing levels across three difficulty tiers: easy, medium, and hard. Classified into levels 1, 2, and 3, stars serve as a reward system that incentivizes players to explore diverse gameplay styles and tackle challenges at varying difficulty levels. This structure not only motivates players to improve their skills but also enriches the overall gameplay experience by promoting versatility and engagement.

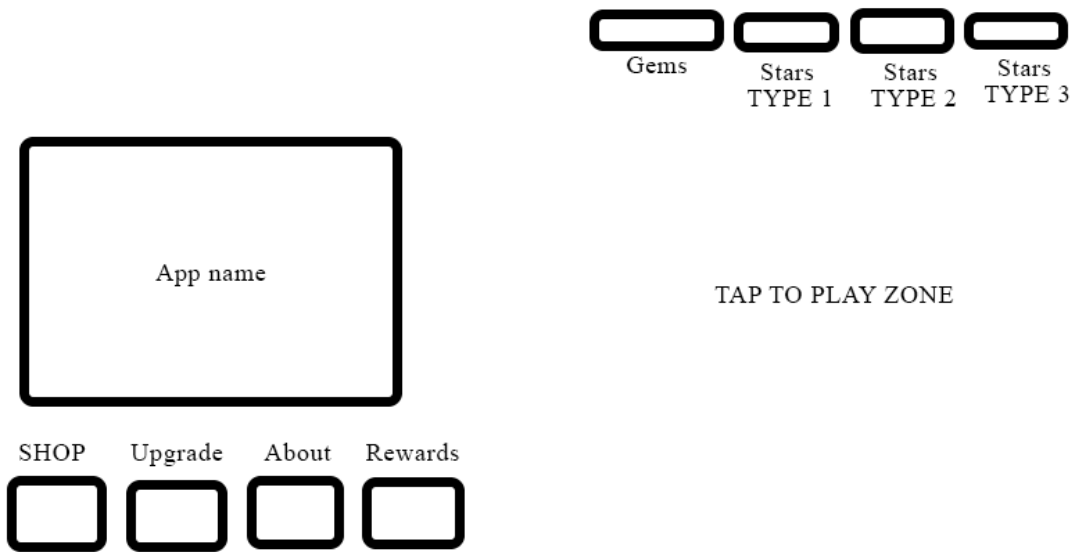


Figure 29 : Menu prototype

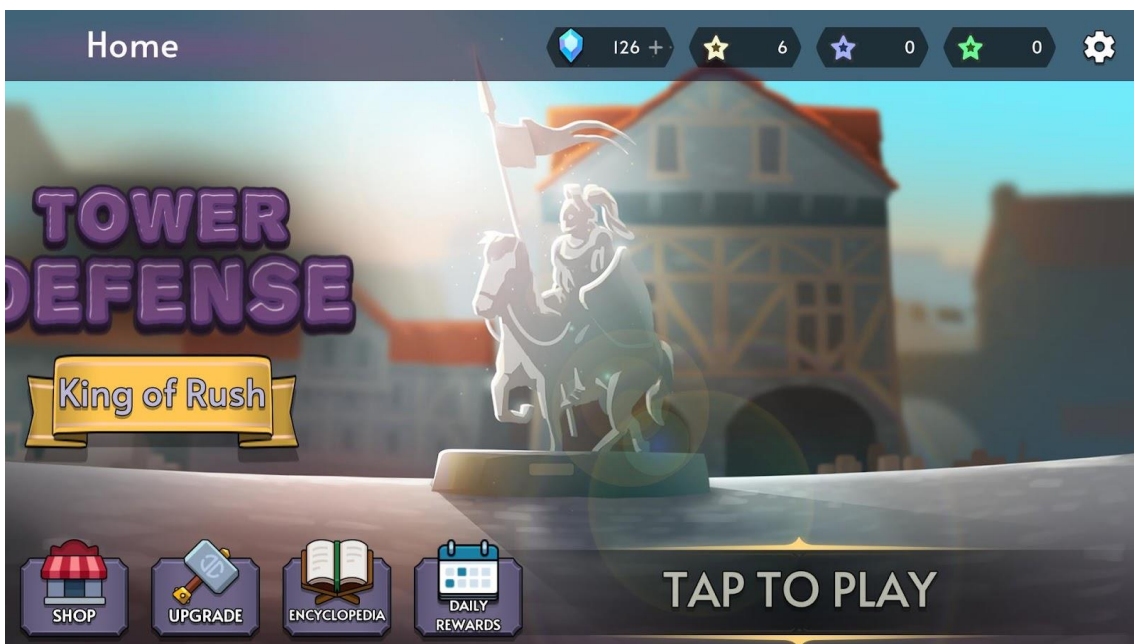


Figure 30 : Menu in game

3.6.6. Daily Rewards

The Reward Window (Figure 31) is a critical feature in mobile games, designed to engage and motivate players through daily interactions. The primary purpose of this feature is to encourage consistent player retention by offering rewards over a set period, typically on a weekly or monthly basis. The structure of the Reward Window is generally organized into consecutive days, with increasingly valuable rewards as the player progresses, incentivizing daily logins. For example, the player receives 20 gems on Day 2, and on Day 7, they get 50 gems.

On the left side, there are weekly tabs, allowing players to track their progress and view upcoming rewards for several weeks ahead. This helps maintain long-term interest in the game.

Each reward becomes available after logging in and is marked with a checkmark once claimed. At the bottom of the window, there is a "Claim" button that allows the player to collect the reward for the day.

The Reward Window plays a key role in player retention by motivating players to return to the game daily. The longer the player logs in, the better the rewards, maintaining interest and encouraging regular engagement with the game.



Figure 31 : Daily Rewards Winwow

4. Monetization Strategies and Their Implementation in the Game

Key functions for monetization in this project:

- In-App Purchases
- Advertising

4.1. In-App Purchases

An in-app purchase, or IAP for short, is a feature that allows app owners to sell content, services, or additional functionalities directly within the app to the end user[7]. This encompasses purchasing in-game currency, additional levels, features, content, subscriptions, and more.

IAPs serve as a primary revenue stream for many app and game developers, enabling them to offer their products for free or at a nominal cost while providing additional features or content for a fee. The "freemium" model, in particular, has gained traction, where the app is free but supplementary content or functionalities incur additional charges .

From a user standpoint, IAPs offer the flexibility to personalize and enrich their app experience. They can gain access to premium features or content that enhance satisfaction and engagement with the app or game. Nonetheless, users should exercise caution to avoid inadvertent spending or unexpected expenses.

Several types of in-app purchases are integrated into the developed game:

Currency-based monetization: Players can simplify their gameplay by purchasing in-game currency (Figure 33). This model allows players to acquire various advantages, enhancements, items, or other content within the game using the purchased currency. This approach is prevalent in many games, particularly in mobile applications. Players can buy in-game currency with real money, enabling them to accelerate progress, obtain exclusive items or advantages, and unlock new levels or features.

For game developers, currency-based monetization is a lucrative model as it allows them to generate revenue from the game even from players who do not pay for the app itself. Additionally, it can enhance player engagement and satisfaction by providing them with opportunities to expedite progress or access exclusive content.

However, it's essential to acknowledge that in-app purchases may result in additional expenses for players, and some may perceive it as a form of "pay-to-win" experience, which can lead to dissatisfaction among certain users. Maintaining a balanced and fair gameplay experience for all players, irrespective of their willingness or ability to make in-app purchases, is crucial for the long-term success and sustainability of the game. Implementing measures to mitigate potential negative perceptions, such as offering alternative progression paths or ensuring that in-app purchases do not provide disproportionate advantages, can help foster a positive player experience and community engagement.

Tower-based monetization: introduces a unique twist to the traditional in-app purchase model by offering players the opportunity to acquire special towers or elements within the game (Figure 32). These towers come with enhanced attributes, unique abilities, or advanced features that set them apart from standard in-game assets.

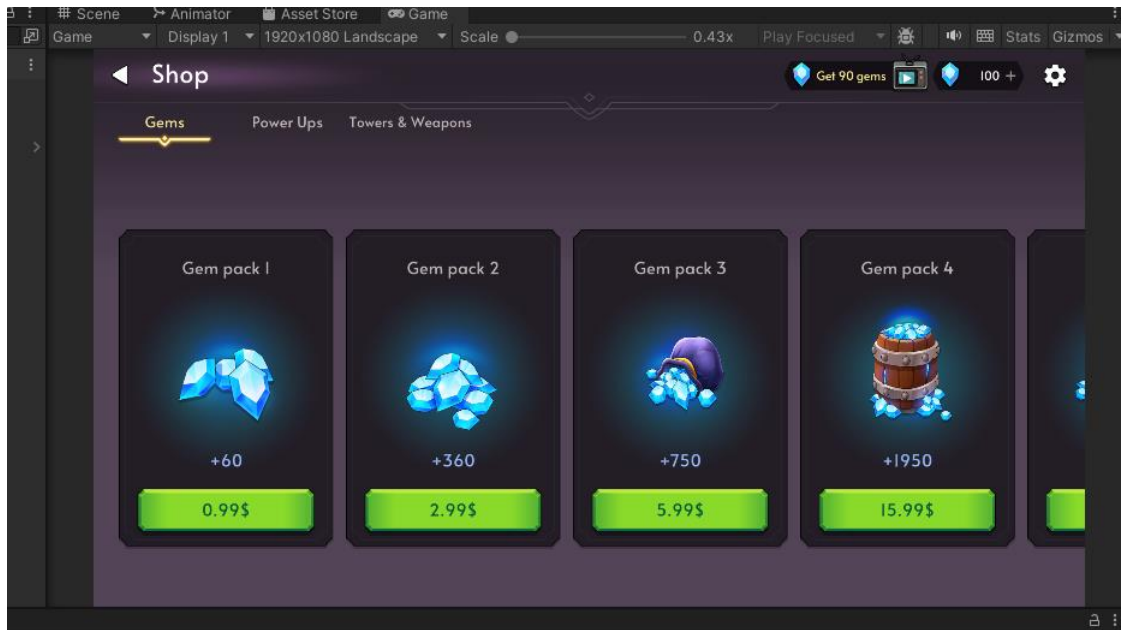


Figure 32 : Game store. Gems tab.

For players, the allure of tower-based monetization lies in the promise of unlocking new gameplay experiences and strategic options. By purchasing these premium towers, players can gain a competitive edge, overcome challenges more efficiently, and explore alternative tactics to progress through the game. Additionally, the enhanced animations and visual effects associated with these premium towers contribute to a more immersive and engaging gaming experience.

From a developer's perspective, tower-based monetization presents a compelling revenue opportunity. By offering premium towers as in-app purchases, developers can capitalize on players' desire for customization and progression within the game. This monetization model not only generates additional revenue streams but also incentivizes ongoing player engagement and investment in the game's ecosystem.

However, the implementation of tower-based monetization requires careful consideration to maintain game balance and fairness. Developers must strike a delicate balance between offering enticing premium content and ensuring that the core gameplay experience remains enjoyable for all players, including those who choose not to make in-

app purchases. Moreover, transparent pricing and clear communication about the benefits of premium towers are essential to foster trust and satisfaction among players.

In summary, tower-based monetization adds depth and versatility to the in-app purchase landscape, offering players new avenues for customization and progression while providing developers with a sustainable revenue model. By prioritizing player satisfaction and maintaining a fair and balanced gaming environment, developers can maximize the potential of tower-based monetization to drive success in their games.

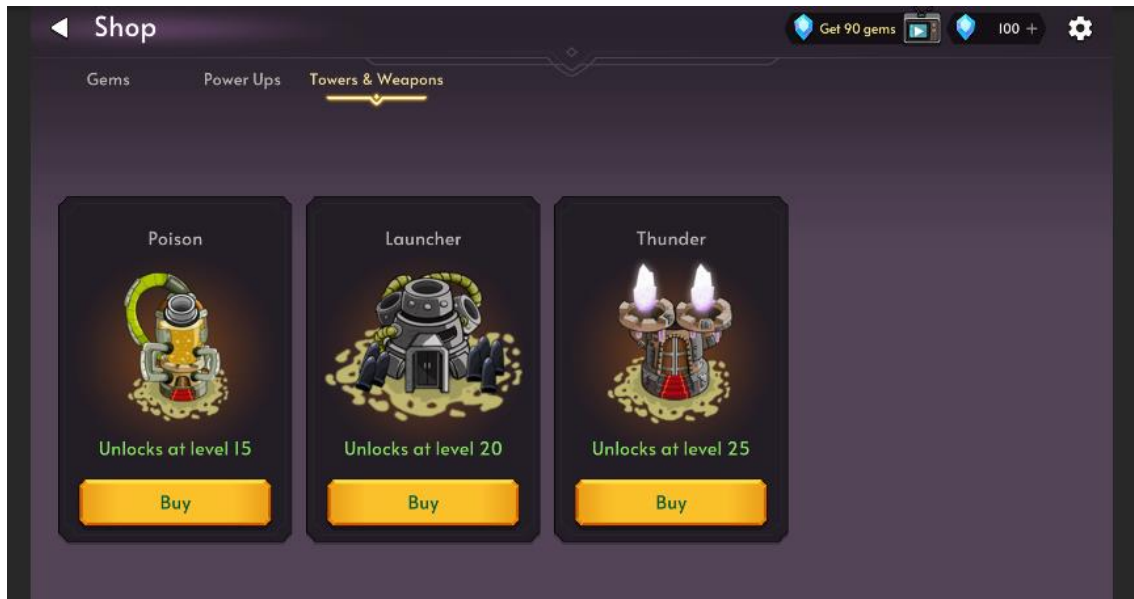


Figure 33 : Game store. Towers tab

4.1.1. In-App Purchases Implementation

For implementing in-app purchases in this game, the Unity In-App Purchases Plugin was chosen. This plugin provides developers with a convenient and reliable way to integrate purchases into the application, offering ease of use and a wide range of functionality.

The plugin ensures the security and reliability of the purchase process, which is important for both developers and users. It provides mechanisms for fraud protection and ensures the confidentiality of user data during purchases.

Additionally, the Unity In-App Purchases Plugin offers a wide set of features, including support for various types of purchases, product and price management, transaction processing, and more. This allows developers to easily customize and manage

their in-app purchases, as well as conduct analytics and optimization of the monetization process.

Overall, the Unity In-App Purchases Plugin (Figure 34) is an excellent choice for implementing in-app purchases in Unity projects, providing convenience, reliability, and extensive functionality for developers while meeting users' needs for secure and convenient in-app purchases.

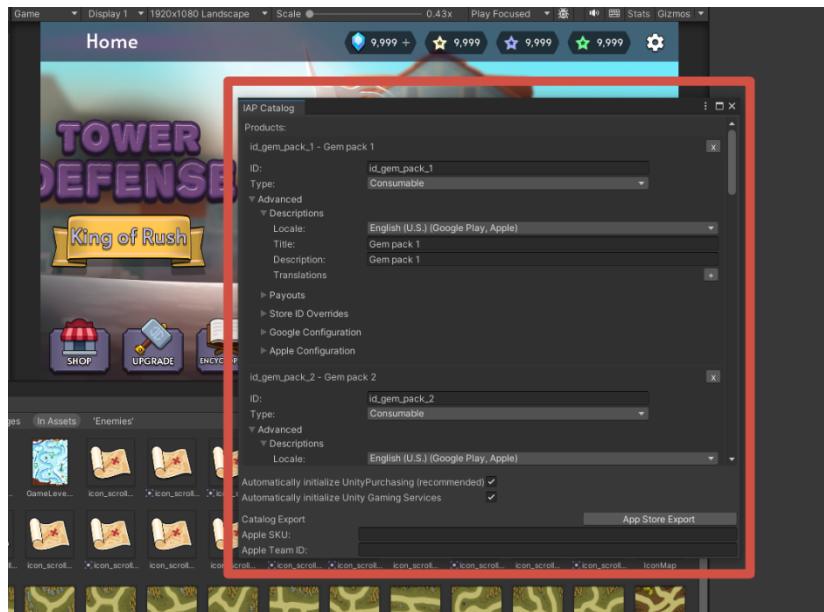


Figure 34 : IAP Catalog

4.2. In-App Advertising

In-game advertising, or IGA is promoting a brand pre, mid, or post-game. Game developers sell space within their games, and these in-game ads come in various formats. The ads can be in the form of video ads, audio ads, or banners[8].

4.2.1. Interstitial

This form of advertising appears between different levels, stages, or game loads. It typically includes full-screen or nearly full-screen ads that appear before or after completing a level, during breaks between gaming sessions, or at other appropriate places in the game. This form of advertising is often used by game developers to monetize their

products, as it allows them to earn revenue through ad impressions. While it may be a minor annoyance for players, for developers, it's one way to generate income from free or cheap games. Platforms and ad networks providing interstitial advertising in games usually require the ad to be closed or skipped after a certain time, such as 5 seconds after it starts displaying. This is done to improve the user experience and reduce irritation from ads. Users are given the option to quickly resume the game by bypassing the ad if they are not interested in viewing it. In the game, this type of advertising is presented only in one place - at the end of the level. When a player presses the "continue" button, they see this type of advertising (Figure 35).

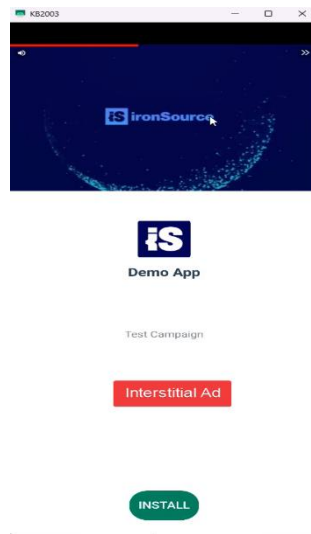


Figure 35 : Iron Source test ad

4.2.2. Rewarded

In-game advertising is a form of advertising that offers players rewards in exchange for viewing ad content. Typically, this involves offering game bonuses, currency, extra lives, or other gaming benefits for watching a short video or performing certain actions related to the ad.

This form of advertising is popular among game developers as it allows them to monetize their products by offering players the opportunity to enhance their gaming experience in exchange for interacting with advertising content.

For players, rewarded advertising is usually more favorably perceived than other forms of advertising, as it provides them with direct benefits in the game. At the same time, most platforms and ad networks also usually provide the option to close or skip the

ad after fulfilling the reward conditions, which helps maintain the user experience and reduce irritation from ads.

This type of advertising can be found: On the in-game currency purchase scene. If players want to get some diamonds for free, they can watch an ad (Figure 36).

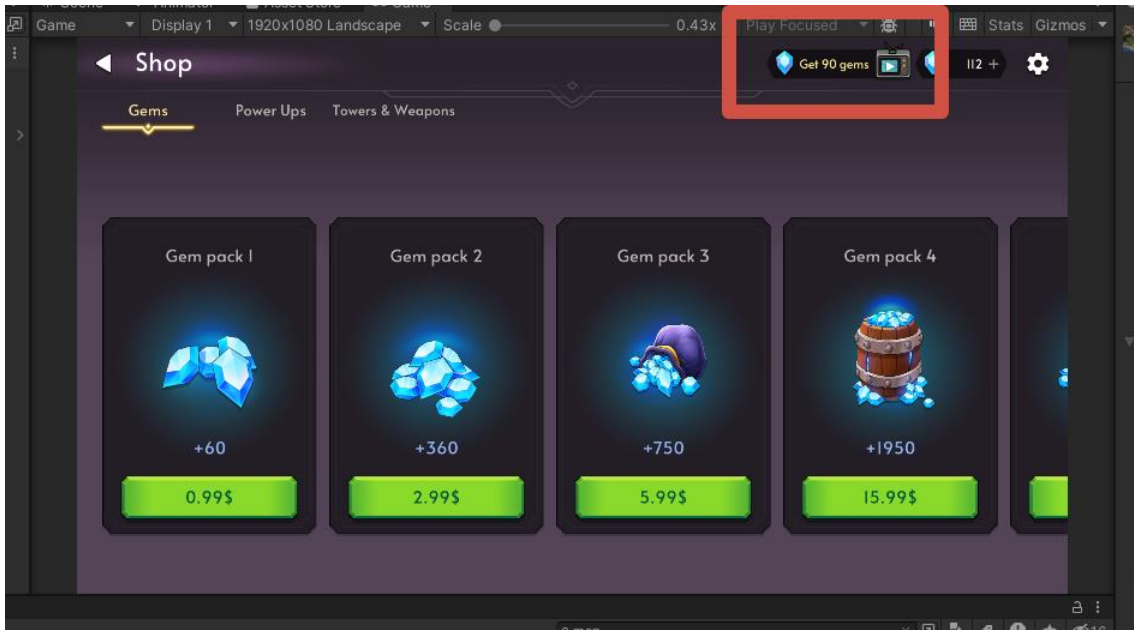


Figure 36 : Get gems for ads button

After completing a level, players could get additional diamonds after watching an advertisement at the end of the level (Figure 37).



Figure 37 : Extra gem button

4.2.3. Ads Implementation

To implement in-game advertising in this game, the IronSource plugin was used. This plugin is a powerful tool for integrating various types of advertising into applications and games, providing developers with convenience and efficiency in monetizing their products.

One of the main advantages of IronSource is its ability to integrate multiple ad networks simultaneously. This allows developers to access a wide range of advertising offers and maximize their ad revenue. IronSource automatically selects the best offers among the available ad networks, ensuring optimal revenue and user experience.

IronSource also provides developers with tools for managing and analyzing their advertising campaigns, allowing them to effectively track and optimize their monetization. This includes the ability to track ad impressions, view counts, conversions, and other metrics necessary to evaluate the effectiveness of the advertising strategy.

Thanks to its wide functionality and ease of use, IronSource is becoming a popular choice among game developers for monetizing their products through in-game advertising. Its ability to integrate multiple ad networks and optimize revenue makes it an ideal tool for effectively monetizing games and applications (Figure 38).



Figure 38 : Iron Source Graph

5. Publication

The game was successfully published on Google Play on April 20, 2024. To publish an application on Google Play, developers must perform a series of actions:

- **Creating a developer account on Google Play Console**

The initial and important step for those who want to publish an application on the Google Play store. This allows access to the tools and resources necessary for uploading and managing your applications.

Upon completing registration, you will gain access to Google Play Console, where you can begin uploading and managing your applications. Here you can add new applications, update existing ones, configure their settings and monetization, as well as track download and revenue statistics.

Creating a developer account gives you full control over your applications in the Google Play store, allowing you to effectively manage their lifecycle and monetization. It also opens up opportunities for growth and development of your mobile app development business

- **Preparing the application for publication**

An important stage that requires attention to detail and a systematic approach. In addition to testing on various devices and screen resolutions, as well as ensuring stability and security, there are several other aspects to consider.

First, it is necessary to ensure that the application complies with all app store requirements, including Google Play rules and recommendations. This includes

adherence to design standards and user experience, as well as ensuring the proper functionality and security of the application.

- **Filling in the application information in Google Play**

Console is a key stage that will help attract the attention of potential users and increase the number of downloads of your application. Here are some details of what this process includes:

Application Name: You need to choose a unique and memorable name for your application. It should clearly reflect the essence of the application and be attractive to the target audience.

It was decided to name the game TD King of Rush: Tower Defense. **Application Icon (Figure 39):** This is the first thing users will see in the store. The icon should grab attention and reflect the key features of the application. It should be clear, high-quality, and comply with Google Play design recommendations.



Figure 39 : Game Icon

Application Description: Describe the main features and characteristics of the application in the description.

Screenshots and Videos (Figure 40): Quality screenshots and videos demonstrating the main features and interface of your application should be added. This will help users better understand how the application works and increase the likelihood of downloads.



Figure 40 : Game Screen for Store

Publishing the Application: After successful verification and testing of the application, you can publish it on Google Play by clicking the appropriate button in Google Play Console.

APK File: The APK file of the application must meet all Google Play requirements. This includes ensuring its security, compliance with data usage policies and store rules, as well as checking for errors and compatibility with various devices and Android OS versions.

Publishing the application on Google Play (Figure 41) is the final stage before it becomes available to millions of users worldwide. After successful verification and testing of your application, you need to publish it so that users can download and install it on their devices (Figure 42).

Google Play Market Link:

<https://play.google.com/store/apps/details?id=com.ElbowGames.TowerDefense>

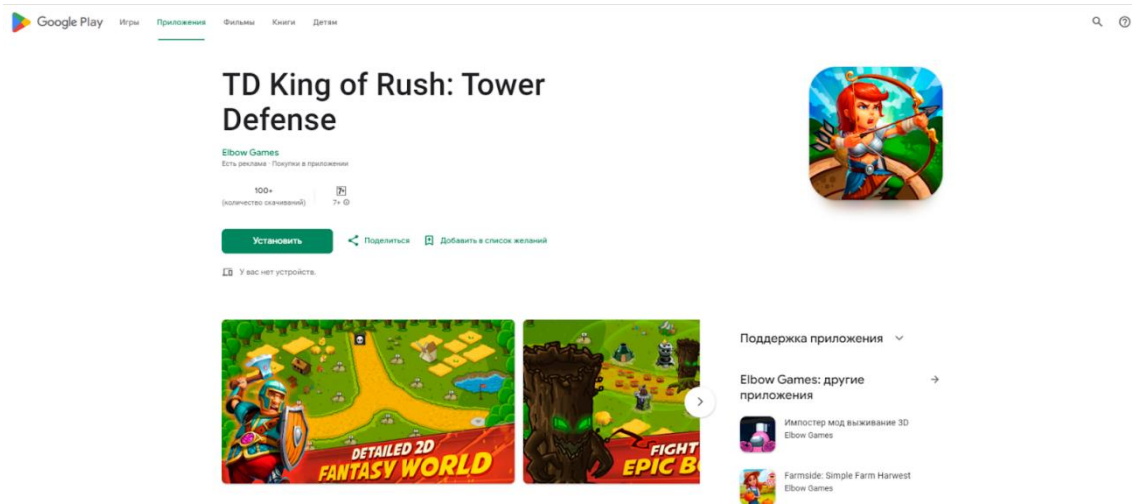


Figure 41 : Game page in Google Play in Windows

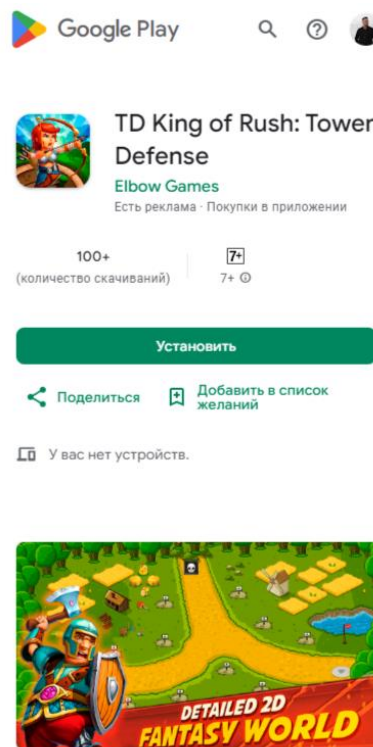


Figure 42 : Game page in Google Play in Android

6. Analytics

Data is a powerful tool in the world of business. Collecting, aggregating, and analyzing it will deliver opportunities on what's working. After all, if you don't measure it, you can't improve it[9].

6.1. General Analytics

Key data presented:

- The total number of installations is 152.
- There is a significant increase of 1,420%.

The line graph (Figure 43) indicates a steady upward trend in the number of installations over the observed period, starting from zero and gradually reaching 152. The overall trajectory shows continuous growth without any notable declines.~



Figure 43: Total Installations

Key data presented:

- Average engagement time is 51min.
- Engaged sessions per user of 2.7.

Users are staying for a substantial amount of time, which can imply they are finding the content useful, entertaining, or informative. This is a positive indicator for content quality and user experience (Figure 44).

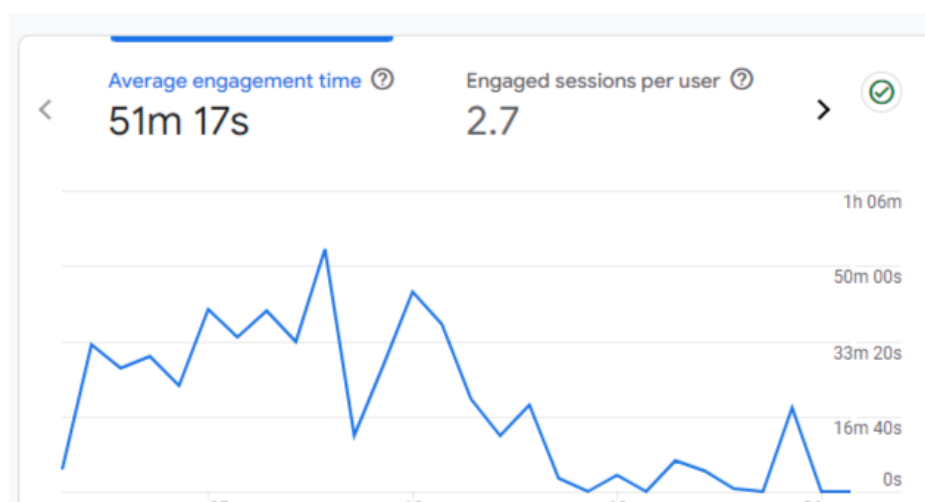


Figure 44: Average engagement time

Incorporating visual data such as world maps (Figure 45) and tables to highlight user distribution by country provides a comprehensive understanding of the geographic spread and user engagement for an application. This approach allows developers and stakeholders to identify key markets and tailor strategies accordingly.

For instance, a world map can visually represent the concentration of users in various regions, offering insights into market penetration and potential areas for growth. Accompanied by a detailed table listing specific countries and the number of users from each, this data becomes actionable, enabling targeted marketing and development efforts.

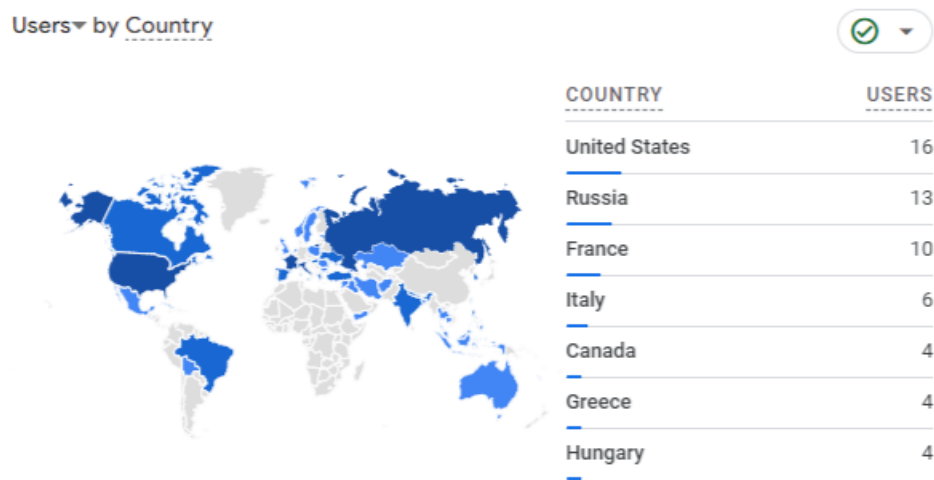


Figure 45 : Users Map

6.2. Commercialization Analytics

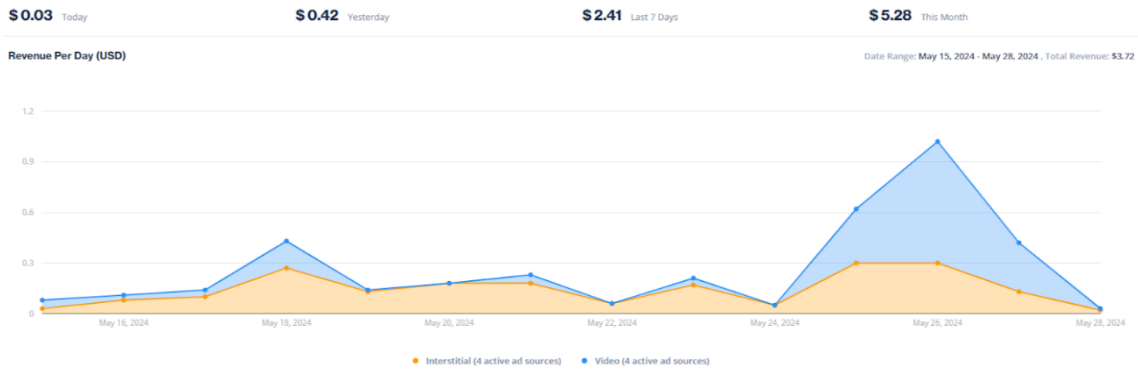


Figure 46 : Ad revenue graph

This chart (Figure 46) displays the daily revenue generated from two types of ads, Interstitial (orange line) and Video (blue line), over the period from May 15 to May 28, 2024. The total revenue for this period is \$3.72.

Key metrics include:

1. Revenue Today: \$0.03
2. Revenue Yesterday: \$0.42
3. Revenue Last 7 Days: \$2.41
4. Revenue This Month: \$5.28

The graph shows fluctuations in revenue, with notable peaks on May 18 and May 26. On these peak days, video ads contributed more significantly to the revenue compared to interstitial ads. After May 26, there's a steep decline in revenue from both types of ads, dropping to near zero by May 28.

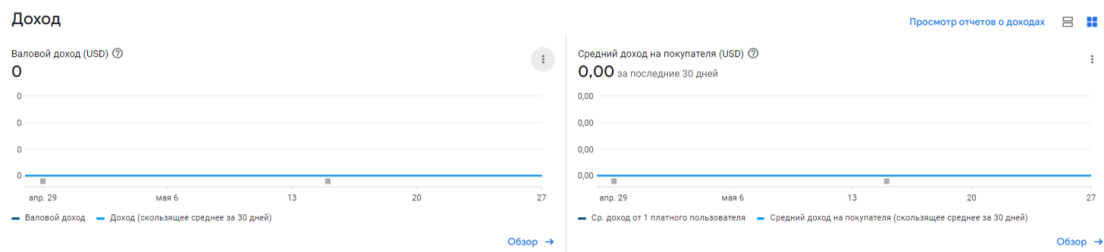


Figure 47 : InApp purchases revenue graph

The image (Figure 47) displays two graphs, both illustrating zero in-app purchase revenue at this point in time. This outcome is entirely expected for a newly launched

game. It is common for games to experience a period of little to no revenue in the initial phases as they build up their user base and engagement levels.

Several factors contribute to this early stage of zero revenue. The game needs time to reach a broad audience, for players to familiarize themselves with the gameplay, and for them to become comfortable with making in-app purchases. During this time, the primary focus should be on growing the game's user base, enhancing the player experience, and promoting the in-game store as a valuable and accessible feature.

Key strategies to drive growth and future revenue include:

1. **Marketing and Promotion:** It is essential to increase the game's visibility through effective marketing campaigns. Utilizing social media, influencer collaborations, and targeted advertising can help attract a wider audience.
2. **Engagement and Retention:** Players are more likely to make in-app purchases if they feel engaged with the game. Regular updates, new levels, special events, and interactive features keep the player experience fresh and exciting. Developing a strong relationship with players through community management, feedback loops, and personalized updates can help with retention.
3. **Optimizing In-App Purchases (IAPs):** Introducing attractive offers in the form of bundled packages, special limited-time deals, or seasonal items can boost IAPs. Additionally, designing IAPs that align with player progression ensures that players feel that their purchases are meaningful and enhance their experience.
4. **Player Progression and Incentives:** Introducing tiered rewards, achievements, and milestones can motivate players to spend in the game. Gamification of the purchasing process, such as offering rewards for first-time buyers or long-term customers, can encourage more frequent transactions.
5. **Leveraging Analytics:** Studying player behavior and purchase patterns can inform decisions on how to improve the store and tailor offers that resonate with the audience. It's critical to understand what drives players to make purchases and adjust the strategy accordingly.

6.3. Commercialization A/B Tests

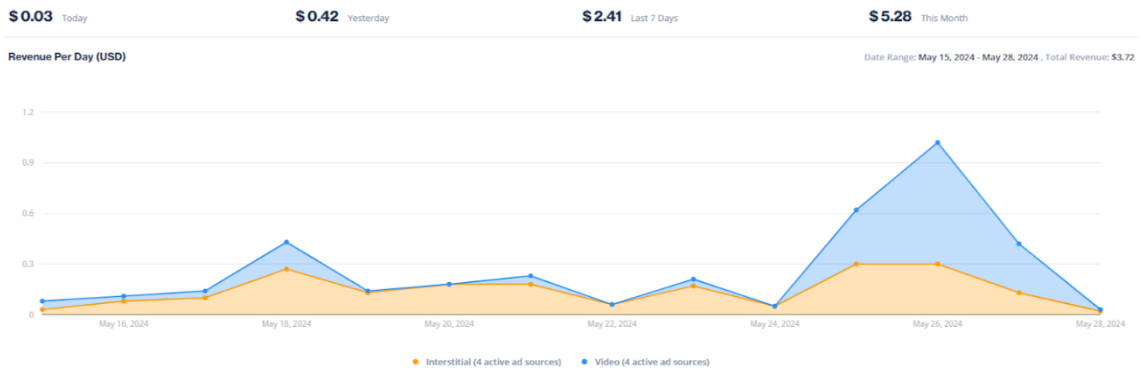


Figure 48: Ad revenue graph

As shown in this graph (Figure 48), there is a significant increase on May 24th. This notable growth can be attributed to the integration of two new ad networks (Figure 49), which have greatly enhanced our revenue streams:

- **Unity Ads**: By incorporating Unity Ads, we tapped into a vast network known for its high engagement rates and quality ad placements. This move has not only increased our ad visibility but also improved user experience with non-intrusive ad formats.
- **Google AdMob**: Adding Google AdMob has further bolstered our advertising efforts, leveraging its advanced targeting capabilities and extensive reach. AdMob's powerful analytics and optimization tools have enabled us to maximize our ad revenue effectively.

The combined impact of these ad networks has resulted in a sharp uptick in our revenue, demonstrating the effectiveness of our strategic enhancements. This integration has set a new benchmark for our ad performance, and we anticipate continued growth and sustained success in our monetization efforts.

The screenshot shows the 'SDK networks' configuration page in Iron Source. At the top, the app name 'TD King of Rush: Tower Defense' and its App Key '1e31f50bd' are displayed. The page is divided into three sections: BIDDING, NON BIDDING, and CUSTOM.

BIDDING

Network	Status	Android	iOS	Web	Action
IronSource		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text" value="Edit"/>
Google		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text" value="Edit"/>
Unity Ads		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text" value="Edit"/>

NON BIDDING

Network	Status	Android	iOS	Web	Action
APPLOVIN	Not Defined	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text" value="Setup"/>
Google AdMob	Not Defined	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text" value="Setup"/>
Google AdMob NATIVE	Not Defined		<input type="checkbox"/>		<input type="text" value="Setup"/>

CUSTOM

Network	Action
Yandex	<input type="text" value="Setup"/>

CALLBACKS

To enable Callbacks go to: [Apps](#) » [set S2S callback](#)

Figure 49: SDK networks tab in Iron Source

7. Post-Launch Performance and Analysis

After the application was published, data was collected over a period of 3 months to analyze its performance based on key indicators: audience growth, user retention, revenue, and overall satisfaction with the gameplay.

Main Analysis Objectives:

- **Audience Growth**: Assessing how successfully the application attracts new users, the effectiveness of marketing promotion through various channels, and how users respond to the game in the first weeks after its release.
- **User Retention**: Examining user retention rates at different stages: Day 1, Day 7, and Day 30 after the first launch. This helps to identify how well the game retains users' attention and what can be improved in terms of mechanics and engagement.
- **Revenue**: Analyzing monetization through in-app purchases and ads, as well as identifying key revenue sources and the most profitable offers. Average Revenue Per User (ARPU) and trends in purchases and ad interactions are evaluated.
- **Gameplay Satisfaction**: Collecting player feedback through app stores, social media, and in-game surveys. Game ratings, comments, and major requests or complaints are examined to determine how well the game meets user expectations.

This analysis provides a comprehensive picture of how the game was received in the market and helps identify areas for improvement, whether they are technical aspects, gameplay balance, or monetization strategies. The collected data offers insight not only into the current performance of the application but also into strategies for its further development, including content updates, enhancing user interaction, and increasing revenue.

7.1. User Growth and Retention

In the first 3 months after launch, the application was downloaded 256 times (Figure 49). Initially, there was a rapid growth in downloads due to active support from Google in promoting new projects. During this period, Google's advertising and promotion played a crucial role in attracting the first wave of users. However, as the promotional activity decreased, the download rates started to slow down. In the start of the analysis period, the number of monthly active users (MAU) stabilized at 94 (Figure 50), indicating that audience growth did not reach the anticipated level.



Figure 50: Application Downloads and User Retention Trends Over the First 3 Months After Launch

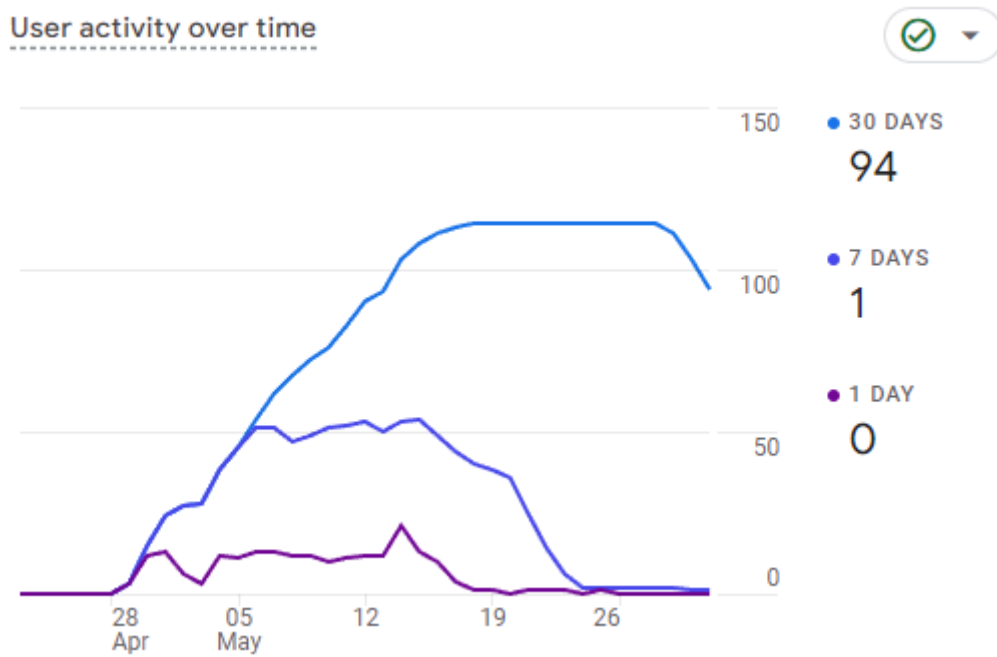


Figure 51: User activity Over the First 1 Months After Launch

For comparison, let's take a look at another, more successful project of mine. The graph shows that over the same period, user activity reached 33,000 people (Figure 52). This highlights the significant difference in the effectiveness of marketing strategies and audience interest between the two projects. The more successful project utilized diverse channels to attract and retain users, including regular updates, improved gameplay, and active community engagement.

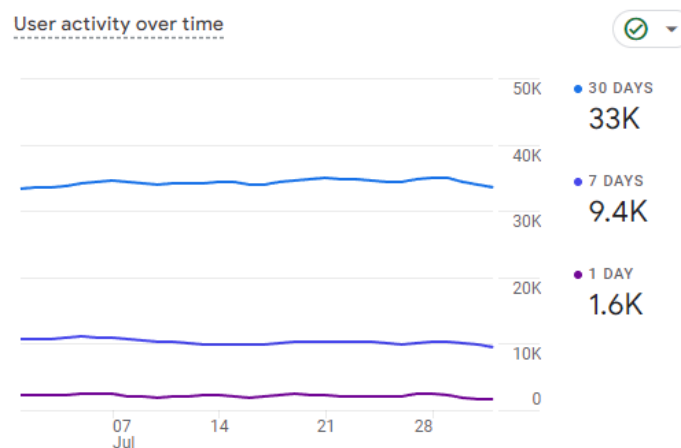


Figure 52: User activity in another project

Despite the initial high download rate, the number of users downloading this application decreased after the first month. This indicates a limited interest in the project without continued external support from Google’s advertising services. It’s likely that users did not find enough unique elements in the game to maintain their long-term engagement.

However, despite the relatively small download volume, those who did install the application demonstrated excellent retention rates. The retention on Day 1 was 22%, on Day 4 it was 12%, and by Day 7 it was 4.4%(Figure 53). These figures indicate that, although the game faced challenges in attracting new players, it has strong potential for retaining users among those who start playing. This is an excellent result for a mobile game, especially given the small download base.



Figure 53: Retention rate

7.2. Revenue Trends

The monetization of the application was carried out exclusively through in-app advertising. During the analyzed period, which lasted approximately five months, the total revenue amounted to \$6.2 (Figure 54). Notably, 100% of this revenue was generated from ads, as in-app purchases did not contribute to the overall revenue. The complete reliance on ad revenue is indicative of a monetization strategy aimed at generating income

from user engagement without placing any paywalls or premium content behind purchases.

The presented chart illustrates clear fluctuations in both sessions and revenues, showing a dynamic relationship between user activity and the resulting earnings from ads. Initially, the app saw significant activity, which is reflected by several distinct peaks that coincide with sharp increases in the number of sessions. These peaks suggest that at certain points, likely due to specific promotions, marketing pushes, or initial launch excitement, user engagement was high, driving ad impressions and thus generating higher revenue.

In the first few weeks following the app's launch, there was an influx of users. This surge in user activity resulted in frequent ad views, which correspondingly increased the overall revenue. It is important to note that the first weeks of a mobile app's lifecycle are often the most critical for gaining user traction, thanks in part to the promotional efforts from platforms like Google Play Store, which tends to feature and promote new applications. As a result, the app reached several peaks in both session counts and generated revenue.

However, despite these early successes, the chart indicates a gradual decline over time. After the initial excitement and burst of downloads and engagement, the number of active users began to drop, leading to fewer sessions and ad views. This is a common trend in mobile applications where the initial wave of user interest subsides as the novelty wears off, and without sustained marketing or content updates, maintaining high levels of engagement becomes challenging.

The concentration of revenue peaks early in the timeline suggests that user retention efforts were not as successful as they could have been. Although the application managed to capture initial interest, it was unable to sustain a strong, active user base in the following months. The decline in both sessions and revenue indicates that the application may have lacked mechanisms to retain users or re-engage them effectively.

By September, the app's activity had dropped significantly, with both revenue and session counts falling to much lower levels, nearly reaching zero. This is an indication that the majority of users stopped engaging with the app over time, either due to a lack of new content, insufficient updates, or the natural lifecycle of an app that doesn't maintain user interest beyond the initial phase.

In conclusion, the revenue trend observed during the analyzed period highlights the importance of continuous user engagement and retention strategies. While initial promotional efforts and the app's launch contributed to high engagement and revenue, maintaining consistent performance over time proved to be a challenge. Future efforts should focus on increasing user retention, perhaps by introducing new content, regular updates, or enhanced features that would encourage long-term engagement. Additionally, exploring in-app purchases as a supplementary revenue stream could diversify income and reduce reliance on ad-generated revenue alone, making the app's monetization model more robust and sustainable in the long term.

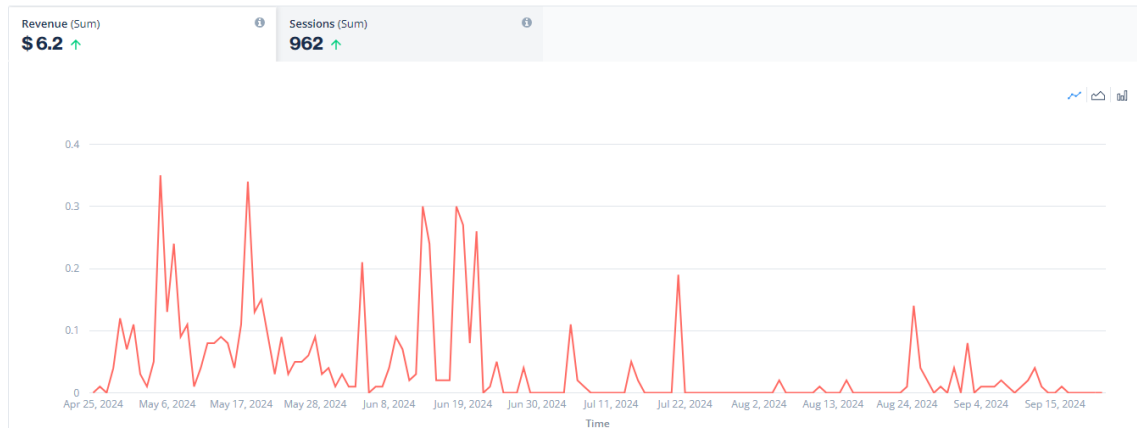


Figure 54: Performance Report

8. Conclusion

In conclusion, while the Tower Defense genre remains a hallmark of strategic entertainment in the mobile gaming world, the project did not meet the initial expectations set. Several significant challenges were encountered, including intense competition for organic traffic and the absence of a well-developed strategy for user acquisition through paid advertising channels. Early promotion through Google provided a substantial boost, but once this support ended, a sharp decline in user interest was observed. This highlighted the limitations of relying solely on organic growth in a highly competitive mobile gaming market, where many competitors actively leverage paid advertising to attract and retain players.

The primary goal of the project was to create a mobile 2D Tower Defense game using Unity, optimized specifically for Android. Despite these challenges, a product was successfully developed that included both advertisements and in-game purchases, carefully integrated to balance revenue generation with user engagement without overwhelming players with excessive advertising. Significant effort went into ensuring high-quality production and meeting the performance standards expected in the commercial sector.

Despite this solid approach to monetization, the limited user base rendered these efforts largely ineffective. With relatively few downloads, ad revenue remained minimal. This underscored the importance of developing a comprehensive user acquisition strategy that combines both organic and paid channels, essential for growth in a competitive environment.

A further challenge for the project was the shifting interests of the audience. By the time the application was launched, users had begun gravitating towards hybrid games, such as merge games, which combine merging mechanics with traditional Tower Defense gameplay. These hybrid games offer a fresh experience and more variety, making classic Tower Defense games less appealing. Consequently, despite strong retention rates among the few users who downloaded the game, the overall player count and revenue fell short of expectations.

This project provides valuable insights: success in the modern mobile gaming market requires more than just developing a high-quality game. It is crucial to understand evolving user preferences and to employ a flexible marketing strategy that incorporates both organic and paid promotional channels. Furthermore, successful projects in today's market must adapt to new trends, such as hybrid genres, and continuously enhance gameplay to offer players unique opportunities and interactivity. Ongoing product improvement will be essential, with a focus on adapting to changing market conditions to achieve long-term success in the Tower Defense genre.

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