A video game screen with a pixelated video game

Description automatically generated



Project Report

Computer Game Development

Final Year Project

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# Project Abstract

This project uses C++ and SFML library in visual studios. I chose this option because I can get a deeper understanding of C++/SFML and learn more about how to code certain things, without help for example Unity does a lot of stuff for the programmer, doing only in C++/SFML I will need to write code for the interface itself all the parameters.

# Project Introduction

I always wanted to create a game that is a RTS (real time strategy) type of genre. So, I decided to make something similar to “Command & Conquer”, these games you usually create buildings and from these buildings you can create units each one has its purpose and these types of games have a cool build up that I like, starts with very few buildings and units then later in the game you end up with a massive army and tons of resources, the whole game goes from slow with a lots of micro-management then constantly spamming units and sending them to attack with little to no attention on the players side for controlling units that much.

There is a cool main menu that has multiple options to select “Play Game”, “Level Editor”, “load Level” and “Exit” the main menu is made to be fancier having a shader on the title text and the background moving wave like to give the theme underwater more purpose.

**Level Editor:** The project has a “Level Editor” in here you can design your own map, after the player is finished, they can save with a name if there is a file that has that name, they can overwrite it if they like, player has the option to load it as well and continue where they left off or edit that current map design. Ther are 4 options the player can use “Walkables” which are tiles that player can move their units and place buildings on top, “Walls” the player units can’t go through and can’t place buildings on top of it. “Resource” a tile that is needed to get currency in game that currency is used to create buildings and units. And finally, “Misc” miscellaneous this is more decorations so it serves the same purpose as “Walkables” units can traverse etc.

**Load level**: In main menu the button “Load Level” will bring the user into another screen it shows the player all the level designs that has been created and you can select one of them to use instead of the default one.

**Play Game:** When starting the game, you the player will have only 1 building with some currency you will slowly start to expand and eventually meet the enemy which is like a player that it can create its own buildings/units and attacks the player.

Who ever destroys all the buildings first wins the game.

By clicking on the main building headquarters a GUI interface will appear showing few icons and a sell button you can sell buildings except the main building – headquarters, you can select 4 options at the bottom of the GUI the first building Is a refinery building this is how you get currency in game by building this refinery building, it will spawn another unit called harvester which searches for resources and after collecting and will bring back to deposit it. The other buildings are – “Barracks” which you can create infantry type of soldiers so 1 unit but multiple entities, “WarFactory” – can create vehicles like a buggy or tank aurora for support and last building is a “Aircraft” building this creates air units so helicopter type and jets.

Each unit are slightly different from another, these are all the current units in game.

1. Rifleman – multiple soldiers who shoots few bullets before reloading.
2. Harvester – searches for resources and brings it back.
3. Buggy – fast scout unit has a turret in the middle that can rotate in all directions.
4. Tank Aurora – support/debuff unit, it heals friendly units and shoots out an emp wave at enemies that slow them down.
5. Hammerhead – has 1 turret on each wing that shoots, deals high damage but poor has accuracy.
6. FireHawk – shoots missiles, very fast with high damage, but longer reload time.

Enemies have 3 phases exploring, grouping, and attacking the player it also spawns with multiple buildings to give the enemy a slight advantage.

You can pause the game which has an option to resume by pressing pause again, restart the game or save the game which saves all the units/buildings and currency the player and enemy has and by going back into the game you will start where you have left off.

After the match ends there is a win/lose screen, it shows the game stats such as how many units/buildings has been build, how long the game lasted, and if they want to restart or exit from game.

Throughout the entire game there is many particle effects such as missile smoke when fired, sparks when the bullets hit other enemies’ units/buildings, and even in game map particle effect like the bubbles that spawn where the area is visible or explored before.

Sound to make the game feel more impactful when playing, there is background music and a playlist of songs when playing in the game so after the songs ends another starts to play, there are sounds when missiles or bullets are being fired as well.

There are shaders added on textures like in main menu the background has a shader to make it wavy giving that underwater theme aesthetic more and buttons have animations to indicate that the mouse is on the button, there is a custom mouse instead of the standard one.

# Project milestones

First Semester:

* Main Menu
* Level editor with saving and loading.
* GUI Panel – when selecting the building it should appear on the right side.
* Creating Buildings – each building has their own units’ slots in the GUI panel.
* Camera view is moving if the mouse is close to the window boundary.
* 1 working unit – health, shooting, behaviour.
* Particle effects & shaders

Second Semester:

* Unit for infantry type
* Units for vehicle type
* Units for air type
* Enemy AI – to create buildings and units.
* Pause game.
* Save game.
* Win/Lose screens.
* More Particle effects and shaders
* Sound/music.

# Major Technical Achievements

**Level editor** was my first major technical achievement it was very hard to make and took a lot of trial and error to get it working as I wanted it, having the grid to be 50x50 or something and then placing the texture and type of tile on it took more time than I expected, after adding buttons at the bottom of the screen where the player can click to select what type of tile it is and them placing them on the grid wasn’t hard or easy but making them rotate that tile that was placed was very hard until I understood the problem was I needed a origin point to be in the middle of each tile before it was the default which is top left and made the tile when I rotated change positions instead of being in the same spot, saving and loading the map into the main game was hard as well, it took a bit of time to see if the tiles was actually that particular type for example resource tile if its that tile or not.

**GUI panel** – So after I finished making the GUI Panel, I needed it to work If I click on the Refinery building icon a ghost building of that sprite should appear to show if it can be placed or not, and then clicking again to place on the mouse position, it took a lot of work to set up for each building type so by clicking that particular building you will get those icons each buildings has different functions for each building type so for example if I click on the headquarters building the GUI panel will appear and the buttons will be other buildings icons such as Refinery, Barracks, WarFactory and Aircraft. If I click on the barracks building the GUI panel will appear but this time, it’s going to have the Infantry units such as “Rifleman Squad” unit that will spawn on that building position.

**Enemy’s** – This was one of the hardest things and longest feature to do, so I started off making the enemy to decide to either create a building or a unit every few seconds, if it creates a building it needs to be somewhere within its range of other buildings and also to take into account for wall tiles and other buildings so it won’t build on top of them, if it creates a unit it has to be from that respective building if there are no buildings it will build one instead of the unit.

I did have an error that consumed a lot of time, but it was an easy fix, I was rendering the enemy buildings and units inside the map grid and using the fog of war but if the units spawn outside of the map I got a call stack a runtime error which ended up taking a lot of time.

When the enemy has units, it goes through 3 phases.

1. It will send the units it has randomly in the map on a valid spot, so it won’t go into walls.
2. Grouping – it will rally some units into a certain spot besides its base.
3. Attacking – it will send everyone to attack the players units or base depends on which is closer to that unit.

**Saving/loading** – It took a lot of trial and error to get the saving and loading to work, I am saving all the stats, buildings, and units everything in the game into a text file. Saving the stats was easier to do but saving the buildings and especiallythe units took very long I wasn’t sure what I need to save and what I didn’t have to so like the textures was unnecessary, the basics such as positions, target positions, health, damage was needed.

**Units** – some units were harder to do than others the main 2 are the Tank Aurora and Rifleman, tank aurora has 2 phases first its where it charges up a emp at the front and 2nd is when it sees an enemy and the emp is fully charged it will fire towards the enemy, the emp will gradually expand and if it hits the enemy, the enemy needs to slow down to a stop when it stops there is few seconds that it wont be able to move, this took some trail and error to get what I needed. The rifleman was the last unit I made which was a mistake on my end the unit class was designed for 1 individual unit, so I had to make a vector of entities and assign the sprite of that unit for all the entities and for them to shoot which as well was a bit tricky to do.

# Project Review

Everything went well, the level editor is what I would like it to be the only thing I can still add would be the starter buildings positions change or have an option for the player to decide where and how many pre-made units/buildings at the beginning of the game will be, I would like to add that feature for the level editor as well.

I enjoyed the units that I have made and what they do, the main menu looks really cool for me it tells people that its underwater themed immediately when starting. When the enemy has a good force made it looks cool when sending your army and the enemy to clash against each other which was my biggest goal to have.

Saving and loading can be better made, instead of saving on a text file I can save it on something else like Json or XML which I like the structure personally on the file and lastly maybe try it on YAML and be encrypted so when users get the game they cant go and change values in the file.

If I can re-do this I wont have tried to add something completely new that I never tried before like neural networks I wasted like 3 full weeks nearly whole month doing something new that consumed so much time with so little to no experience, I thought adding neural networks would be cool which it was, I learned tons of new stuff but at the same time my main project didn’t use that in the game itself. And thinking back if it didn’t attempt at that I could’ve added the stuff below I listed.

Here is a list of stuff that I would really like to add to my project if I had time.

* A different faction with new units/buildings designs
* If same faction is being played there should be an option to change colours so the player can tell if the same units which faction they belong to. So red for enemy and blue for player or green for player if they like. Each building and unit will have some kind of outline on their sprite.
* More units/buildings for current faction
* Buildings such as defence towers.
* Faction abilities – radar
* Mini map
* Dynamic weather – so while playing the lighting will change or smoke to appear etc.
* Improve on everything such as current units, buildings, more particle effects, and sound.
* Saving/loading buttons when pressing play game for easier to understand.
* Tutorial mode
* Real time tactics – such as like if the harvester unit spots an enemy, it will immediately retreat for a while and then go back to what it was doing.
* Environment interactions – what I was doing to “Misc” type of tiles so like if a tank drove over a plant that plant would be squashed something like that.
* Improve enemy behaviour so like it will send like 1or 2 units to counterattack go around the map while player is busy attacking the main force something like that.

# Conclusions

This project was challenging yet I am very proud of it making a real-time strategy game inspired by classics like “Command & Conquer”.

The project has a good gameplay, player unit/building creation and enemy that creates buildings/units and attacks player, particle effects, music/sound and shaders making the game itself stand out more, feel more impactful when playing, saving/loading and win/lose screens for the game with a pause menu as well.

The technical achievement of this project was significant. The level editor stands out as a complex tool allowing the player to customize maps and use them in game.

A GUI interface panel to show which buildings creates stuff, each one has their own buttons. An enemy that tries to expand its base and controls units to explore, group and attack the player.

There are potential future upgrades/improvements that can be made, plans include introduction to a new faction each with unique units and buildings to enrich the game, improve on the features that I already have, improve my own programming skills by learning from the mistakes I’ve made during the project work.

In conclusion, this project not only fulfilled its goal of creating a functional RTS game but also set the stage for future development. The skills gained, challenges overcome, and knowledge acquired during this project will serve as a solid foundation for further exploration and innovation in the field of game development and mostly put on my CV.

# Future Work

I would love to keep working in my spare time to fix some bugs I may have and also add another faction, create new units which all behave slightly differently while keeping the theme (underwater), I was also thinking of making this a unity/unreal project which would make it easier to GUI interface making all by code can be annoying and tedious for GUI side which in return I can have more time adding other features – factions, units, levels, different modes and more like the list of stuff I mentioned above in project review.

Depending on life circumstances, I would like to make an official pixel RTS game using Unity.

# References

This project is very inspired from other RTS games such as “Command & Conquer” and “Age of Empire’s ” series.