Northeastern University – Silicon Valley

CS 5150 Game Artificial Intelligence

Project Report

Sushruth Bhandary and Michelle Lee

SUMMARY

The Game is a strategic game with aspects of tower defense and real-time strategy characteristics where a human player and an AI are competing against each other. The goal of the AI is to capture the castle and the goal of the human player is to prevent that from happening. The game shall progress in levels. The player has to destroy all the AI characters on the screen to proceed to the next level. The difficulty increases at each level. The human player and the AI have multiple resources at their disposal to achieve their goal.

ENVIRONMENT

Information About Objects Operating in the Environment

The environment needs to track the following information about the objects contained within it:

Terrain

There are two main types of terrain.

1. Water – The water terrain is only accessible by the enemy ships that spawn here. To simulate realism, the ships have been given random velocity as they travel through the water. This takes into account variations like wind, ocean swells, and the capabilities of the seamen. The water also changes the type of mines that can be placed.
2. Island – The island terrain is accessible by the enemy soldiers and the player's troops. The ships that reach the island will unload enemy soldiers that are targeting the player's castle which is the goal waypoint for the enemy. The land changes the type of mines that can be placed.

Player Operable Objects

In this game, these take the format of weapons.

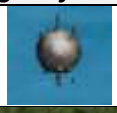
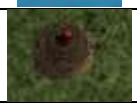
Cannons - There are two cannon stations on the main island. The human player can shoot cannon balls from these cannon stations in any direction within the shooting radius. Since the cursor of the game is a crosshair, it will change color based on whether or not a targeted area is in range of the cannon. Additionally, based on where the cursor is, the closer of the cannons to the target will fire. The cannon destroys all the soldiers within a certain radius of where the cannon ball lands.

Images of Cannons:

	*Left cannon*
	*Right cannon*

Land Mines - The players can deploy land mines around the main island. If an enemy character comes in contact with the mines, all the characters inside the blast radius are killed.

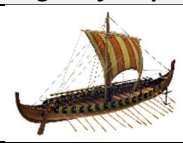
Aquatic Mines - The players can deploy land mines around the main island. If an enemy character comes in contact with the mines, all the characters inside the blast radius are killed.

Images of Mines:	
	*Aquatic mine*
	*Land mine*

Other Objects in the Environment

Ships: Shown as boid circles. The circles are filled in white. Ships are used to transport the soldiers via water. The ships can land only at the Piers where the soldiers will get off and head towards the castle.

- Stats:
    - Each ship can carry 6 soldiers at a time
    - If a ship is hit with a cannon, it will lose soldiers each hit

Images of Ships:	
	*An image of a ship*

Points of Interest

Gate: This is a waypoint for the enemy soldiers. It is shown as an image at the base of the circular wall surrounding the castle. Once this gate has been breached, the game is over and the user loses.

Piers: This is a waypoint to rendezvous for the ships. Once the ships reach this point, the enemy soldiers disembark onto the land.

CHARACTERS

Human Player Soldier: Shown as boid circles. The player's soldiers (good guys) are filled in yellow. The human player can direct their soldiers around the island. Human player soldiers are controlled as a platoon and cannot be given instructions individually.

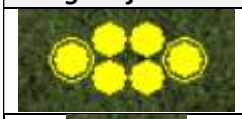
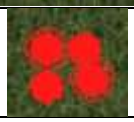
- Stats:
    - If an enemy soldier makes contact with a friendly soldier, they both die

Human Knight: Represented as concentric boid circles. A knight is twice as powerful as a soldier and can destroy 2 enemy soldiers before it dies.

Enemy Soldier: Shown as boid circles. The enemy's soldiers (bad guys) are filled in red. Enemy player soldiers operate as a platoon and their movement is controlled by hive.

- Stats:
    - If an enemy soldier makes contact with a friendly soldier, they both die
    - 5 enemy soldiers in front of a gate will destroy the gate

Enemy Knight: Represented as concentric boid circles. A knight is twice as powerful as a soldier and can destroy 2 enemy soldiers before it dies.

Images of Platoons	
	*Human player soldiers in a platoon. The two outer characters are knights.*
	*Enemy soldiers in a platoon. The top left and bottom right characters are knights.*

RULES/FLOW OF THE GAME

When the game starts, ships with enemies spawn. The ships randomly pick piers to go to and they move at varying velocities. Once the ships dock, the enemy soldiers unload and head for the castle.

The player starts the game with an army of a given size and a limited number of weapons (5 mines of each type). The player can dynamically create mines while the game is running and fire the cannon at will.

The player wins by eliminating all of the enemy soldiers. The enemy wins by having at least 5 soldiers reach the castle goal.

ALGORITHMS

Movement Algorithms

ALGORITHM	DESCRIPTION
Steering Behaviors	The game uses seek, chase, flee, and pathfinding for the ships and soldiers to move around the level.

ALGORITHM	DESCRIPTION
Dijkstra's Algorithm	The fully optimized version of the game would use Dijkstra's for finding the shortest path for the ships.
Decision Making	The game uses decision trees to determine what happens during engagement .

IMPLEMENTATION APPROACH

Steps for Implementation

Phase 1: Create classes for each of the characters that work independently of each other.
Phase 2: Create the environment and interweave the classes that depend on each other.
Phase 3: Create the algorithms that will be required by the characters - army path finding, steering and swarming behaviors and they should be capable of reaching the target if there are no obstacles.
Phase 5: Implement interactivity aspects in the game such as allowing the player to use weapons to destroy the AI army.
Phase 6: Apply the AI Army decision making capabilities.
Phase 7: Create levels for the game to run in.

Implementation Notes

These are design notes that were discussed for future versions of the game:

Decision Making Capabilities – Currently the enemy soldiers have a one track mind for completing their objective of capturing the castle. In future versions, we could increase the intelligence of the AI. There could be multiple ways to win including:

1. Destroying the gate to the castle and capturing it
2. Exhausting the player resources by defeating the entire player army and making the player use all of their finite resources (cannonballs and mines)

In later versions the soldiers would query the environment for these statistics and alter their decisions based on this. Then for further improvement, there would be more realistic ways for the enemy army to query the environment since in the real world, enemy soldiers would need to gather some kind of reconnaissance to get that sort of tactical information.

Implementing Waves – To be more true the tower defense base, the game should be able to determine whether it needs to increase its difficulty for the user. If a user completes a level very quickly, the game

could scale the difficulty accordingly in a number of different ways. One way of making the game harder would be adding more enemies.

Implementing More Character Types – In the proposal, it was discussed that there would be a knight class. In addition to adding this class, there could be more categories with varying objectives that could make the game more interesting. Some examples are:

- Cavalry – These units could move faster and do more damage to walls.
- Reconnaissance – These units would only be visible to the player some of the time and if they reach certain view or cover points, they would be able to gather information on the player and strategize with the rest of the army.
- Knight – The knight would be a more robust soldier and would be able to kill more units versus the soldier.
- Archers – These could be long range units that could attack for some distance in front of them.

Implementing More Environment Objects – This would involve adding different types of tactical points on the island. For example there could be weapons that could be accessed by both sides and that they would have to fight about.

Increasing Player Customization – Initially we discussed adding the ability to create walls on the fly as an obstacle to the opposing army. The next iteration of this game could add upgrades to the walls, cannons, mines, and even the castle itself. This would increase interactivity and add more realism to the game.