International Journal of Application on Sciences, Technology and Engineering
(IJASTE)
Volume 1, Issue 4, 2023. ISSN:2987-249

DESIGNING A 2D PLATFORMER GAME "FROG MARIO" BASED ON WINDOWS

Eiji Yoshikawa[1], Jeanny Pragantha[2], Darius Andana Haris[3]

[1] Department of Computer Science, , Tarumanagara University, Jakarta, Indonesia
Email: eiji.535200063@stu.untar.ac.id
[2] Department of Computer Science, Tarumanagara University, Jakarta, Indonesia
Email: jeannyp@fti.untar.ac.id
[3]Department of Computer Science,, Tarumanagara University, Jakarta, Indonesia*
Email: dariush@fti.untar.ac.id

*Corresponding Author

Submitted: 26-09-2023, Revised: 27-10-2023, Accepted: 08-12-2023

ABSTRACT

"Frog Mario" is a singleplayer puzzle platformer game played on the PC platform. This game was developed with the Unity 2020.3.28f1 game engine and the C# programming language. This game tells the journey of a frog who will meet his true love. However, the journey to meet true love is not easy because you have to overcome various obstacles. The basic mechanics of this game are moving left or right, jumping, pushing boxes, climbing walls. The objective of this game is to overcome various obstacles until the final stage to find true love and return to human form again.

Keywords: *Frog Mario, Game platformer puzzle, Singleplayer, Unity*

1. INTRODUCTION

Game development is the process of using graphics libraries, game engines and image editing software to display images on the screen and let the player manipulate the images on the screen to create experiences and tell the player a story [1].

2D platformer games in particular are a classic game genre named for their gameplay in which the player character jumps on platforms to overcome obstacles. This genre is often combined with other genres such as shooter, puzzle and action. This genre is also starting to become increasingly popular nowadays, in the 2010s since the popularity of mobile gaming and the many platformer games that appeared on the platform [2].

The definition of games is digital interactive entertainment that can be done via computers, game consoles, mobile phones or tablets. As technology advances, more and more games are played by more people. According to current trends, game genres are increasing, including action games, arcade games, card games, simulation games, role-playing games and adventure games.

The development of games or what are usually called "GAMES" over time is something that is sought after and played by everyone, both children, adults and even the elderly. The game is still young, has no platform, and anyone can play it. As time goes by, games change and develop as technology advances, the gaming industry and game developers around the world compete and create a new era for the gaming world.

"Frog Mario" is a 2D singleplayer game with the Puzzle Platformer genre which can be played on the Windows platform. This game is designed to be played in singleplayer mode and can only be played offline.

Tujuan penelitian ini adalah menginvestigasi, merancang, dan mengembangkan game platformer 2D "Frog Mario" di Windows. Kami berupaya memahami elemen perancangan game, mekanika permainan, dan antarmuka pengguna secara mendalam untuk menciptakan pengalaman bermain yang optimal. Selain itu, penelitian ini mengevaluasi kinerja dan respons pengguna guna memastikan kualitas implementasi, dengan harapan memberikan kontribusi pada pengembangan pemahaman di bidang perancangan game 2D Windows.

Game Reference

The "Frog Mario" concept combines elements of complex ideas, mechanisms and styles inspired by several leading games. His main sources of inspiration are Mario Bros., Cat Mario, and Trap Dungeons. An image of the game "Mario Bros" is shown in Figure 1.

Figure 1. Super Mario Bros
Source : Chris Kohler. This AI Builds Super Mario Levels by Watching Youtube, 2015.

2. RESEARCH METHOD

Prior to embarking on the journey of game creation, it becomes imperative to establish a robust design methodology that lays the groundwork for the game development endeavor. While the landscape of game development, as Schell (2020) suggests, does not prescribe a rigid template to adhere to, it does present a set of vital principles and factors that warrant meticulous attention. Among these, as articulated by [4] Bates, as follows:

1. High Concept

High Concept serves as a concise encapsulation of the essence of Frog Mario, featuring a charming frog protagonist. The main goal is to maintain a clear direction for game development to align with the desired design. Our game, "Frog Mario," was envisioned as an exciting 2D platformer. In this unique adventure, players will take on the role of Frog Mario, a frog with a heart full of determination, navigating a series of dynamically designed rooms filled with cunning enemies and challenging obstacles. Players will be faced with a choice – they can engage in tense combat with enemies or use smart strategies to overcome these obstacles well. Ultimate victory awaits those who guide Frog Mario to the final room, where a thrilling boss confrontation awaits. Below, you will find the proposed specifications for the charming world of "Frog Mario":

a. Game Title: Frog Mario
b. Genre: Platformer, Strategy
c. Language: English

d. Audience: Children aged 13 and above to adults
e. Number of Players: Single Player
f. Graphics: 2D
g. Game Engine: Unity Engine
h. Programming Language: C#
i. Controls: Keyboard
j. Platform: Windows 8 and above

2. Gameplay

In the game "Frog Mario," players will guide this frog character through an exciting adventure full of obstacles to find his lover and return him to his original human form. This game is a platformer game that requires players to overcome the various challenges they face.

Players will control Frog Mario as he jumps, moves left or right, climbs walls, and even pushes boxes to get over various obstacles. His goal is to reach the final stage in the game to reunite with his true love and return himself to human form. In this epic adventure, Frog Mario must show his toughness and overcome all the obstacles that stand in his way.The game "Frog Mario" consists of several levels that become more challenging as the game progresses. Players will encounter various types of obstacles and enemies that must be overcome to achieve their goals.

In this game, players will experience a deep and emotional sensation of adventure as Frog Mario struggles to find his true love. Every step and jump of Frog Mario will bring players closer to the game's satisfying ending.

a. Control Design

The control scheme for Frog Mario offers players an intuitive way to interact with the game world. Designed for the Windows operating system and played on PC, players will navigate the charming frog character using the keyboard. The control layout embraces simplicity, true to the classic 2D platformer genre, allowing players to easily guide Frog Mario through an enchanting world. Movement is streamlined, with the main actions being movements to the right, left, and performing exciting jumps. For a detailed overview of the control design in Frog Mario, please see Table 1 below.

Table 1. Frog Mario Control Design

Button	**Function**
A	Move to the left
D	Move to the right
W	Open and enter the door
Space	Jump

b. Character Design

Character design explains things related to the character, both the main character and the enemy character. In the game "Frog Mario". The character design in the game "Frog Mario" is divided into two, namely the player's character and the Non-Playable Character (NPC).

1) Main Character

In the game "Frog Mario", the main character is a frog. The main characters can be seen in Figure 1.

Figure 2. Main Character

Table 2. Specification Main Character

Name Character	Health Point	Damage
Frog	1	1

2) Non-Playable Characters (NPC)

All NPC characters in the "Frog Mario" game are enemies, cannot be eliminated by players, and can eliminate players. There are four NPC characters in the "Frog Mario" game:

a) NPC Character Slime

The first NPC character is a slime character. Slime is a blue character. This character can finish off players by moving left and right.

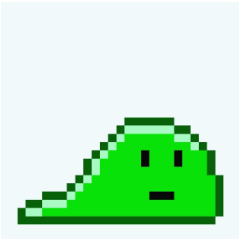


Figure 3. Slime Enemy Character

Table 3. Specification Enemy

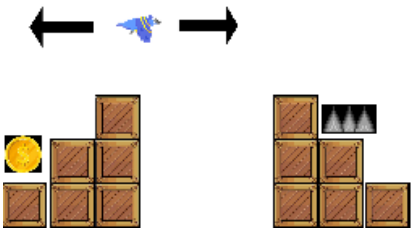
Name Character	Movement Pattern
Slime	

b) NPC Character Bird

The second NPC character is a bird character. As the name suggests, this character flies from right to left and can kill players.

Figure 4. Bird Enemy Character

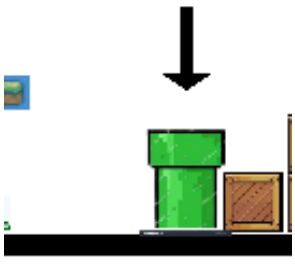
Table 4. Specification Enemy

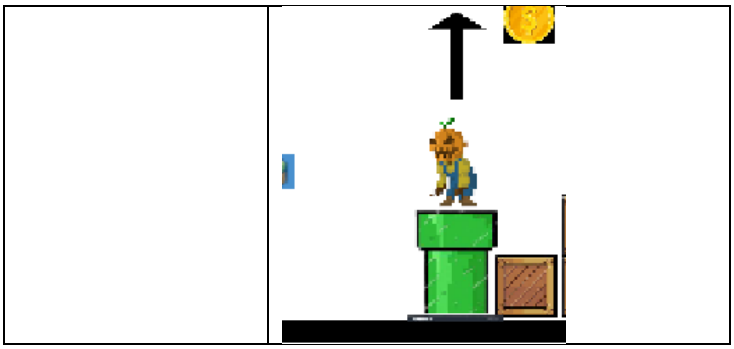
Name Character	Movement Pattern
Bird	

c) NPC Character Pipe
The third NPC character is the pipe character. As the name suggests, this character moves in and out of a pipe capable of eliminating enemies.

Figure 5. Pipe Enemy Character

Table 5. Specification Enemy

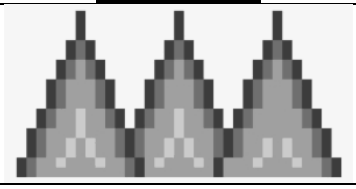
Name Character	Movement Patterns
Pipe	

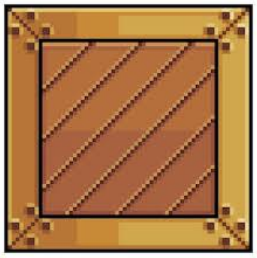


c. Object Design

Object design explains the objects in the game, both the function of the object and other things. The object design used in this game is as follows:

Table 6. Object Spesification

Name Object	Object Design	Description
Moving Platform		The moving platform object is a platform-shaped object. This object can move left, right, up, and down.
Coin		The player must collect coins that appear in the Time theme to get a key.
Mushroom		Mushroom (Jump pad) is an object that helps players jump and move objects to a higher place.
Platform		This object is just a platform that does not move. It serves as a footing for players to move to a higher place. The platform only has one form: vertical.
Checkpoint		This object is simply a stationary checkpoint. This serves as a player's respawn place when the player dies.
Spike		This object is just a nail. When the player hits this object, the player will die.

Door		As its name implies, this object can later be entered by players to change levels after the players have found the key
Box Push		The Box Push is an object that takes the form of a box that can be pushed by players. This box has its own weight to be able to be pushed. The weight is determined by the number of players in one level. This box also displays the weight in numbers.
Cannon		This object can fire a bullet that can eliminate players. The speed of the bullet increases from slow to fast.

d. Level Design

Level design describes the level design that players must complete in the game. In the game "Frog Mario" there are 3 levels and in each theme there are two levels that have different levels of difficulty. Because this game is an impossible platform game, the objects in the level will change. The following is a brief explanation of each theme:

1. Introduction
   Introduce is an introductory level with jumping and collecting coins. Then here we introduce pipes, and increase the difficulty with water and moving platforms.
2. Underground
   The levels here increase in difficulty with deeper holes and more enemies. And this level has an underground theme with more complex obstacles. We also added challenges with deeper water and faster platforms.
3. Snow
   This level is a snow level with layers of ice and sliding on ice. This level is also snow-themed with trickier obstacles and deeper holes.

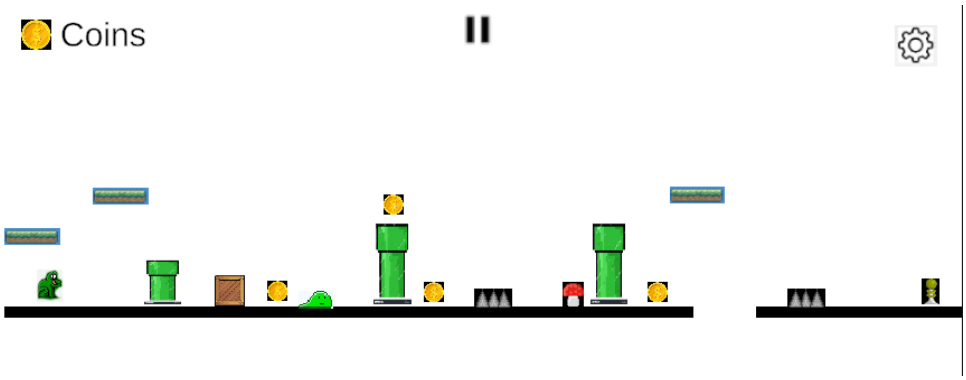


Figure 6. Introduction Level 1-1

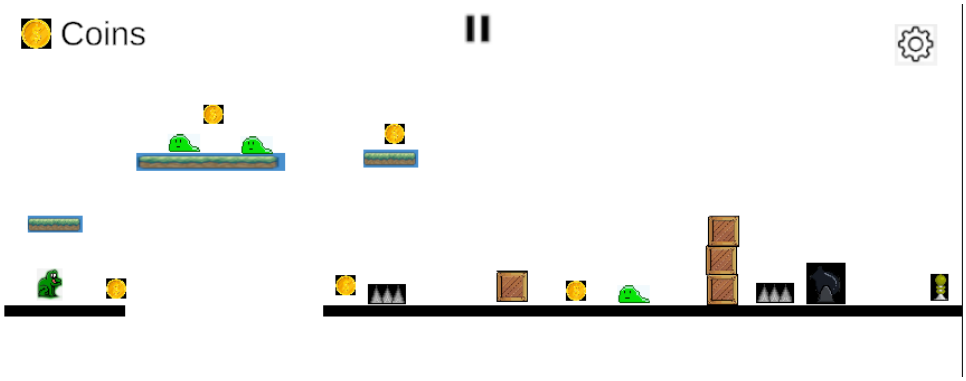


Figure 7. Introduction Level 1-2

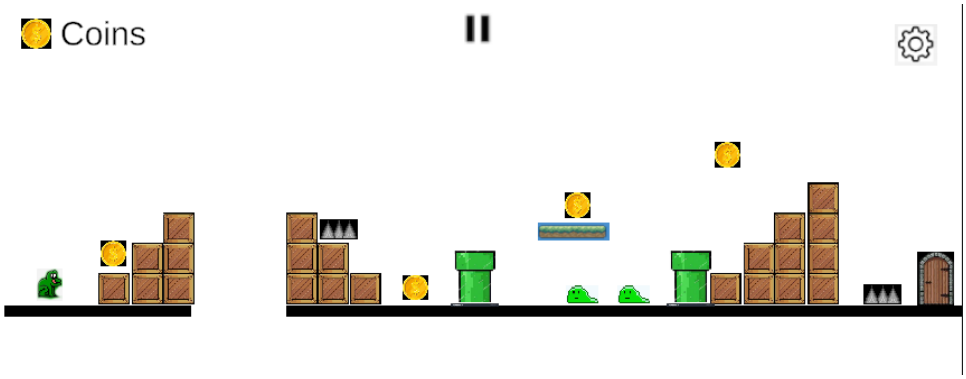


Figure 8. Introduction Level 1-3

e. Sound Design

Audio description refers to the sounds that make up the game experience, including background sounds and sound effects. The sound in the game "Frog Mario" is divided into two main parts: Background Music and Sound Effects. Background Music will accompany players from the start of the game until selecting the game level. Meanwhile, Sound Effects will accompany players when interacting or carrying out actions such as jumping or picking up coins.

Story

The story is a summary of the game's storyline. The game "Frog Mario" has a short story about a human who was cursed to become a frog. Then after he was cursed, he was told that he could return to human form as long as he could meet his true lover.

Audience

The audience is the target for whom the game is made, which is determined through the game content and becomes a limitation. The target audience of this game is everyone over the age of 13 or at least those who can read. This is to ensure the game is easier to play. This game is designed to train patience, train memory, so this game is suitable for everyone.

Hardware Platform

Hardware Platform describes the minimum specifications of hardware as well as software required to play the designed game.

The following are the computer hardware specifications used in making the game:

1) Processor : Intel Core i3 Gen 2 OR AMD Ryzen 3
2) Ram : 2GB
3) VGA : Intel HD Graphics 2000 or better
4) HDD : 500 GB
5) SSD : 250 GB
6) Other Devices : Keyboard and Mouse

Software Utilized for Development

In the process of creating a game, there is various software that is used for various purposes, such as game design, script creation, and user interface creation. This software includes:

a. Unity
   Unity is a game engine and integrated development environment (IDE) for creating interactive media, usually video games [5].

b. Visual Studio Code
   Visual Studio Code stands as a formidable code editor, serving as a pivotal tool for scripting and debugging endeavors throughout the development journey. Its expansive capabilities and user-friendly interface render it an effective instrument for crafting and resolving code-related challenges. By harnessing the potential of Visual Studio Code, developers can elevate their efficiency and optimize the developmental pipeline [6].

c. Blender
   Blender is open source software used to create 3D graphics, animation, rendering, simulation, and more. It has a number of powerful features, including 3D modeling, texturing, character animation, visual effects, and compositing. Blender is used by 3D artists, game designers, filmmakers, and many more to create diverse 3D content, such as animated films, video games, architectural presentations, and more. One of the advantages of Blender is that it is available for free, so it can be accessed by anyone who is interested in learning and working in the field of 3D graphics [7].

3. RESULT AND DISCUSSION

The game that will be made is entitled "Frog Mario" is a puzzle platformer genre with a 2D theme. This game will be available exclusively for PC with a minimum operating system requirement of Windows 9 and can only be played singleplayer. In "Frog Mario", players must overcome various obstacles located in each level until the last level to win it.

The results of this test aim to provide a general overview of the design of the Windows-based 2D platformer game "Frog Mario". Currently, our main focus is on the conceptual design stage, user interface and other creative elements. The test results and performance evaluation of the game will be covered in detail in the next implementation section, where the game will be thoroughly tested to measure user response, effectiveness of game mechanics, and other technical aspects. At this stage, we will explain in detail the testing methodology that we applied and the results obtained to provide a deeper understanding of the performance and successful implementation of the 2D platformer game design "Frog Mario".

MODULE DESIGN

The appearance design specifications for the game "Frog Mario" are as follows:

1. Main Menu Module
   It serves as a major component in the game "Frog Mario". In this component, you can find four different options, including Start, Load Game, About Us, and exit.

Figure 9. Main Menu Module

2. About Module
   In this section, users can access details regarding creators and supervising instructors. Apart from that, there is also the symbol of Tarumanagara University along with the Game Development symbol.
3. Settings Module
   In this module, players can set the "Frog Mario" game, such as music, can return to the main menu, can exit.

Figure 10. Settings Module

4. Exit Game Module
   This module will display a pop up saying “Are you sure you want to log out?”. If the player presses the “Yes” button, the player will exit the game. Then if the player presses the "No" button, the player will return to the Main Menu module or return to the game if he opens settings while playing.
5. Game Display Module
   This display will appear when the player has selected start on the main menu. In the Gameplay display at the top left there are coins, the number of coins you get. Then there is a pause button in the top center and a settings button at the top right. The gameplay display can be seen in Figure 5.

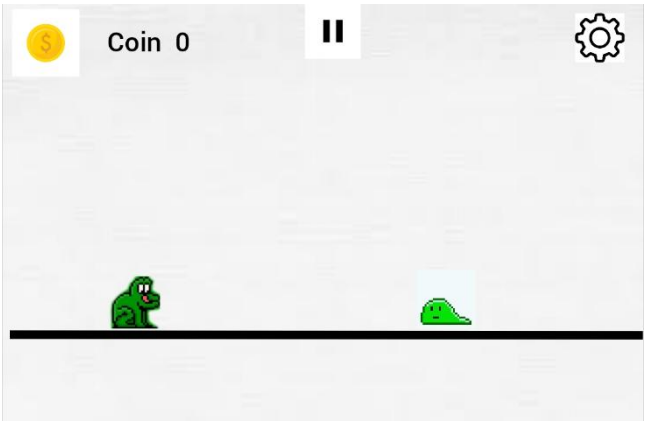


Figure 11. Game Display Module

6. Pause Module
   This module appears when the player presses "ESC" on the keyboard or clicks using the mouse. This module will pause the game. The game will resume when the player presses the continue button in the Pause Module.

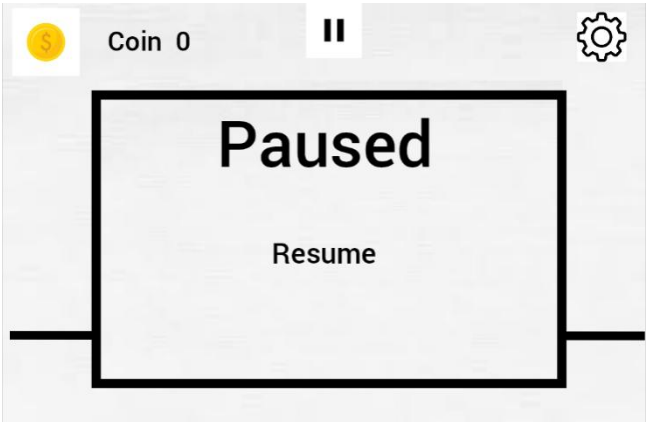


Figure 12. Pause Module

7. Level Finish Module
This module appears when the player has completed a stage or obstacle. This module contains scores using a system of coins obtained.

From the results of trials carried out at the implementation stage, it can be seen that the imaginative user interface design and interesting game mechanics in the 2D platformer game "Frog Mario" significantly increase the level of user satisfaction. The positive response from users to these design elements supports our initial hypothesis.

4. CONCLUSIONS AND SUGGESTIONS

The "Frog Mario" game is still in development, designed to be offline Singleplayer with a 2D display. Frog Mario features 3 stages, each with different mechanics. This game combines two genres, platformer and puzzle. The goal of this game is to find a way out to meet his true lover so that he can change into his original form (human).

Windows-based Frog Mario" provided valuable insights. The applied testing methodology yielded significant data on user response, particularly to the transmitting interface design and engaging game mechanics. These findings demonstrated a significant increase in user satisfaction levels, validating the successful implementation of the design concept Nevertheless, some technical aspects require further improvement. In conclusion, the results of these tests strongly support the effectiveness of the design of “Frog Mario,” confirming the achievement of the goal of creating an entertaining and engaging gaming experience. The insights gained also provide a foundation for further development and improvement ., making this game a valuable contribution to the gaming industry.

REFERENCES

[1] Bhosale, T., Kulkarni, S., & Patankar, S. N. (2018). 2D Platformer Game in Unity Engine. *International Research Journal of Engineering and Technology*, *5*(04), 3021-3024.

[2] Sagala, M. L., Jonemaro, E. M. A., & Wardhono, W. S. (2017). Pengembangan Game Platformer 2D Menggunakan Teknik Projection Mapping. *Jurnal Pengembangan Teknologi Informasi dan Ilmu Komputer*, *1*(11), 1160-1168.

[3] Bates, Bob. Game Design,2nd Edition. Boston: Thomson Course Technology, 2004.

[4] Alexander, Kevin; Pragantha, Jeanny; dan Haris, Darius Andana. Materials Science and Engineering The Development of Android Impossible Platformer Game "My Unfair Adventure", 2020.

[5] Nicoll, B., Keogh, B., Nicoll, B., & Keogh, B. (2019). *The Unity game engine and the circuits of cultural software* (pp. 1-21). Springer International Publishing.

[6] Nintendo, R. D. (1985). Super mario bros. *Game [NES].(13 September 1985). Nintendo, Kyoto, Japan*.

[7] Dondlinger, M. J. (2007). Educational video game design: A review of the literature. *Journal of applied educational technology*, *4*(1), 21-31.

[8] Bhosale, T., Kulkarni, S., & Patankar, S. N. (2018). 2D Platformer Game in Unity Engine. *International Research Journal of Engineering and Technology*, *5*(04), 3021-3024.

[9] Sugianto, H., Prangantha, J., & Haris, D. A. (2017). Pembuatan Game Survival Horror "Can you Survive?" Dengan Menggunakan VR Android. *Prosiding Seminar Nasional Teknologi Informasi, Volume 7*, 41.

[10] Unity Documentation. (n.d.). *Unity's Interface*. Retrieved Februari 24, 2023