**Car Simulation Game**

Using Unreal Engine 5

**Project Owner**

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02/18/2022

**Course Info**

CISC 4900 - Section VC1B

Spring 2022

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# Abstract

The overall purpose of this project is to create a car simulation video game from the ground up using Unreal Engine 5, which is currently in early access. Critical game assets (such as game vehicles) will be designed and created using Blender, a free-open source 3-D graphic design software toolset. These assets will be imported into Unreal Engine 5 for use in the game. The game will consist of a user-controlled vehicle that will be free to explore the level(s). A major focus of this project will be on level design, which will take advantage of many of Unreal Engine’s existing assets and assets available for free through their Unreal Engine marketplace.

# Project Details

The motivation behind this project is to gain experience in video game development, particularly with 3-D game development. I am currently taking CISC 3667 – Game Design and Development, and the focus in this course is on game rules/design and on 2-D game development. While many of the principles will undoubtedly overlap with 3-D game design and development, I wanted to gain experience in this field and creating a car simulation game is a great way to broaden my video game design experience.

While many car racing and car simulation games currently exist, this project will seek to create a new video game that takes advantage of the new advancements available in Unreal Engine 5 to create immersive levels by which the user can explore and enjoy driving in the game. As Unreal Engine 5 is yet to be fully released, this project will be one of the early attempts to create a functional and immersive car simulation experience. This game will feature multiple cars that the user can choose from, all of which will be custom designed using Blender and imported into Unreal Engine for implementation. Additional free car assets may be used for Non-Player Characters (NPCs) that will populate the levels. Level design will be a major aspect of this project, with levels taking inspiration from real life locations (but will not seek to create them exactly). While Unreal Engine 5 comes with extensive “blueprints” for game design, the underlying code is written in C++ and this project will likely require some changes to existing blueprint code or entire sections of code written by the author for use in the game.

This project targets anyone that is interested in car simulation games, with no age restrictions. While Unreal Engine 5 supports video game development for PC and most next-gen consoles, this project will focus entirely on PC development and functionality; however, the game will support both mouse & keyboard and controller inputs. The result of this project will be a workable demo that allows the user to freely explore the level(s). The design process for this game will first focus on designing game assets (such as game vehicles, buildings, etc…) 🡪 level design (road course, landscapes, foliage, etc..) 🡪 game implementation of assets 🡪 finalization of workable demo.

**Technical overview of the project**

This project will create a workable interactive video game demo. Game assets will be designed and created using Blender, free open source 3-D graphic design software and imported into Unreal Engine for game implementation. Unreal Engine 5 comes with many new advancements that will facilitate the development of this game. Most notably:

* Nanite – Unreal Engine’s new virtualized geometry system that provides a gigantic leap forward in object polygon count (orders of magnitude more polygons with no loss of performance)
* Lumen – Unreal Engine’s new fully dynamic global illumination/reflection system that provides realistic lighting across and entire level.

Each of these advancements will help with graphical immersion of the game, allowing for highly realistic game models and world lighting. Unreal Engine comes standard with many “blueprints” for game development which are templates for use in developing a wide range of video games. The underlying code for these blueprints is C++ and it is expected that these blueprints may need to be manually edited or new blueprints created during the course of this project.

NOTE: Unreal Engine 5is currently still in early access, and while the above features are currently implemented, they may not yet be in their finished state. Unreal Engine is expected to be fully released in early 2022.

**Background**

In the world of video game development, I would consider myself a novice. I have limited experience in graphic design and zero experience in developing video games. During the course of this project, I will have taken multiple online tutorials in the areas of Blender, Unreal Engine 5, Unreal Engine 4 (there is much overlap between UE 5 and UE 4), and C++ (refresher courses to refamiliarize with the language). I am currently enrolled in CISC 3667- Game Design and Development at Brooklyn College and will use/consider many of the principles learned in this class in the development process. CISC 3667 utilizes Unity as the game development suite, and I expect there to be some overlap in features/processes. My interest from this project stems from my extensive experience with playing a wide range of video games and my desire to enter the field of video game development. A car simulation was suggested during the search for a project supervisor, and the unique challenges in asset design and level design appealed to me as a project.

***Literature Review***

**Project Objectives and Expected Outcomes**

***Objectives***

Mandatory Objectives:

* Allow the user to select from multiple vehicles, each with different car profiles
* Allow the user to play a demo of this game
  + User will be able to freely explore level(s)
  + User will experience realistic driving, including collision with world objects

Secondary Objectives: (if development process/time allows)

* Implement a “racing” mode
  + User will be able to participate in drag race against AI or another user
  + User’s will be able to participate in time trials of pre-built course

***Expected Outcomes***

The expected outcome of this project is a working interactive video game demo. The end-user should be able to easily load this program and choose the vehicle of their choice. The user will then be able to freely explore the level.

**Actual Outcomes**

(To be completed at a later date)

**Obstacles & Risks**

One of the main obstacles/risks of this project is my lack of experience in video game development, graphic design, and Unreal Engine. I expect them to be a steep learning curve in each of these areas; however, there are many tutorials and online courses (many are offered through Unreal Engine) I will utilize to broaden my knowledge.

Another major risk is the demands on hardware. I will mainly be developing this video game on my personal desktop computer, which is equipped with top end hardware and should have no issues with developing/running this demo. I realize that this is not going to be the case with all computer builds and this risk will always be in mind throughout the development process to strive for compatibility with most systems (within reason).

(More obstacles will be added as they are encountered throughout the development process).

**Software and Hardware Technology Requirements**

**Hardware Requirements**

Video Game development with Unreal Engine 5 requires significant hardware to ensure ideal performance throughout the development process. The minimum requirements for development in UE 5 are:

* **Operating System:** Windows 10 64 – bit**Processor:** Quad-core Intel or AMD, 2.5 GHz or faster
* **RAM:** 8 GB DDR4 or higher
* **Video Card:** DirectX 11 or DirectX 12 compatible graphics card (Recommended to at least have a Nvidia RTX 2070 or higher, but not required)
* **Visual Studio 2017 or higher**

These are just the minimum requirements for running UE 5, and likely would be insufficient for this project due to the graphical/CPU demands of this 3-D video game. I will be developing on the following system which will be much more in line with the expected requirements a project of this scope:

* **Operating System:** Windows 11 64 – bit
* **Processor:** 12th Gen Intel Core i9-12900KF 3.19 GHz
* **RAM:** 16 GB DDR5 RAM
* **Video Card:** Nvidia GeForce RTX 3070 8 GB
* **Visual Studio 2022 CE**

The hardware requirements to run this demo are not known at this time and will likely largely depend on the development process. As this project develops, the requirements toward running this demo will be estimated and added to this document.

**Software Requirements**

**Unreal Engine 5:** This project will extensively use Unreal Engine 5 throughout the development process. Unreal Engine 5 is a free to download program; however, any games that use Unreal Engine 5 for their development must pay royalties of 5% gross revenue after a game hits the market. This project will also use free game assets and for-purchase game assets (if necessary) through the Unreal Engine marketplace.

**Blender:** Blender is a free-open-source 3D graphic design toolset

**Visual Studio 2022 CE:** IDE that will be used to edit or create code in C++

**Architecture**

At the core of this game, the program will accept user inputs via either Mouse/Keyboard or game controller. This data will be fed into the program and will control the car object, whose position will continuously be outputted to the monitor. It is important to understand that this will be constantly occurring process as it will be continuously accepting user inputs to control the object. Figure 1.1 illustrates this process.

**Diagram

Description automatically generated**

Figure 1.1

**Software Construction**

One of the main benefits to using Unreal Engine 5 is that the engine will automatically manage all source code dependencies, program features (such as Nanite & Lumen), all add-on/Extensions, and automatically review any manual changes to code and ensure there are no errors in submitted code (UE will display compilation errors or code errors when attempting to save user generated code to a project). This will ensure that video game is constantly being checked to ensure code is correct.

Created assets will be saved directly on this device and added to a GitHub repository that will manage this project files. The game demo project will not necessarily be added to GitHub until it reaches a certain state of operability. Revision changes will therefore be tracked manually until it is added to GitHub.

**Milestones and reporting**

The purpose of this section of the document is to lay out the expected project tasks and a rough timeline for completion. Note, the time frames in this section are subject to change throughout the course of the project.

**Project Management**

This project will be an individual project, with no other team members. The project supervisor for this project works in the field of Motorsport Marketing and has no technical background in video game development or coding. One of the main appeals for Patrick as a project supervisor, is his general knowledge around vehicles and vehicle racing locations. Patrick will be utilized heavily in the design process, specifically aesthetics and car object profiles. I plan to meet with Patrick once every 2 weeks to update progress on this game and perhaps slightly more often early in the development process.

**Tasks**

* C++ Data Structures Education
  + **YouTube Series:** Data Structures & Algorithms with C++ Practical by Simple Snippets
* Unreal Engine 5 Education
  + UE5 Early Access Quick Start Course – Through Unreal Engine Learning Portal\
  + Welcome to Game Development Course – UE Learning Portal
  + Welcome to Unreal Engine Course – UE Learning Portal
* Blender Education
  + Car in Blender Part I & Part II
  + Miscellaneous other tutorials
* Create GitHub Page
* Design/Create Game Assets
  + At least 3 cars designed in Blender, possibly more
* Design Level in UE 5
  + Level will consist of a road course
  + Level will include varying degrees of elevation changes
  + Level will consist of many different foliage assets, many of which come standard with UE 5
  + Other game assets, such as buildings, may either be designed or purchased from the UE marketplace
* Implement car object into game level
  + Without any mesh assets at first and no specific game profiles
  + Test game functionality at this time
* Import designed car objects into UE 5 and apply to car object.
* Implementation of NPC vehicles.
* Testing/Delivery

**Estimated Timeline**

* Week 1 – 5
  + C++ Data Structures Education
  + Unreal Engine 5 Education
  + Blender Education
  + Create GitHub page

The education process in this project will be one of the most time consuming and beneficial parts of this project. As I am a novice to most of the software being utilized, this will be crucial to the overall success of this project.

* Week 6 – 7
  + Design/Create Game Assets
* Week 7 – 12
  + Design Level in UE 5
* Week 10 – Interim Report Due
* Week 12 - 13
  + Implement car object into game level
  + Import designed car objects into UE 5 and apply to car object.
  + Implementation of NPC vehicles.
* Week 14
  + Testing/Delivery
* Week 15 – Final Report and Presentation Due

**Delivery**

**Testing**

As the goal of this project is to make a working demo, the test cases will revolve around ensuring the game demo achieves the goals of this project.

Test Case 1: Does the vehicle respond appropriately to user controls

* This case will refer to both Mouse/Keyboard and controller inputs
* Does the car move in all directions (forward, reverse, left, right)?

Test Case 2: Does the vehicle interact appropriately with world objects?

* Does object collision work properly?
  + Object meshes should not intersect each other
    - Vehicle should stop if it hits another object.

Test Case 3: Do game design elements work as intended?

* Game mode selection menu
* Game car selection menu
* Do NPC vehicles act believably?

**Documentation & Source Code**

Detailed game instructions will be provided with this game upon completion. These instructions will provide the end-user with installation instructions, as well as in game instructions. In game instructions will instruct the user to choose a game mode, choose a car, and how to get started in the game (movement and other elements that may be found in a tutorial).

For version control I will be using GitHub. I will be including a project log file, as well as any assets to the GitHub page. More research will be needed in terms of uploading unfinished UE 5 game elements to GitHub, as this might not be useful/possible until a more completed program is available. Any manually edited or created code will be manually added to GitHub.

**Additional Project Documents**

(To be added at a later date)

# Bio Sketch

**Shawn Philipps** – Project Owner/Developer

Shawn Philipps is a Computer Science Major and senior at CUNY – Brooklyn College. Previously, Shawn worked in hotel hospitality management in San Diego, before pursuing an education in computer science. Shawn has always had a passion for playing a wide variety of video games and wants to pursue a career in video game development upon graduation. Prior to transferring to Brooklyn College, Shawn previously studied at LaGuardia Community and received a foundational education in C++. Shawn is excited to embark upon this project and work toward completing a working demo and build his current video game development skillset.

**Patrick Thomas** – Project Supervisor

Patrick Thomas is the owner of IMM Entertainment, a leading motorsports marketing company and was connected to Shawn via Dr. Katherine Chuang, the professor of this course. Patrick brings extensive industry knowledge to the project and is a great resource for much of the design process of the vehicle class objects and their profiles. Patrick will meet with Shawn bi-weekly via telephone or video conferencing when needed to review progress and discuss design ideas.