COS30031 Games Programming
Custom Project Report

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1 Introduction

1.1 Background

Computers are incredible and complicated these days, with many components that allow for the more efficient and effective computation of various tasks. For me personally, by far the most interesting modern day development (which many will actually take for granted) is the humble GPU. Short for graphics processing unit, it is a core aspect to any computer whether it is pushing hyper-realistic game graphics or displaying the words on your social media feeds. These GPUs differ greatly from the CPU which many view as the beating heart of any computer. CPUs have been designed to be more general purpose, allowing for operations such as logical branching, maths, and bitwise magic. GPUs on the other hand are entirely focused on floating point maths operations, and have been architected to be able to do those rapidly and in parallel. This means modern day graphics requirements, such as being able to independently address one of the literal millions of pixels on your screen (a standard 1080p screen contains a little over 2 million pixels!), is now a trivial task that can be completed with great speed.

Computers haven't always been like this however, and many moons ago we would have required the CPU to perform all of the logical and graphical work of a computer. This complicated matters greatly as soon as you wanted to display complex graphics, and it only got worse if you wanted to display complex graphics *and* provide complex logic–such as in a game. It's for this reason that many games of yore have had to come up with some very clever techniques to "cheat" graphics. Most games for the longest time were purely 2D since that was about as much as we could reasonably handle with the hardware at the time. Before 3D accelerated technology hit the general consumer market, 3D games were but a dream... Kind of.

Enter the raycaster. There will be more later on about how it works and why it's so fast, but for now just know that raycasters were some of the earliest attempts at creating 3D graphics in games. Not to be confused with ray marching and ray tracing (two very cool 3D graphics techniques as well!), raycasters have a very distinct look to them that many will remember from the first Wolfenstein 3D game. They tend to look very blocky, with billboarded sprites representing the entities within a scene. This technology forms the basis of my custom project.

1.2 The Project

At a high level, this project will take form of a first person shooter using 3D raycaster graphics. The front end will use SFML to display the internal frame buffer as well as receive/process the window events. The back end will be far more complex, consisting of the actual raycasting engine, an ECS implementation for managing enemy entities, multi-threading to assist with performance, and some simple collision detection. The entire project has been written in C++

within a Linux environment using the gcc toolchain, and borrows greatly both from Austin Morlan's writeup on ECS[1] and Dmitry V. Sokolov's tinyraycaster series of tutorials[2].

2 Implementation

2.1 Front End

2.2 Back End

2.2.1 Raycaster

2.2.2 Enemy AI

2.2.3 Collision Detection

2.2.4 Multi-threading

3 Conclusion

[1] https://austinmorlan.com/posts/entity_component_system/
[2] https://github.com/ssloy/tinyraycaster/wiki/Part-0:-getting-started