TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
PULCHOWK CAMPUS

Project Proposal
on
Landscape Generation

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Introduction

Computer Graphics is a course dedicated to mimicking the real life objects in the computer with the use of extensive mathematics and physics. Every camera image or image shown on a screen is 2D. Graphics may be utilized to provide more realistic functions to any image. To accomplish so, programming in the Graphics Development Unit should be done. Marching Cubes, an algorithm used for random generation of meshes, will be used in our project for the generation of terrain. Various illumination models for realistic lighting will also be programmed. The mesh will next be rendered via coding shaders and projection mapping. These concepts will be employed to build a 3D image in this project.

Objectives

The main objectives to be met in this project can be summarized as follows:

1. To work as a group for developing a computer graphics project that is clear in concept.
2. To learn more about OpenGL's capabilities.
3. To get an understanding of the fundamentals of graphics production and rendering.
4. To become familiar with OpenGL graphics programming and projection mapping.
5. To create an attractive terrain.
6. To minimize the amount of memory used and run as quickly as feasible.

Existing Systems

At present, there are many similar games in various platforms with terrain generation. Landforms are created via procedural terrain creation in applications like computer games and flight simulators. The most popular game that uses terrain generation is *Mine craft,* a sandbox video game produced by *Mojang Studios.*

Medical visualizations, special effects, and 3-D modeling are just a few of the applications of this technique. The marching cubes method is designed for usage in three dimensions; the marching squares method is designed for usage in two dimensions.

Proposed System

Description

This project's main purpose is to create a landscape with realistic structure. To accomplish this, we will first use a marching cube algorithm to generate terrain at random. Different colors will be assigned to different pixels when the terrain is produced, resulting in a landscape-like image. Different simplified lighting models that are an approximation of the real world will be employed to make the terrain more realistic.

We'll be simulating an aquatic body in addition to the terrain. The water will be represented as a translucent mesh with an outside surface using techniques such as reflection, refraction, and illumination to make the scene more realistic.

A skybox that spans the full screen will be used to create the appearance of an unending sky. With the camera's position as the origin, we'll create a coordinate system with three perpendicular unit axes. The user will then be able to move around the terrain as seen from the camera's point of view as the scene's origin.

System Block Diagram

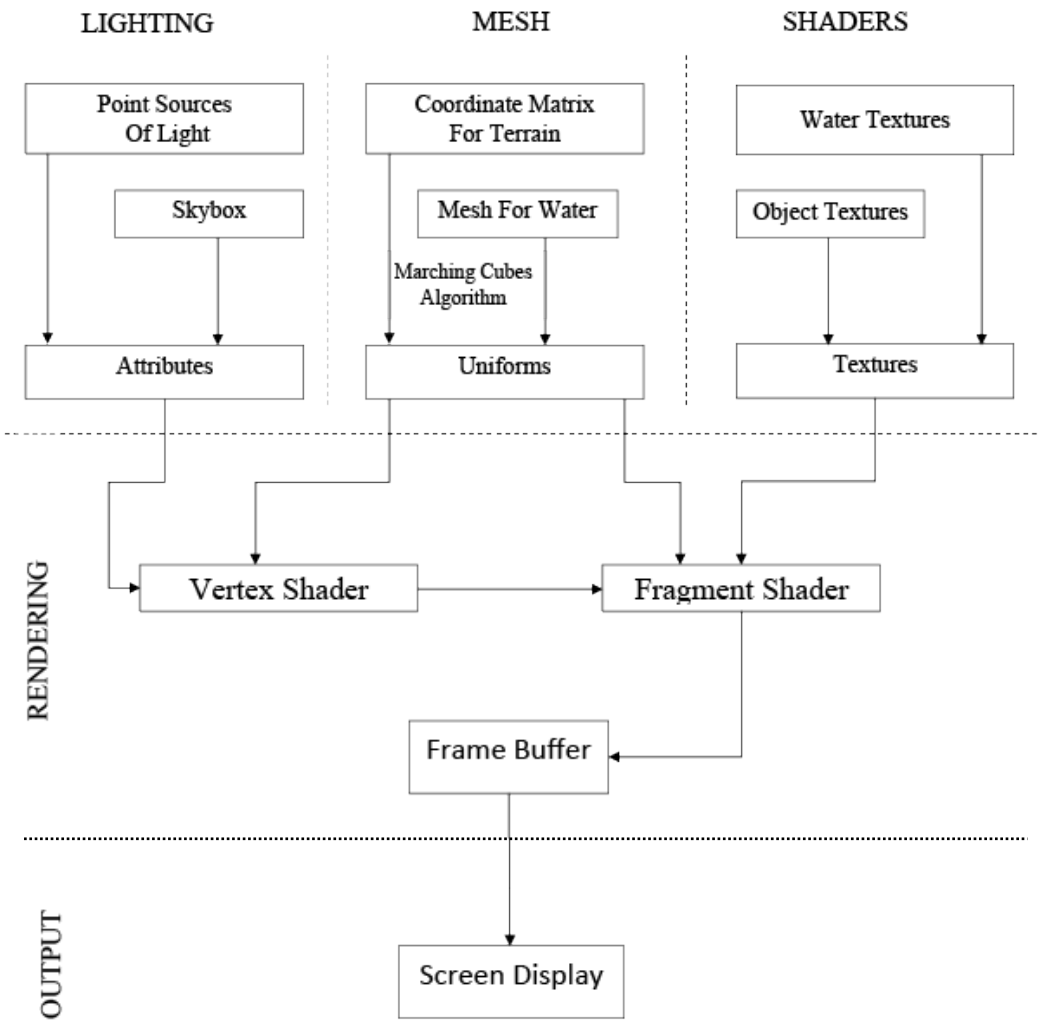

Fig. Block Diagram

Methodology

This project would be based on C++ programming language utilizing the OpenGL graphics library, and the Object Oriented Programming concept. The concept of *"Marching cubes"* will be used for generating our mesh. This mesh will then be rendered by using our rendering class. The events for each component of mesh generation and rendering will be handled by different classes for smooth execution of the program, making the code efficient and concise.

For the completion of the project, first we will collect necessary materials. We will go through various books and online resources of Computer Graphics and OpenGL. As computer graphics is totally new for us, we will learn the basic logic of projection of 3D graphics, viewing angle, lighting and rendering by surfing through related resources, forums and consulting related books.

As for the compiler, IDE and Operating System, we will be using Visual Studio Community as IDE and GCC (GNU Compiler Collection) as compiler in Windows. The software can easily be built to run on other platforms as required. For graphics and other math related applications, we will be using the OpenGL and GLM libraries. After collecting necessary materials, we will develop the workflow for our project and work according to it. Since the main motto of the project is to learn Computer Graphics, various graphics concepts like composite transformation, shading, lightening, elimination, surface rendering will be used during the terrain generation.

Initially, the basic code for individual components of the application will be written separately adopting the concept of modular programming. The terrain, which is our mesh that is generated using the Marching Cubes algorithm, will be coded as a 3D object and projected onto a 2d plane for viewing. The function for rendering the world according to viewing angles and lighting conditions will be defined. Once all the components work independently on the modeling level, they will be bind together to make a proper working application.

Project Scope

This program has a wide range of opportunities in the real world application. It can serve as a base for development of some virtual world. The application will be efficient enough to provide a visual aid for simulation of real-world random landscapes. As for the system and algorithms, it will just appear as a clone of the many programs that have been developed till date. If promoted, this project can be used as a sort of library to make many similar kinds of application software, medical visualizations such as CT and MRI scan data images, special effects on 3-D modeling or even game worlds. It can be developed as an advanced program by adding more detail in the graphics and artificial intelligence to generate terrain similar in structure to real-life landscapes if the feedback will be positive and resources will be plenty.

Project Schedule

The schedule that we will adopt for our project can be summarized below: