



RACOL

Rural Advanced Community of Learners

Galaxy Pirates Design Document

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Produced by Luke Ilett
Written by Luke Ilett and Jared Hopf
Illustrations by Luke Ilett

1.1 Game Story

The planet Gonzio is host to many different species from across the universe. The residents of Gonzio don't disturb their cosmic neighbors and have never faced a major threat until now. Darikin, a galaxy pirate from the realm of wood has been traveling through time and space taking over planets. Darikin is able to create wooden solder clones to do his work. He has set up in Gongzio's dark Monoke forest, a feared part of the planet for Gonzios.

The only ones brave enough to take on Darikin are our heroes Dom and Maxwell.

Their strategy is to travel through Monoke forest in a vehicle specifically designed to fire unique energy balls that have been discovered to destroy Darikin's clone men. As they journey through this enigmatic forest destroying the wooden soldier clones sequentially to eventually face Darikin in the final stage.

1.2 Game Structure

The structure of the game is to traverse the game world battling off enemies by using kinematics. At various junctures in the game the player will encounter events that will generate new mini levels, informational cut scenes, game specific events, or enemies for the player to combat. The player will continue play in this mode and if they are successful, they will face a more difficult challenge in the final stage of the game.

1.3 Game Play

The goal of the game is to progress through each stage of the game, utilizing concepts of kinematics to defeat enemies with your cannon equipped vehicle. The culmination of the game play will be a final battle with the enemy fortress at the end of the level. This aspect of

the game play will allow the game to take on an adventure feel, and as the player progresses through the world they will experience a sense of accomplishment by defeating the enemies they encounter.

For each encounter with an enemy, the player is required to solve some form of kinematic equation that will align their cannon and enable it to destroy the enemy. These equations range from simple alignment calculations to more complex calculations taking into consideration wind forces and differing elevations.

Also, for each enemy encounter the player has a random amount of time available to destroy the enemy before the enemy will destroy them. This gives the player a sense of urgency in that they must solve the equations in a certain amount of time.

1.4 Target Audience and Demographics

1.4.1 Target Audience

The demographic of players for this game will be

- Physics Students of the grade 11 and 12 level that are either taking Kinematics for the first time or are reviewing Kinematics.
- Players that enjoy action/shooting games.
- Players that enjoy anime style games.

1.4.2 Physics

The physics covered in the game will be the basic formulas that deal with Kinematics. The following is a list of the formulas that will be covered in the game:

1.4.2.1 Horizontal Alignment (Tangent Equation)

This equation will be used to align the cannon in the X and Z plane so that the cannon will be lined up with the enemy.

1.4.2.2 Level Plane Distance (Range Equation)

This equation will be used to calculate the distance needed to fire the cannon ball at an enemy that is at the same height as the player.



1.4.2.3 Differing Planes (Quadratic Equation in Y, Linear equation in X,Z)

These equations will be used to solve trajectories for enemies that are not at the same height as the player is.

1.4.2.4 Wind Forces (Quadratic Equations in X, Y, Z)

Similar to the Differing Planes problems, except that now wind factors will make the X,Z calculations quadratic instead of linear.

1.4.2.5 Potential Energy (Kinetic and potential energy Equations, and Height Equation)

Finally enemies may require that a certain amount of energy be used to destroy them, this would require that shots reach a certain height to gain enough energy so that when they fall they will destroy a given enemy.

All of these concepts will be contained in the game. The physics properties described will be realized via the Havok Physics Engine which allows for accurate physics simulation.

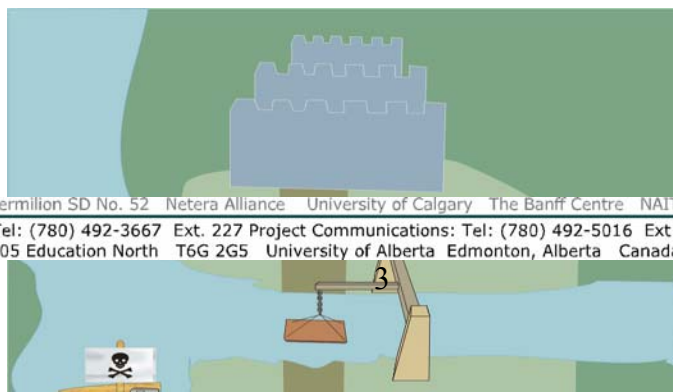
1.5 Conceptual World Map

1.5.1 World map

An important feature of the game is to have a unique and rich environment for the players to traverse while they are playing the game. The world will be divided into various stages so that each of the physics concepts will be presented in an environment that will bring meaning to the concepts and demonstrate their purpose.

The game world will be designed in an anime cartoon style. Using the visual appeal of the genre.

World Map Description and Physics relationship



1.6 Stage I: Introduction (Cannon Alignment).

The first area of the game will introduce the game play and allow the user to familiarize themselves with the controls for the cannon vehicle including the practice of aiming the cannon and controlling the camera. In this area is a variety of targets/enemies for the user to shoot at without being concerned about being targeted by the enemy. Targets in this area will include castle towers, rocks/boulders, barrels, and junk cannon vehicles. In total there will be about 5-6 objects for the player to fire upon.

Physics Formulas:

$$\mathbf{Tan}(\theta) = \frac{\mathbf{P}_z}{\mathbf{P}_x}$$

In this area the physics content is also minimal. The questions given to the player will consist of lining up the horizontal direction of the cannon using trigonometric equations. The questions will also vary in the type of data given to solve the equation. These variables will either be a selection of point locations, or given in a point/vector direction format.

1.7 Stage II: Plains. (Range Equation)

In next area the player will begin to utilize the range equation. In this area they will start to be targeted by the enemy cannon placements. The main placement for cannons in this area will be on level planes with the player, but the cannons may or may not be seen directly by the player. Players will have to deal with around 5-6 cannons in this area.

Physics Formulas:

$$R = \frac{V_0^2 \sin(2\theta)}{g}$$

The physics content for this section mainly involves the Range formula for calculating trajectories, as well as using the previous tangent formula for aiming the cannon horizontally. Questions will be given to solve the Range equations given, data aspects and will also call into view the dual answer nature about shot angles and velocities stemming from the nature of the Range equation. Again, data will be given in the form of either point/point locations for the cannons, or in a point/vector direction format.

1.8 Stage III: There are enemies in the hills. (Quadratic/Linear Equations)

After the player eliminates the enemy cannons in the plains, including those that are hiding behind hill sections, they will continue on into a

section of steeper hills and terrain. Again, enemy cannons and scout towers will try to impede the progress of the player.

Physics Formulas

$$x = x_0 + V_{0x}t \qquad y = y_0 + V_{0y}t - \frac{gt^2}{2}$$

$$t = \frac{b \pm \sqrt{b^2 + 4ac}}{2a}$$

The physics content for this section moves on to the fact that for uneven terrains the Range Equation no longer applies and the only way to solve the problem is to now use the quadratic equation to solve for Y and to use a linear equation to solve for the distance in the horizontal direction. Questions will again range from solving the quadratic equation alone, to solving the entire range of equations involving the quadratic, linear equation and the tangent equation.

1.9 Stage IV: Wind Forces (Quadratic Equations)

Once past the hilled terrain, the player will enter a windy area. In this area there will be additional cannons and enemies to deal with. At the end of this area the player is required to damage/destroy a crane that is holding up a bridge for the river ahead. Once this crane is destroyed the player can then move on to the final area.

Physics Formulas:

$$x = x_0 + V_{0x}t + \frac{a_x t^2}{2} \qquad y = y_0 + V_{0y}t - \frac{gt^2}{2}$$

$$z = z_0 + V_{0z}t + \frac{a_z t^2}{2} \qquad t = \frac{b \pm \sqrt{b^2 + 4ac}}{2a}$$

The physics content in this section involves equations that deal with accelerations occurring not only in the vertical direction (gravity) but also in the X and/or Z directions (wind). Again, equations will be given to solve any one aspect and also to solve the full range of equations giving differing types of data.

1.10 Area V: Hitting with enough Momentum/Energy (Energy and Height)

In this final area the player is presented with a giant castle to destroy with various cannons by targeting weak points on the castle.

Physics Formulas:

$$KE = \frac{1}{2}mv^2$$

$$PE = mgh$$

$$V_y^2 = V_{0y}^2 + 2a(y - y_0)$$

Physics content within this section deals with work energy and the conservation of energy. In this area, certain amounts of energy and momentum will be needed to destroy the various cannons and sections of castle in this area. These formulas and the formulas of the prior levels will be used to insure that a cannon ball will be fired correctly and will hit the targets with enough energy to destroy them.

1.11 World Objects

There are several objects that will be found in the world environment of Galaxy Pirates. Most of these objects are static and will not change their positions. While other objects may have simple animations but will remain fixed in place.

The static objects that will be found in the world of Galaxy Pirates are as follows:

Trees

Various corrupted trees will litter the landscape sneering at the player as he traverses the level.

Rocks/Boulders

Various piles of rocks and boulders will also litter the landscape making the landscape more scenic.

Towers

Various scout towers will be littered though out the world and the player will be able to shoot and destroy these towers. The towers will be a little misshapen and have vines growing on the exteriors of them.

Bramble Growths

A growth of brambles and vines will decorate the roadside posing to take over the road side track.

Gates

Castle gates will provide a barrier to the user by being placed along the track at key points.

Enemy Cannons

Enemy cannons will combat the player. The cannon will be able to rotate horizontally and vertically enabling it to fire at the player regardless of where they are located in the world space.

Energy balls

Energy balls will be specially textured with transparencies and other effects.

1.12 Front End

1.12.1 Main Menu

The main menu will offer the following choices:

- Play Game
- Instructions

The play game option will take you directly into the game. The instruction menu will be divided into the following sub menus:

Cannon Controls

This menu will list the instructions for controlling the Cannon and the car in the game.

Camera Controls

This menu will list the keys that will control the camera views in the game.

Physics Help

This menu will provide a help screen detailing each of the formulas that the player will use in the game.

1.13 In Game Heads Up Display (HUD)

Once inside the game the player will have various displays to inform them of events within the environment, and the status of the world.

The HUD contains various elements relating to game play. These elements of the HUD are broken down as follows:

Upper Left Corner

In the upper left corner, players will notice statistics that will help inform them of the game's progression. These statistics include the player's score, what level they are currently playing in, and how many lives they have left.

Bottom Left Corner

The bottom left corner of the HUD is where the representative states of the cannon are located. The data presented here is the players

position in the world in x , y , z coordinates, the horizontal angle of the cannon, the vertical angle of the cannon, the shot speed a cannonball will have when it is fired, and the reload time for the cannon until it is next able to fire.

Upper Right Corner

In the upper right area of the screen is a help button, the pause button and the quit button. Activating any of these will pause the game and display the relevant information. The Help Button will activate a pop-up window, allowing the player to browse all of the help pages found in the Instruction Button linked from the Main Menu. The Pause Button will only halt the game. Finally, the Quit Button will prompt the user to decide if they really want to leave the game.

Bottom Middle and Lower Right Corner

This area of the HUD displays the information about the current state of the game and information relevant to the calculation of cannonball trajectory. Various modes like Driving Mode, Enemy Detection mode, and Calculation mode will be displayed here.

A partial prototype screen of the in game HUD is shown below





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