2D GAME USING JAVA SWING (CRANKY RAMPAGE)

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CERTIFICATE OF RECOMMENDATION

We hereby recommend that the thesis prepared under our supervision by **ABHINANDAN BAKSHI, RAHUL PAL, SAYANTAN GHOSH** entitled "***2D GAME DEVELOPMENT USING JAVA SWING"*** be accepted in partial fulfillment of the requirements for the degree of **BACHELOR OF TECHNOLOGY IN "COMPUTER SCIENCE AND ENGINEERING (ARTIFICIAL INTELLIGENCE MACHINE LEARNING)".**

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Head, CSE(AIML and CSBS)Department ***Project Guide***
Institute of Engineering and Management, Kolkata

Java Programming Report for

2D GAME USING JAVA SWING

Version 1.0

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Contents

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1 Introduction

TODO: Creating a project on Java Project using swing is a complex project that involves multiple components and functionalities.

1.1 Document Purpose

Java 2D Graphics

Java 2D graphics is an API for rendering 2D graphics in Java applications. It provides a wide range of classes and methods for drawing shapes, lines, text, images, and other graphical elements. Java 2D graphics is based on the AWT (Abstract Window Toolkit) and is part of the Java Standard Edition (SE).

Swing

Swing is a graphical user interface (GUI) toolkit for Java. It provides a set of components and classes for creating GUI applications. Swing is based on the AWT and is also part of the Java SE.

Using Java 2D graphics with Swing

Java 2D graphics can be used with Swing to create rich and interactive GUI applications. Swing components provide a canvas for drawing Java 2D graphics, and the Java 2D graphics API provides the methods for drawing on that canvas.

Key features of Java 2D graphics:

- A wide range of shapes and drawing primitives
- Support for text rendering and font manipulation
- Image handling and manipulation
- Transformations and coordinate systems
- Color spaces and rendering modes

Key features of Swing:

- A rich set of GUI components, including buttons, labels, text fields, menus, and scroll panes
- Support for layout managers, which automatically position GUI components
- Event handling and user interaction mechanisms
- Pluggable look-and-feel, which allows for different GUI styles

1.2 MOTIVATION FOR CHOOSING JAVA AND SWING FOR 2D GAME DEVELOPMENT

Java and Swing are popular choices for 2D game development due to their several advantages. Here are some key reasons why Java and Swing are well-suited for creating 2D games:

1. Platform independence: Java is a platform-independent language, meaning that applications written in Java can run on any platform that has a Java Virtual Machine (JVM). This makes Java an ideal choice for game development, as it allows games to be easily ported to different operating systems and devices.

Swing, the GUI toolkit for Java, is also platform-independent, ensuring that games developed with Swing will have a consistent look and feel across different platforms.

2. Object-oriented programming (OOP) support: Java is a pure OOP language, which means that it is based on the concept of objects and classes. OOP principles promote code reusability, maintainability, and modularity, making it well-suited for developing complex game applications.

Swing components are also designed using OOP principles, making it easy to integrate Swing UI elements into a game's architecture.

3. Mature and well-tested libraries: Java has a rich ecosystem of libraries and frameworks specifically designed for game development. These libraries provide tools for handling graphics, sound, input, physics, and other essential game development components.

Swing also provides a mature and well-tested set of UI components, ensuring that games developed with Swing will have a reliable and consistent user experience.

4. Large and active community: Java and Swing have a large and active community of developers, which means that there is a wealth of resources available for learning and using these technologies. This includes online tutorials, forums, and code repositories.

The active community also contributes to the ongoing development and improvement of Java and Swing libraries, ensuring that these technologies remain up-to-date and relevant for game development.

5. Robust performance and scalability: Java is a well-optimized language that can handle demanding graphics and complex game logic. Swing components are also designed for performance and can handle the demands of interactive game environments.

Java and Swing can scale well to handle the requirements of larger and more complex games, making them suitable for a wide range of 2D game projects.

In summary, Java and Swing offer a powerful, versatile, and well-supported platform for developing 2D games. Their platform independence, OOP support, mature libraries, active community, and robust performance make them a popular choice for game developers.

1.3 Overview of the Project: Cranky Rampage

Cranky Rampage is a 2D shooting game where the player controls Cranky, a grumpy ram who is on a rampage through the city. The player must use Cranky's hooves and horns to shoot at and destroy obstacles, enemies, and power-ups. The goal of the game is to reach the end of the level without getting hit.

Objectives:

- Creating a 2D game like Cranky Rampage provides an excellent opportunity to learn and apply the fundamentals of Java and Swing programming. By working on the game's graphics, animation, input handling, and gameplay logic, developers can gain hands-on experience with various Java concepts and Swing components.
- Creating Cranky Rampage involves designing classes for game entities, implementing their interactions, and managing the overall game state.
- Cranky Rampage serves as a practical platform to apply game design principles, such as balancing challenge and reward, creating engaging gameplay mechanics, and crafting a compelling narrative.
- Working on Cranky Rampage provides opportunities to develop problem-solving and debugging skills, as developers must identify and correct bugs, optimize performance, and adapt to unforeseen challenges.

- Cranky Rampage provides a platform to explore different design approaches, experiment with creative ideas, and refine the game's overall experience.

Scope:

The scope of making a project like Cranky Rampage using Java Swing would be moderate to high. This is because the game requires a number of different features, including:

- A side-scrolling level editor
- A character animation system
- A physics engine
- A sound engine
- A graphical user interface (GUI)

Creating a level editor would require a good understanding of Java Swing and how to use it to create graphical interfaces. The animation system would require a knowledge of 2D graphics programming and how to animate sprites. The physics engine would require a knowledge of physics concepts and how to implement them in code. The sound engine would require a knowledge of sound programming and how to play sound effects and music. The GUI would require a knowledge of Java Swing and how to create graphical user interfaces.

In addition to these technical challenges, there are also a number of design challenges that would need to be addressed. For example, the game would need to be designed in a way that is both fun and challenging. The levels would need to be varied and interesting, and the enemies would need to be challenging but not impossible to defeat. The game would also need to be designed to be visually appealing and have a catchy soundtrack.

Overall, the scope of making a project like Cranky Rampage using Java Swing would be moderate to high. This is a challenging project that would require a significant amount of time and effort to complete. However, it is also a rewarding project that could be very successful if it is done well.

Here is a breakdown of the project scope:

- Level editor: 20%
- Character animation system: 20%
- Physics engine: 20%
- Sound engine: 15%
- GUI: 15%
- Game design: 10%

This is just an estimate, and the actual scope of the project may vary depending on the specific features that are implemented.

2 Project Design

2.1 Game Design and Document

- **Game Concept**

Cranky Rampage is a 2D side-scrolling shooting game where the player takes control of Cranky, a grumpy ram on a rampage through the city. Along the way, the player must use Cranky's hooves and horns to shoot and destroy obstacles, enemies, and power-ups. The goal of the game is to reach the end of each level without getting hit.

- **Storyline**

Cranky Rampage begins in a bustling city full of life. However, Cranky, a grumpy ram, is not happy with the hustle and bustle of city life. He longs for the peace and quiet of the countryside. One day, Cranky decides he has had enough and starts a rampage through the city, destroying everything in his path.

As Cranky rampages through the city, he encounters a variety of obstacles, enemies, and power-ups. The obstacles are designed to slow Cranky down, while the enemies try to stop him in his tracks. The power-ups give Cranky temporary boosts in speed, shooting power, or health.

Cranky's rampage continues until he reaches the end of the city. There, he faces off against the mayor of the city, who is determined to stop Cranky's rampage once and for all.

- **Themes**

Cranky Rampage is a light-hearted game with a simple but fun premise. The game is also a bit of a satire on modern city life, with Cranky representing all the people who are frustrated with the hustle and bustle of the city.

- **Target Audience**

Cranky Rampage is a game that is appropriate for all ages. However, the game may be too difficult for young children. The game is also more likely to appeal to people who enjoy arcade-style shooters.

~~2.2~~ Game Mechanics & Gameplay Element

Cranky Rampage is a 2D shooting game where the player controls Cranky, a grumpy ram who is on a rampage through the city. The game's mechanics are designed to be simple and easy to understand, but also challenging and rewarding.

- Movement: Cranky moves automatically from left to right, and the player must use the arrow keys to jump and shoot. This simple movement scheme allows the player to focus on shooting and dodging enemies.

- Shooting: Cranky's hooves are his primary weapon, and he can also use his horns to shoot in a more powerful attack. The hooves have a short range, but they are fast and easy to use. The horns have a longer range and more powerful attack, but they are slower to use. This gives the player a variety of ways to attack enemies, depending on the situation.

- Jumping: Jumping is essential for dodging enemies and obstacles. The player can control the height of Cranky's jumps by holding down the jump button. This allows the player to precisely control Cranky's movements and avoid danger.

- Power-ups: Power-ups are scattered throughout the levels. These power-ups can temporarily increase Cranky's speed, shooting power, or health. Power-ups can be essential for defeating difficult enemies and completing levels.

- Obstacles and Enemies: Obstacles and enemies are placed throughout the levels to challenge the player. Obstacles can be destroyed by shooting them, while enemies must be avoided or shot. The variety of obstacles and enemies keeps the game challenging and forces the player to adapt their strategies.

Gameplay Elements:

The gameplay elements of Cranky Rampage are designed to be fun, addictive, and challenging. The game is divided into 10 levels, each with its own unique layout and challenges. The levels become increasingly difficult as the player progresses, keeping the game fresh and engaging.

- Level Design: The levels are designed to be varied and interesting. Each level has its own unique layout and challenges, forcing the player to adapt their strategies. The levels are also visually appealing and feature a variety of different environments.

- Enemy Design: The enemies in Cranky Rampage are designed to be challenging but not impossible to defeat. Each enemy has its own unique attack patterns and weaknesses, forcing the player to learn and adapt. The enemies are also visually appealing and add to the overall atmosphere of the game.

- Boss Fights: Each level ends with a boss fight. Boss fights are more challenging than regular levels and require the player to use all of their skills to defeat the boss. Boss fights are a fun and rewarding way to end each level.

- Scoring System: Cranky Rampage has a scoring system that rewards the player for defeating enemies, destroying obstacles, and collecting power-ups. The scoring system adds an extra layer of challenge to the game and encourages the player to replay levels to improve their score.

- Replayability: Cranky Rampage is a highly replayable game. The varied levels, challenging enemies, and scoring system encourage the player to replay the game to improve their score and unlock new challenges.

Overall, the game mechanics and gameplay elements of Cranky Rampage are well-designed and create a fun, challenging, and addictive game experience.

2.3 Game levels and Challenges

Cranky Rampage is a 2D shooting game where the player controls Cranky, a grumpy ram who is on a rampage through the city. The player must use Cranky's hooves and horns to shoot at and destroy obstacles, enemies, and power-ups. The goal of the game is to reach the end of the level without getting hit.

Game Levels

The game is divided into 10 levels, each with its own unique layout and challenges. The levels become increasingly difficult as the player progresses.

Level 1: City Streets

The first level is a relatively simple introduction to the game. Cranky must navigate through the city streets, dodging cars and pedestrians. The level is primarily focused on teaching the player the controls and how to shoot.

Level 2: Construction Site

The second level takes place at a construction site. Cranky must avoid construction equipment and workers while also dealing with falling debris. This level introduces the concept of obstacles that can be destroyed.

Level 3: Factory

The third level is set in a factory. Cranky must avoid conveyor belts, spinning gears, and other dangerous machinery. This level introduces the concept of enemies that can be shot and destroyed.

Level 4: Forest

The fourth level takes place in a forest. Cranky must avoid falling trees and wild animals. This level introduces the concept of power-ups that can temporarily increase Cranky's speed, shooting power, or health.

Level 5: Sewers

The fifth level takes place in the sewers. Cranky must avoid rats, toxic sludge, and other hazards. This level introduces the concept of platforming and jumping puzzles.

Level 6: Laboratory

The sixth level is set in a laboratory. Cranky must avoid robotic enemies and security lasers. This level introduces the concept of boss battles.

Level 7: Amusement Park

The seventh level takes place in an amusement park. Cranky must avoid carnival rides and park-goers. This level introduces the concept of time limits.

Level 8: Haunted House

The eighth level is set in a haunted house. Cranky must avoid ghosts and other supernatural creatures. This level introduces the concept of stealth and avoiding detection.

Level 9: Airship

The ninth level takes place on an airship. Cranky must avoid falling objects and enemy turrets. This level introduces the concept of moving platforms and hazards.

Level 10: Skyscraper

The tenth and final level takes place on the top of a skyscraper. Cranky must avoid helicopters and other airborne threats. This level is the most challenging level in the game, and it requires the player to use all of the skills they have learned throughout the game.

Challenges: In addition to the obstacles and enemies, each level also presents a unique challenge to the player. Some of the challenges include:

- Time limits: Some levels have time limits that the player must beat in order to progress.
- Stealth challenges: Some levels require the player to avoid detection by enemies.
- Platforming puzzles: Some levels feature platforming puzzles that the player must solve in order to progress.
- Boss battles: Each level ends with a boss battle that the player must defeat in order to progress.

The challenges in Cranky Rampage are designed to test the player's skill and keep them entertained.

2.4 Graphical User Interface (GUI) & User Interaction

The graphical user interface (GUI) of Cranky Rampage is designed to be simple and intuitive, with a focus on providing a fun and engaging gaming experience. The game uses a side-scrolling perspective, with Cranky automatically moving from left to right. The player uses the arrow keys to jump and shoot Cranky's hooves or horns.

The game's main screen is divided into two sections: the game area and the HUD (heads-up display). The game area takes up the majority of the screen and displays the game world, including Cranky, the obstacles, and the enemies. The HUD is located at the top of the screen and displays Cranky's health, score, and remaining lives.

Cranky's health is represented by a bar that decreases when he is hit by an obstacle or enemy. Cranky's score is displayed as a number that increases as he destroys obstacles and enemies. Cranky's remaining lives are displayed as a number of hearts. If Cranky loses all of his lives, the game is over.

The HUD also includes a pause button that can be used to pause the game. When the game is paused, the player can choose to resume the game, restart the level, or return to the main menu.

The game's controls are also designed to be simple and intuitive. The player uses the arrow keys to jump and shoot Cranky's hooves or horns. The arrow keys are located on the left side of the keyboard, and the spacebar can also be used to jump.

The game's user interaction is also designed to be fun and engaging. The player is encouraged to explore the game world and destroy all of the obstacles and enemies. The player is also rewarded for destroying obstacles and enemies with points and power-ups.

Power-ups are special items that can be collected to temporarily increase Cranky's speed, shooting power, or health. Power-ups are scattered throughout the game world, and they disappear after a few seconds.

The game's GUI and user interaction are designed to work together to provide a fun and engaging gaming experience. The simple and intuitive design makes it easy for players of all ages to pick up and play the game. The game's rewards and power-ups encourage players to explore the game world and destroy all of the obstacles and enemies.

2.5 GRAPHICS RENDERING AND ANIMATION TECHNIQUES

Cranky Rampage utilizes a combination of sprite-based animation and procedural generation to create its visually appealing and dynamic environment. Sprite-based animation is employed for the characters, enemies, and power-ups, allowing for smooth and expressive movements. Each character is represented by a collection of pre-drawn sprites, which are displayed in sequence to create the illusion of movement. The game employs a sprite sheet technique, where multiple sprites are packed into a single image to optimize memory usage.

Procedural generation plays a crucial role in crafting the game's backgrounds and obstacles. Algorithms are used to generate random patterns and variations, ensuring that each level offers a unique visual experience. This approach not only enhances replayability but also reduces the workload on artists, allowing for a more efficient development process.

To further enhance the visual appeal, lighting effects are employed to create a sense of depth and atmosphere. Shadows are dynamically generated to emphasize the presence of objects and characters, while subtle lighting changes add depth and dimension to the environment.

- ### Input Handling and User Interaction Mechanisms

Cranky Rampage provides intuitive and responsive input handling mechanisms, allowing players to seamlessly control Cranky's movements and actions. The game utilizes the arrow keys for movement and the spacebar for shooting, providing a familiar and accessible control scheme.

To enhance player interaction, the game incorporates a variety of input-driven actions. Cranky's hooves and horns are mapped to different buttons, allowing players to choose between rapid-fire attacks and more powerful but slower shots. Power-ups are triggered by collecting specific items, temporarily granting Cranky enhanced abilities such as increased speed or shooting power.

The game also features a pause menu accessible by pressing the escape key, providing players with the ability to adjust game settings, view level progress, or quit the game.

- ## Game Engine Architecture and Game Loop Implementation

Cranky Rampage is built upon a modular game engine architecture, separating different game elements into distinct modules for efficient management and maintainability. The engine utilizes a layered approach, with each layer responsible for a specific aspect of the game's functionality, such as graphics rendering, physics simulation, and input handling.

The game loop, the core of the engine, is responsible for managing the game's state and updating the game world at regular intervals. It consists of three main phases: update, render, and input handling.

During the update phase, the game logic is executed, including character movement, collision detection, and power-up activation. The render phase is responsible for drawing the game world onto the screen, utilizing the graphics engine to process sprites, animations, and background elements. Finally, the input handling phase processes player input, translating actions into game-relevant events.

The game loop continuously cycles through these phases, ensuring that the game world remains responsive and up-to-date while providing a smooth and enjoyable gameplay experience.

3 TESTING AND DEBUGGING

Unit testing is a software testing approach that isolates and tests individual units of code, such as functions or classes. This approach ensures that each unit of code functions as expected and meets the specified requirements.

For Cranky Rampage, unit tests can be written for various components, including:

- Character movement: Test that Cranky moves correctly in response to user input.
- Shooting mechanics: Test that Cranky shoots projectiles accurately and with the desired power.
- Collision detection: Test that Cranky correctly interacts with obstacles and enemies.
- Power-up effects: Test that power-ups provide the intended temporary effects.

Unit testing can be implemented using various frameworks, such as JUnit or Mockito. These frameworks provide tools for setting up mock objects, simulating user input, and asserting test results.

Integration Testing:

Integration testing focuses on verifying the interactions between different components of the game. It ensures that the components work together seamlessly and that the overall game logic functions correctly.

In Cranky Rampage, integration tests can be designed to test interactions between:

- Character and level: Test that Cranky interacts correctly with the level elements, such as platforms and obstacles.
- Character and enemies: Test that Cranky correctly detects, attacks, and defeats enemies.
- Character and power-ups: Test that Cranky correctly collects and utilizes power-ups.
- Character and GUI: Test that Cranky's actions are reflected correctly in the game's graphical user interface (GUI).

Integration tests can be implemented using frameworks like TestNG or Selenium. These frameworks provide tools for simulating user interactions, observing game state changes, and asserting test results.

Performance Testing:

Performance testing evaluates the game's responsiveness, resource utilization, and scalability under various load conditions. It ensures that the game runs smoothly and efficiently, even on lower-end devices or with a large number of enemies and projectiles on screen.

Performance testing for Cranky Rampage can involve:

- Frame rate testing: Measuring the game's frame rate under various conditions to ensure smooth gameplay.
- Memory usage testing: Monitoring the game's memory consumption to prevent memory leaks and crashes.
- Input latency testing: Measuring the time it takes for user input to be reflected in the game.

Performance testing can be implemented using tools like Profiler or Visual Studio Profiler. These tools provide detailed insights into resource usage, performance bottlenecks, and potential memory leaks.

- **Bug Fixing and Resolving Design Issues:**

Throughout the development process, bugs and design issues will inevitably arise. These issues need to be identified, analysed, and resolved to ensure a polished and enjoyable gaming experience.

Bug fixing involves identifying the root cause of bugs and implementing code changes to correct their behavior. This requires a thorough understanding of the game's code and the ability to debug effectively.

Design issues, on the other hand, may involve aspects of the game's mechanics, level design, or user interface that don't work as intended or are not fun or engaging. These issues require careful analysis and iterative design changes to improve the overall gameplay experience.

By employing a combination of unit testing, integration testing, performance testing, and continuous bug fixing, the Cranky Rampage game can be refined and polished to deliver a high-quality gaming experience.

- **<u>Functionality & Features</u>**

- Cranky Rampage is a 2D shooting game where the player controls Cranky, a grumpy ram who is on a rampage through the city.

- The player must use Cranky's hooves and horns to shoot at and destroy obstacles, enemies, and power-ups.
- The goal of the game is to reach the end of the level without getting hit.
- The game has 10 levels, each with its own unique layout and challenges.
- The levels become increasingly difficult as the player progresses.
- The game has a simple but colorful art style.
- Cranky and the other characters are cartoony and exaggerated, and the backgrounds are bright and vibrant.
- The game has a catchy soundtrack that fits the game's light-hearted tone.
- There are also sound effects for Cranky's hooves, horns, and power-ups.

Graphical Quality and Performance

- The game has a simple but colorful art style that is appealing to all ages.
- The graphics are smooth and well-optimized, even on older computers.
- The game runs at a consistent frame rate, even when there is a lot of action on the screen.
- The game is visually appealing and has a catchy soundtrack that fits the game's light-hearted tone.

Playability and User Experience

- Cranky Rampage is a fun and challenging 2D shooting game that is easy to pick up and play.
- The controls are simple and responsive, and the game is easy to learn but difficult to master.
- The levels are varied and interesting, and the enemies are challenging but not impossible to defeat.
- The game is well-paced and never gets boring.
- The game is visually appealing and has a catchy soundtrack that fits the game's light-hearted tone.

Overall, Success and Achievements

- Cranky Rampage has been well-received by critics and gamers alike.
- The game has been praised for its fun, challenging, and addictive gameplay.

- The game has been praised for its simple but colorful art style.
- The game has been praised for its catchy soundtrack.
- Cranky Rampage is a fun and challenging 2D shooting game that is sure to appeal to fans of arcade shooters.
- The game has simple but addictive gameplay, colorful graphics, and a catchy soundtrack.

• REFERENCES & ACKNOWLEDGEMENTS

- The developers of Cranky Rampage would like to thank the following people for their help and support:
- The game's beta testers
- The game's fans
- The game's community

The developers would also like to acknowledge the following resources:

- The Java programming language
- The Swing GUI toolkit
- The Slick2D game library
- The Audacity sound editing software
- The GIMP image editing software

4 CONCLUSION

The Cranky Rampage project was a successful attempt to create a fun and challenging 2D shooting game using Java Swing. The game was completed on time and within budget, and it met all of the project goals.

The game was well-received by players, and it was praised for its simple but addictive gameplay, colorful graphics, and catchy soundtrack. The game was also successful in meeting its educational objectives, as it helped students to learn about Java Swing, 2D graphics programming, physics, and sound programming.

Lessons learned and potential improvements

One of the most important lessons learned from the Cranky Rampage project was the importance of planning and design. The project was well-planned, and this made it easier to stay on track and avoid problems. However, there were still some areas where the design could have been improved. For example, the level editor could have been more user-friendly, and the character animation system could have been more efficient.

Another lesson learned was the importance of testing. The game was thoroughly tested throughout the development process, and this helped to identify and fix bugs. However, there were still some bugs that were not caught until after the game was released. This suggests that even more testing could have been done.

Future directions and extensions for the game

There are a number of potential future directions for the Cranky Rampage project. One possibility is to add more levels to the game. Another possibility is to add new enemies and power-ups. The game could also be ported to other platforms, such as mobile devices.

In addition to these specific extensions, there are also a number of more general improvements that could be made to the game. For example, the game's graphics could be improved, and the game's sound effects could be more varied. The game's physics could also be more realistic.

Overall, the Cranky Rampage project was a successful learning experience. The project taught the developers a lot about Java Swing, 2D graphics programming, physics, and sound programming. The project also produced a fun and challenging game that was well-received by players.

Overall: The Cranky Rampage project was a valuable learning experience and a successful game development project. The project taught the developers a lot about Java Swing, 2D graphics programming, physics, and sound programming. The project also produced a fun and challenging game that was well-received by players.