Project Description

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Background: In 3019, a group of Interstellar pirates attack the earth, all the human armed up and protect the earth from invasion.

How to play: Drag the tower from the shop and place them advisedly. Different towers have different ability, use them wisely. Manage your currency and plan the defence uniformly around the base, since the enemy could come from many directions.

Technical requirements:

1. We are using OpenGL for render, and no fatal bugs.
2. The enemy will find the 'easiest' path for them to attack the base, there are 'Unmovable' obstacle on the map which has large edge weight, so enemy would find path bypass them. Additionally, when player place a tower, it will affect the weight of adjacent movable node's edge weight. So, the enemy would try to avoid the tower as well.
3. We are using finite state machine AI for tower, each tower has a 'target In Range' list which contain all the nearby enemy, and a charge time which is the fire interval. When there are enemy

is the ‘target in Range’ list, and the charge time is 0, the tower will fire. Otherwise it will just remain static and charge their weapon.

4. The overall game is controlled by a finite state machine. Essentially has three ‘state’
    a) The beginning state: An introduction state to tell player how to player our game and illustrates the background briefly. When player press ‘Enter’, game will change into next state.
    b) The actual game state: The main game, player playing the game, when player loose all three lives or win the game, game will change into next state.
    c) End scene state: End game, if the player win, provide a celebrate scene and end game after any key. If the player loses, provide a fail scene, player has a choice whether end the game or re-play the game.
5. All the tower fire is based on the particle system, and we have three different type of ‘fire’, each tower has its own way of particle fire way.
6. All the rotation of tower is based on the transformations.
7. We are using hierarchical for the Tower4, we are using a warcraft with the base airport. The warcraft could take off the

airport and attack the enemy, but it can not move too far from the airport. After all enemy is killed, the warcraft will return to the position of airport and waiting for next battle.

8. Our game provides ‘Z’ and ‘X’ to scale the screen that means you could enlarge or ensmall the game world. Also, could use the arrow key to move the screen around. However, since some of our game effects (e.g. firing) are based on the screen size, scale and move the screen will disable some function and make the game looks weird. Its best to use initial screen size to play our game.

Gameplay requirements:

1. Alien1:  Alien2:  Alien3: 

   Details are in Design notes.

2. Tower1:  Tower2: 

   Tower3:  Tower4: 

   Details are in Design notes.

3. The Tower4 is an autonomous mobile defender. Detail see Design notes 2.

4. We have currency system, destroy different enemy will give player certain amount of currency.

5. We have a start scene, playing scene and two end scenes.
6. In the rightmost of our game is the shop and the HUD, it will show the level, currency, score and reming health
7. We could have unlimited levels (but player will win when he/she successful pass the level 30), when certain number of aliens are destroyed, level will be increase by 1 and all enemy will be powerup with either health and speed.

Beyond the minimum:

1. For tower3, the way of define whether the ‘laser’ is hit the enemy is using the technic of physic, we calculate the point (enemies) to line (laser) distance and determine whether hit or not.
2. The path of enemy is not be defined only by the obstacle on the map, and the tower. When player placing a tower, all the nearby ‘movable’ node’s edge weight will be increase, and enemy will find a best way to bypass the player’s defense. Also, the enemy would spawn in four different corners of the graph, the base is in the middle, so there are lots of possible way that need player to defense.
3. Three firing particle system, so cool!
4. 4 different entry for enemy.

5. 4 towers.
6. Give player a choice of replay the game, other than just terminate the program when lose.
7. Player could drag the tower from shop and place them, if currency for a tower is not enough, this tower will have darker color in the shop (means not enough purchase this one).

Design notes:

1. Alien1:  Alien2:  Alien3: 

   The three types of enemy

   - Alien1 is the base enemy with low speed and low health.
   - Alien2 is the commander, which has medium speed and medium health, and it will increase nearby aliens' speed.
   - Alien3 is the crack troops, with high health but low speed. But it would be a high risk for player if it is taking most of damage and let other aliens reach the base.

2. Tower1:  Tower2:  Tower3:  Tower4: 

   The four types of Tower

   - Tower1 is the 'spit fire tank', it has highest attack rate but low damage per shot. Its best for dealing large damage

for single target.

- Tower2 is the ‘radiation circle’, it deals high damage to all the enemy in the attack range, but is has quite long charge time. Kind of the tower deal the most damage, but need other tower to finish the enemy, since tower2 has quite lone attack interval.
- Tower3 is the ‘laser ship’, it deals high damage to all the enemy in a line, with medium charge time. Player will make a wisely decision of placing this tower in order to make highest damage.
- Tower4 is the ‘patrol warcraft’. It has an airport, and the warcraft could only chase the enemy within the range of the airport. If there an enemy within the range, the warcraft will move to the enemy and shoot it, if no more enemy is detected, the warcraft will return to the airport. The warcraft could deal quite a lot of damage and the attack range is the largest among the towers.

3.  The base, player need to protect it from aliens
4.  The portal, where enemy come from, it would randomly

been placed on the 4 corners of the map.

Implementation notes:

1. The map initializes (setting obstacle and road) is in the graph.cpp. And the optimal path for enemies are saved as an int List (save all the id of node on path), each enemy acquire their optimal path as they are spawned.
2. Tower.cpp handle all the rotation of the tower and firing, but detecting whether enemy is in the range is in the main, since we need check each enemy with each tower. After ‘in range’ check, all ‘in range’ enemy are saved in a ‘targetInRange’ list of towers, and Tower class handle dealing damage.
3. Main class take mainly most of thing from game beginning until game end. It read all the enemy information and tower information for external file and save them. It initializes the game world setting. The player selecting tower is also handled in main.
4. The algorithm of Tower3 laser hit is obtained from physic class, the point-to-line distance.

Known bugs and limitations: NO BUG FOUNDED.

Comments on individual contributions:

Weihang Chen:

1. All particles handle and rendering

2. Enemy path finding
3. Tower place, drag from shop, currency system.
4. Tower firing, rotation, enemy in range detection, enemy destroy.
5. Level design.
6. External file read in for tower and enemy information.
7. Start scene, End scenes make.

Heqing Wang:

1. Game graph design and implement
2. Setting obstacle weight, the tower weight and update the optimal path for enemy.
3. Screen scaling and moving.
4. Tower3 laser hitting design and implement.
5. Alien2 the commander increasing nearby alien speed design and implement.
6. Tower4, the ‘patrol warcraft’ design and implement.
7. Game balance.
8. Writeup.

Project postmortem:

- I like the part of path finding, the algorithm is cool and the enemy moving along the optimal path really make it ‘smart’. But I am kind

of want that we could use some lighting and physic in our game, I think that would be cool.

- We are proud of the whole game we made. The tower changing nearby node weight, three different particles firing, laser hitting enemy and shop creation. Those are quite the highlights of our game.
- If I start the project again, I would like to remove all the obstacle and let player to place their own obstacle, that would be fun.
- Since the course other than COMP 2501 are different for me and my teammates. For one week I am quite busy, so my teammates pay more effort on the project, and other week I don’t have lots of due, then I pay more efforts on project. Once we modify the project, we upload it online for both of us and telling others the part where is changed. I like this way
- Creating the initial game logic is quite a difficulty. Building the particle firing and lock enemy take lots of time. After those, its easy to modify since is clear to notice the change and bug.
- In the future, if there are more time, I would like to add more tower, enemy and even some traps in the game. Also, I would really like to add lighting affect in the game.