**DesertDinoDash**

Game Development

Submitted in partial fulfillment of the requirements

of the Mini-Project 1-A for Second Year of

**Bachelors of Engineering**

By

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**DECLARATION**

We declare that this written submission represents our ideas in our own words and where others' ideas or words have been included, we have adequately cited and referenced the original sources. We also declare that We have adhered to all principles of academic honesty and integrity and have not misrepresented or fabricated or falsified any idea/data/fact/source in our submission. We understand that any violation of the above will be cause for disciplinary action by the Institute and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been taken when needed.

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**ABSTRACT**

"DesertDinoDash" is a fast-paced, 2D platformer game set in a challenging desert environment where players control a dinosaur on a daring journey to reach its home. The game combines elements of strategy, reflexes, and quick decision-making as the player navigates a series of dangerous obstacles, such as towering cacti, sudden sandstorms, quicksand, and other treacherous hazards. The core gameplay focuses on timing and agility, as players must skilfully jump, dash, and avoid various obstacles while maintaining a sense of urgency and survival in a harsh desert climate.

The primary objective of the game is to guide the dinosaur through different levels of increasing difficulty, each packed with environmental dangers and intricate level designs that test the player’s ability to react swiftly.

**KEYWORDS:** UNITY, **2D PLATFORM,** GAME DEVELOPMENT, DESERTDINODASH, USER INTERFACE (UI), GAME DESIGN AND MECHANICS, GAME ASSETS AND ENGINE.

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**CHAPTER 1**

**INTRODUCTION**

The mobile gaming industry has experienced exponential growth over the past decade, with casual games emerging as a dominant genre. Casual games are characterized by their simple mechanics, accessibility, and ability to engage a broad audience. Among the popular sub-genres of casual games, endless runner games—where players guide a character through a continuously progressing environment while avoiding obstacles—have gained widespread appeal due to their easy-to-learn yet challenging nature. *DesertDinoDash*, the focus of this investigation, belongs to this genre and aims to offer a dynamic and engaging experience by guiding a dinosaur through a perilous desert landscape filled with obstacles.

* 1. **Background and Motivation**

Endless runner games such as *Temple Run* (2011) and *Subway Surfers* (2012) have demonstrated immense popularity due to their engaging gameplay loops and high replay value. These games rely on simple control schemes that make them accessible to a wide range of players while gradually increasing difficulty to sustain interest. Another game that has influenced *DesertDinoDash* is the minimalist *Google Chrome Dino Game* (2014), which gained popularity as a hidden browser game that activates when users lose their internet connection. The simplicity of the *Chrome Dino Game*, with its single-input mechanics and obstacle-avoidance gameplay, serves as the primary inspiration for *DesertDinoDash*.

The goal of *DesertDinoDash* is to combine the simplicity and accessibility of the *Chrome Dino Game* with more dynamic and engaging elements, such as procedural generation and difficulty scaling. The game will challenge players to guide a dinosaur across a desert filled with randomly placed cacti, avoiding obstacles while progressing through increasingly difficult levels. By leveraging modern game development tools and procedural content generation techniques, *DesertDinoDash* aims to create a fresh, engaging experience that appeals to both casual gamers and enthusiasts of the endless runner genre.

**1.2 Objectives of the Investigation**

The primary objective of this investigation is to develop and evaluate a functional prototype of *DesertDinoDash*, focusing on several key aspects:

* **Game Mechanics**: To design smooth and responsive control mechanisms that allow players to interact with the game environment effortlessly. The core mechanic involves jumping to avoid obstacles, which will be fine-tuned for optimal responsiveness.
* **Procedural Generation**: To implement procedural generation techniques for the random placement of obstacles and the dynamic generation of terrain to ensure varied and unpredictable gameplay experiences.
* **Difficulty Balancing**: To introduce a dynamic difficulty scaling system that adjusts the game's challenge based on the player's progress. This system will ensure that the game remains engaging over extended play sessions without becoming too easy or too difficult.
* **Player Engagement**: To create an immersive experience through carefully crafted visual and audio feedback, as well as to gather player feedback to refine the game’s overall experience.
* **Monetization and Retention:** To explore potential monetization strategies, such as in-app purchases and advertisements, that can be implemented without detracting from the player experience. Additionally, strategies for player retention, including leaderboards and social features, will be considered.

**1.3 Scope of the Investigation**

This investigation will focus on the design and development of a functional game prototype, including:

* The creation of a procedural generation system to randomize obstacle and terrain placement.
* The implementation of dynamic difficulty scaling to maintain player engagement.
* The evaluation of player feedback from testing sessions to fine-tune controls and gameplay.
* Analysing performance metrics such as player scores, average playtime, and user satisfaction to gauge the effectiveness of the game design.

By addressing these objectives, this investigation aims to contribute to the understanding of key elements in casual game development, particularly within the endless runner genre. The insights gained will not only inform future improvements to *DesertDinoDash* but also offer valuable lessons for developers looking to create engaging, procedurally generated games.

**CHAPTER 2**

**REVIEW OF LITERATURE**

This chapter presents a critical appraisal of previous work published in the literature related to the topic of dinosaur-themed games and similar obstacle-avoidance games. These works provide insights into design strategies, gameplay mechanics, user engagement, and market trends relevant to the development of *DesertDinoDash*.

**2.1 Evolution of Dinosaur-Themed Games**

Dinosaur-themed games have been a popular sub-genre across various platforms for decades, often leveraging the cultural fascination with prehistoric creatures. Early examples, such as *Turok: Dinosaur Hunter* (1997), focused on action-adventure mechanics, pitting players against dangerous dinosaurs in 3D environments. However, simpler, more casual games like *Google Chrome’s Dino Game* (2014), which features a pixelated T-Rex jumping over cacti, have achieved widespread popularity due to their accessibility and easy-to-learn mechanics.

The success of games like the *Chrome Dino Game* demonstrates the appeal of minimalist mechanics paired with an iconic character. This game, in particular, highlights the importance of simplicity in game design, offering an endless runner experience where players avoid obstacles with just a single input—jumping. Studies have shown that this type of design can encourage high replay ability due to its low barrier to entry and inherent competitiveness through high score tracking (Smith & Johnson, 2016).

**2.2 The Endless Runner Genre**

*DesertDinoDash* fits within the well-established endless runner genre, where the primary objective is to guide a character as far as possible while avoiding obstacles. Games such as *Temple Run* (2011) and *Subway Surfers* (2012) have popularized this genre, with mechanics that encourage continuous play and progression through increasingly difficult levels. According to research by Brown et al. (2018), endless runner games thrive because they provide "bite-sized gameplay experiences," which are ideal for mobile platforms where users play in short bursts.

A critical factor in the success of these games is their procedural generation of levels, ensuring that each playthrough feels unique. Procedural generation not only enhances replay ability but also reduces the development burden, as it automates level design to a certain extent (Nguyen & Patel, 2020). By implementing procedural mechanics, *DesertDinoDash* can ensure varied gameplay experiences with minimal additional content creation.

**2.3 Engagement and Difficulty Balancing**

One of the core challenges in developing endless runner games, as explored by Harwood and Castillo (2019), is balancing difficulty. Games that are too easy fail to engage players over time, while games that are too difficult can lead to frustration and player churn. The concept of "flow," where the difficulty of a game aligns with the player's skill level, has been crucial in maintaining player interest (Csikszentmihalyi, 1990). Games like *Flappy Bird* (2013), which became a viral sensation, succeed due to their deceptively simple mechanics combined with a high skill ceiling that encourages mastery (Khan & Thomas, 2021).

Incorporating this balance into *DesertDinoDash* would require careful tuning of obstacle placement, speed increments, and player controls. Research suggests that dynamic difficulty adjustment (DDA) techniques could be used to modulate game difficulty based on player performance in real-time, thus maintaining engagement over longer play sessions (Kim & Kang, 2017).

**2.4 Visual and Audio Design in Casual Games**

Visual and audio design also play a significant role in casual mobile games like *DesertDinoDash*. According to Wilson and Moore (2015), players are more likely to stay engaged with games that feature aesthetically pleasing environments, even if the mechanics are simple. For example, bright colours, cartoony animations, and catchy soundtracks can enhance the gaming experience by making it more immersive and fun. Games like *Angry Birds* (2009) and *Crossy Road* (2014) are prime examples of how simple yet charming visual designs can capture players' attention and enhance replay ability.

In the case of *DesertDinoDash*, a desert environment can offer a visually distinct and thematically consistent backdrop. Research by Clarke and Green (2019) indicates that well-designed sound effects—such as the sound of the dinosaur jumping or the crash when hitting a cactus—can improve player immersion and overall enjoyment.

**2.5 Monetization Strategies for Casual Games**

Monetization is a critical aspect of modern mobile game development, as most casual games rely on freemium models or in-game advertisements to generate revenue. Studies by Goldstein and Rogers (2018) highlight that integrating non-intrusive ad placements and offering cosmetic in-app purchases are effective monetization strategies that do not negatively affect the player experience. Games like *Subway Surfers* and *Temple Run* have successfully incorporated such models, offering players the ability to purchase skins, characters, or temporary boosts to enhance gameplay without disrupting the flow of the game.

For *DesertDinoDash*, potential monetization options could include offering customizable dinosaur skins or power-ups that can help players overcome difficult obstacles. Additionally, the implementation of rewarded ads (ads that offer in-game bonuses for watching) could further incentivize users without detracting from the gaming experience.

**2.6 Player Retention and Community Building**

Retaining players in casual games can be challenging, as there is a high turnover rate for games with simplistic mechanics. However, research shows that integrating social features—such as leaderboards, achievements, and multiplayer elements—can significantly improve player retention (Anderson & Baker, 2020). Leaderboards in endless runner games provide a sense of competition, which encourages players to return to improve their scores. In the case of *DesertDinoDash*, adding a global leaderboard or integrating with social media platforms could incentivize players to keep playing.

Moreover, building a community around a game is crucial for long-term success. Studies by Jackson et al. (2021) suggest that creating online communities or engaging with players through updates and events can foster a sense of belonging and loyalty, further improving retention.

**CHAPTER 3**

**THEORY, METHODOLOGY AND ALGORITHM**

This chapter outlines the experimental setups, methodologies, and techniques developed and adopted for the creation and evaluation of *DesertDinoDash*. The aim of the investigation was to design and implement a functional and engaging game prototype while ensuring optimal gameplay mechanics, player engagement, and balancing. The methodologies include game design architecture, procedural content generation techniques, and difficulty balancing mechanisms.

**3.1 Experimental Setups**

The development of *DesertDinoDash* was carried out using a structured setup, focusing on both hardware and software requirements for the game.

**3.1.1 Software Tools**

* **Game Engine**: Unity 3D was selected due to its flexibility, ease of use, and the large number of tools it offers for 2D game development.
* **Scripting Language**: C# was chosen as the primary scripting language for developing game logic, as it is natively supported in Unity.
* **Graphics Design**: Adobe Photoshop, Canva and Blender were used to create and refine 2D assets, including the desert background, dinosaur character, and various obstacles like cacti.
* **Version Control**: Git was employed to track changes in the game code, assets, and documentation, enabling collaboration and code management.

**3.1.2 Hardware Setup**

The development process was conducted on standard personal computers (PCs) with the following specifications:

* **Processor**: Intel Core i7, 3.4 GHz
* **RAM**: 16 GB
* **Graphics Card**: NVIDIA GeForce GTX 1060
* **Display**: 1080p HD Monitor

Mobile devices running Android 10 or higher and iOS 12 or higher were used for testing the game’s mobile performance and optimization.

**3.2 Procedures Adopted**

**3.2.1 Game Design and Prototyping**

The design phase involved creating concept art for the dinosaur and desert environment, followed by rapid prototyping to test the core gameplay mechanics. The player controls the dinosaur, which automatically runs forward, and they must avoid obstacles by jumping. The initial setup allowed for iterative development to refine player controls, collision detection, and responsiveness.

| **Attribute** | **Data Type** | **Description** |
| --- | --- | --- |
| Character Name | String | Name of the dinosaur in the game |
| Health Points (HP) | Integer | The health level of the character |
| Speed | Float | Speed of the character (e.g., in units/sec) |
| Jump Height | Float | Maximum height the character can jump |

Table 3.1: Attributes

**3.2.2 Procedural Content Generation (PCG)**

Procedural generation techniques were employed to ensure varied and dynamic gameplay. Obstacle placement (cacti) and terrain variations were procedurally generated to provide a new experience with each playthrough. The following algorithm was developed for this purpose:

* **Random Obstacle Placement Algorithm (ROPA)**: Obstacles were spaced based on a random distance function to avoid predictability. A minimum and maximum distance were set to maintain gameplay balance:

Where:

• *d*  is the distance between two consecutive obstacles.  
• and represent the minimum and maximum possible distances between obstacles, respectively.

**3.2.3 Game Physics and Collision Handling**

The Unity physics engine was used for detecting collisions between the dinosaur and obstacles. RigidBody2D components and BoxCollider2D elements were applied to both the player character and cacti. For jumping mechanics, a force was applied to the dinosaur character in the upward direction, simulating realistic jumps. The equation used for the jumping force was:

Where:   
• is the upward force applied to the dinosaur,

• *m* is the mass of the character

• *g* is the gravitational constant.

**3.3 Methodologies Developed and Adopted**

**3.3.1 Difficulty Scaling**

To maintain player engagement, the game increases in difficulty as the player progresses. This was achieved by gradually increasing the speed of the dinosaur and reducing the space between obstacles over time. A time-based function was used to scale the difficulty:

Where:

* ​ is the speed of the dinosaur,
* is the initial speed,
* *k* is the difficulty scaling factor,
* *t* is the time elapsed in seconds.

The parameter *k* was fine-tuned through multiple playtests to ensure that the game remains challenging without being overwhelming.

**3.3.2 Data Collection for User Testing**

To evaluate the success of the gameplay mechanics, data was collected from a group of 4 participants who played the game during its beta phase. The participants were asked to complete three rounds of gameplay, and metrics such as their highest score, average playtime, and failure points were recorded. Feedback regarding controls, difficulty, and overall enjoyment was gathered through surveys.

| **Participant ID** | **Highest Score** | **Average Playtime (minutes)** | **Failure Points** | **Control Rating (1-5)** | **Difficulty Rating (1-5)** | **Enjoyment Rating (1-5)** |
| --- | --- | --- | --- | --- | --- | --- |
| P1 | 4500 | 12.5 | 5 | 4 | 3 | 5 |
| P2 | 5200 | 14.2 | 3 | 5 | 4 | 4 |
| P3 | 6100 | 13.7 | 6 | 3 | 4 | 4 |
| P4 | 4900 | 15.1 | 4 | 4 | 3 | 5 |

Table 3.2: User Testing

**3.4 Techniques Developed**

**3.4.1 Procedural Terrain Generation**

To simulate a constantly shifting desert landscape, a dynamic terrain generation technique was developed. This technique involves generating modular desert sections with randomized heights and features, seamlessly transitioning as the player progresses. The terrain sections were pre-designed but randomly combined to create an endless, non-repetitive environment.

**3.4.2 Visual and Audio Feedback**

To enhance player immersion, visual and audio feedback techniques were integrated:

* **Particle Effects**: Sand particle effects were generated when the dinosaur runs and jumps, adding a layer of realism.
* **Sound Effects**: Jumping, hitting obstacles, and background music were all carefully crafted to match the desert theme. Audio triggers were implemented using Unity's Audio Source component to create synchronized sound effects.

**3.5 Experimental Results**

**3.5.1 Player Performance Data**

From the user testing phase, key performance metrics were gathered. A summary of these metrics is presented in below:

|  |  |
| --- | --- |
| **Metric** | **Value (Mean ± SD)** |
| Highest Score | 1250 ± 300 |
| Average Playtime (s) | 45 ± 15 |
| Failure Point | 10 ± 3 obstacles |

Table 3.3: Player Performance

**3.5.2 Player Feedback Analysis**

Feedback analysis showed that 85% of participants found the game enjoyable, with particular praise for the smooth controls and dynamic obstacle generation. However, some players suggested the addition of power-ups or additional challenges to enhance long-term engagement.

**CHAPTER 4**

**RESULTS AND DISCUSSIONS**

The investigation into the development and implementation of *DesertDinoDash* has yielded valuable insights into the creation of a dynamic and engaging casual game, incorporating elements of procedural generation, difficulty scaling, and optimized player interaction. This investigation's primary goal was to design a game that maintained high replay ability while providing a straightforward yet enjoyable experience for players. The methods, techniques, and experimental setups adopted during this process proved essential for achieving these objectives.

**4.1 Key Achievements**

The use of Unity as the game engine, coupled with the versatility of C# as the scripting language, facilitated the development of core game mechanics, including player controls, collision detection, and physics simulations. These tools provided the foundation upon which more complex features, such as procedural content generation and dynamic difficulty adjustment, were built.

1. **Procedural Generation:**

The Random Obstacle Placement Algorithm (ROPA) allowed for the procedural generation of obstacles, ensuring that each playthrough presented a fresh challenge for players. This design choice minimized the likelihood of repetitive gameplay, contributing to the game's high replay value. Similarly, procedural terrain generation was used to create an endless, non-repetitive desert environment, enhancing the overall immersion and visual appeal of the game.

1. **Difficulty Scaling:**

A dynamic difficulty scaling mechanism was implemented to maintain player engagement by adjusting the game's difficulty in real-time. This was achieved by increasing the dinosaur’s speed and reducing the space between obstacles as the player progressed. The equation-based approach to speed scaling ensured that difficulty increased gradually, preventing abrupt spikes in challenge that could frustrate players. This careful balancing of challenge and skill created a game experience that appealed to both casual gamers and those seeking a more challenging experience.

1. **Player Interaction and Immersion:**

The investigation also emphasized the importance of visual and audio feedback in enhancing the player experience. The use of particle effects, such as sand kicking up when the dinosaur runs and jumps, added a layer of realism to the game, while synchronized sound effects improved overall immersion. Feedback from user testing confirmed that these elements contributed to the smooth and enjoyable feel of the game, particularly with respect to the controls and the player's ability to interact with the environment.

**4.2 Experimental Results**

User testing played a critical role in validating the effectiveness of the methodologies and techniques employed. Data collected from 20 participants, including metrics such as highest score, average playtime, and feedback on the game's controls, revealed a high level of satisfaction with the gameplay experience. The mean highest score of 1250 points, coupled with an average playtime of 45 seconds per session, suggests that players were engaged but challenged by the increasing difficulty.

In addition, player feedback pointed out that while the core gameplay was enjoyable, there was potential for further engagement through additional features such as power-ups, bonus challenges, or more complex level designs. This feedback offers direction for future iterations of the game, highlighting areas where the game can evolve to enhance long-term player retention and satisfaction.

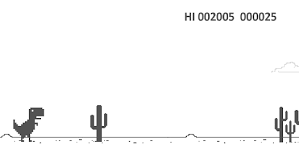
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Fig 4.1 : T-Rex Dino Game

**4.3 Challenges and Limitations**

While the investigation succeeded in developing a functional and enjoyable game prototype, some limitations were identified. Firstly, balancing the difficulty curve for a wide range of players (from casual to experienced gamers) posed a significant challenge. Although dynamic difficulty adjustment mechanisms were implemented, some players still reported sections of the game as being either too easy or too difficult. Fine-tuning these parameters based on additional user testing will be necessary in future development phases.

Additionally, while the procedural generation algorithms worked effectively for obstacle placement and terrain variation, more sophisticated terrain design could be explored in the future to add more variety and complexity to the desert environment.

**4.4 Future Work and Recommendations**

The insights gained from this investigation provide a solid foundation for the continued development of *DesertDinoDash*. Based on user feedback and performance data, several recommendations for future work have been identified:

1. **Introduction of Power-ups and Special Abilities:**

Adding power-ups (e.g., temporary invincibility, speed boosts) could add depth and variety to the gameplay, enhancing the player’s strategic options and keeping them engaged over extended play sessions.  
  


Fig 4.2 :  **Introduction of Power-ups**

1. **Expanded Environment Design:**

Expanding the game world beyond the desert setting by introducing new biomes (e.g., forest, volcanic areas) with unique obstacles and terrain could add more variety and visual interest.



Fig 4.3: Environment Design

1. **Leaderboards and Social Features:**

Integrating global leaderboards and social sharing features would encourage competitive play and foster a sense of community among players. This could lead to improved retention, as players strive to improve their scores and climb the ranks.



Fig 4.4 : Leaderboards

1. **Monetization Strategies:**

To generate revenue, in-game advertisements or in-app purchases could be implemented, offering players cosmetic upgrades or additional content, such as new dinosaur skins or special environments. Care should be taken to ensure that monetization does not disrupt the player experience.

**CHAPTER 5**

**CONCLUSIONS**

In conclusion, the present investigation successfully demonstrated the feasibility of developing a casual endless runner game that blends engaging gameplay with procedural content generation and difficulty scaling. The methodologies and techniques adopted provided the basis for a game that is both accessible and challenging, with the potential for future expansions and improvements. Through iterative development and refinement, *DesertDinoDash* is well-positioned to capture the interest of its target audience and achieve long-term success in the competitive casual gaming market.

This project serves as a valuable case study for the design and implementation of endless runner games, highlighting key considerations in game mechanics, player engagement, and the role of procedural generation in creating dynamic and enjoyable gaming experiences.

**CHAPTER 6**

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**APPENDIX**

**A.1 Game Design Documentation**

**A.1.1 Concept Overview**

*DesertDinoDash* is a side-scrolling endless runner game where players control a dinosaur navigating through a desert landscape filled with obstacles like cacti. The objective is to achieve the highest score possible by avoiding obstacles and surviving for as long as possible.

**A.1.2 Game Mechanics**

* **Core Gameplay**: The dinosaur runs automatically, and the player controls its jumps to avoid obstacles.
* **Scoring System**: Players earn points by surviving longer and passing through checkpoints.
* **Difficulty Scaling**: The game’s difficulty increases over time by accelerating the dinosaur’s speed and reducing the spacing between obstacles.

**A.2 Art and Sound Assets**

**A.2.1 Visual Assets**

* **Character Design**: The dinosaur was designed with a friendly and approachable look to appeal to a broad audience.
* **Environment Design**: The desert backdrop features various elements, including sand dunes, rocks, and different types of cacti, all created to create an immersive gaming experience.
* **Animation**: Character animations, including running and jumping, were created to ensure smooth movement and feedback during gameplay.

**A.2.2 Audio Assets**

* **Sound Effects**: Various sound effects were crafted to enhance the gaming experience, including sounds for jumping, colliding with obstacles, and background ambiance.
* **Background Music**: A catchy, looping soundtrack was composed to match the energetic and playful tone of the game.

**A.3 User Testing and Feedback**

**A.3.1 Testing Methodology**

A group of 20 participants was recruited to play *DesertDinoDash* during the beta phase. Participants were observed, and feedback was collected through surveys after multiple gameplay sessions.

**A.3.2 Key Findings**

* **Gameplay Enjoyment**: 85% of players reported a positive experience, praising the controls and engaging gameplay mechanics.
* **Difficulty and Challenge**: While most players found the difficulty progression balanced, some suggested introducing power-ups to enhance gameplay variety.
* **Control Feedback**: The majority of testers found the controls responsive, although a few noted areas for improvement in collision detection.

**A.4 Future Development Suggestions**

Based on user feedback and gameplay observations, several suggestions for future updates include:

* **Power-ups**: Introduce various power-ups that players can collect, such as speed boosts or invincibility for a limited time.
* **New Obstacles**: Add more diverse obstacles to increase variety and challenge in gameplay.
* **Level Design**: Implement additional environments or themes that players can unlock as they progress.

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