CS4610 Project Report
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Project Description:

Title: VR Fractal Viewer
Github Repo: https://github.com/davidhannan/VR-Fractal-Viewer
Demo Video: https://www.youtube.com/watch?v=butlHn-9PZw

For my final project I have created a Unity program that allows the user to view and generate different types of fractals in virtual reality. Users can choose to view a Mandelbrot fractal as viewed from right in front of it, users can also view a Mandelbrot fractal that is being projected onto the inside of a sphere that the user is also inside of. Users can also choose to generate a custom fractal, specifying a fractal type, number of generators, width, maximum amount of iterations, and noise level.

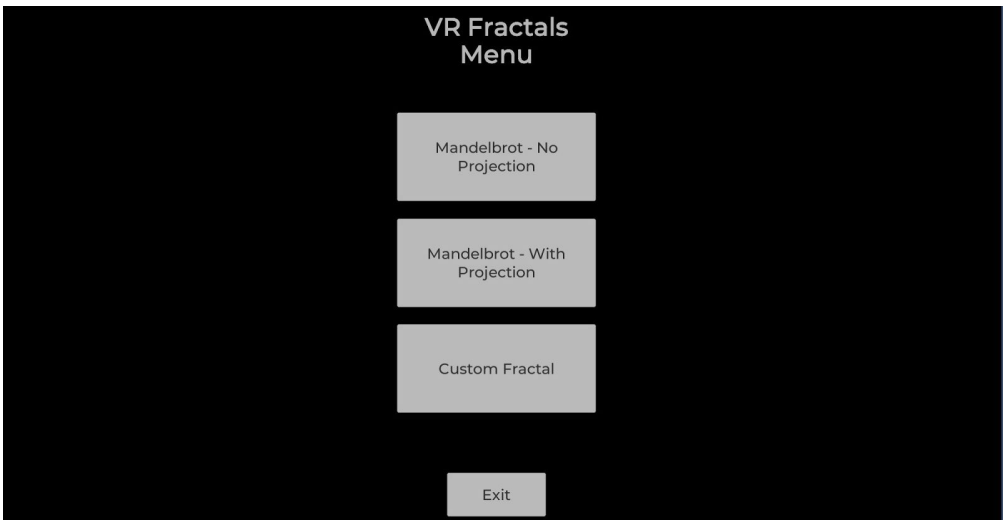
1. Mandelbrot no-projection mode:
    a. Places a Mandelbrot fractal directly in front of the users view
    b. The view can be moved with WASD, zoomed in with Z, zoomed out with c
    c. More and less iterations of the algorithm can be applied with left shift and left ctrl respectively.
    d. Can press escape to return to the main menu
2. Mandelbrot with projection mode:
    a. Places the user inside of a sphere, the inside surface of the sphere is rendered as the Mandelbrot fractal
    b. User can look around the sphere with headset tracking
    c. Same controls as no-projection mode
3. Custom Fractal mode:
    a. Allows the user to specify all components of a fractal to be generated
    b. Dropdown menu to select the type of fractal to generate options are: Koch, Brain, Hilbert, and Binary
    c. Slider to adjust number of generators, enables and disables groups of sliders to adjust x, y, and z offsets of each generator
    d. Sliders to adjust number of iterations to apply, width, and noise
    e. Preview window of the fractal in real time
    f. Pressing enter disables the canvas and enables the VR camera which then allows the user to move around with WASD, space, mouse movement, and headset tracking

Methods:

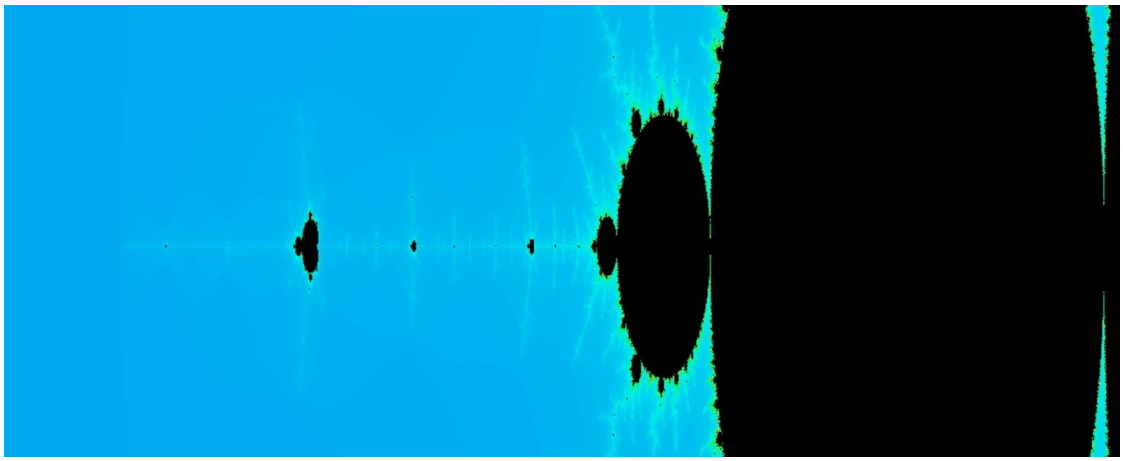
1. I found the algorithms that generate the fractals on Github:
    a. Mandelbrot: https://github.com/MatJab94/mandelbrot
    b. Fractal Generator: https://github.com/tylerpayne/unityfractal
2. Mandelbrot No-Projection:
    a. This scene consists of a VR camera GameObject with a script applied to the eye component to create and control the fractal
3. Mandelbrot With Projection
    a. This scene consists of a sphere and a VR camera GameObject, and a regular Camera GameObject
    b. The sphere has a script applied to reverse the normals to create the effect of being inside of it
    c. The VR camera is at the center of the sphere
    d. The fractal script is then attached to the regular camera, which then renders to a render texture, this render texture is then applied as the texture of the sphere
4. Custom Fractal
    a. This scene contains: a canvas that houses all of the controls for the fractal generator, and all of the necessary components to create the fractals
    b. The type of fractal is defined by the dropdown menu, this enables the correct previewFractal/previewTraceReplicator/previewTracer object to allow it to be seen in the preview window
    c. The number of generators slider enables and disables slider groups, it also adds generators in the form of a Vector3 to the generator object
    d. Each slider group is 3 sliders, one for each axis, Start() initializes the values of the sliders to be what is defined in the generator object. Update() sends the value currently in each slider to the generator object
    e. The previewManager GameObject handles dropdown changes and slider changes using multiple scripts
    f. Slider groups are found in canvas->Sliders->gen1-gen10, attached to each of them is the script manage them

g. previewManager also has the script to disable the canvas and enable the VR camera
h. The preview window is a RawImage object on the canvas whose texture is defined as a render texture from a camera that is looking at the fractal that the user is generating

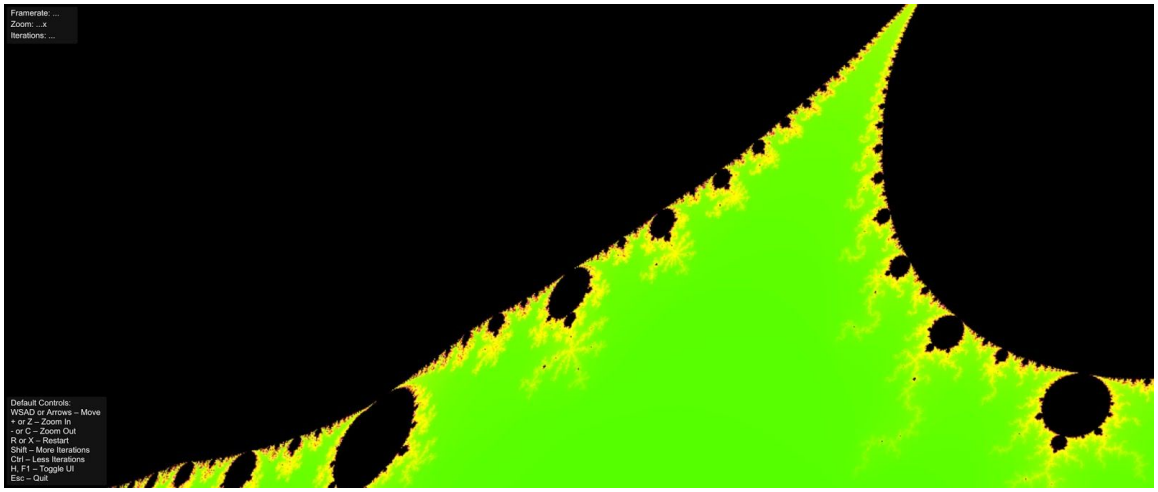
Screens:



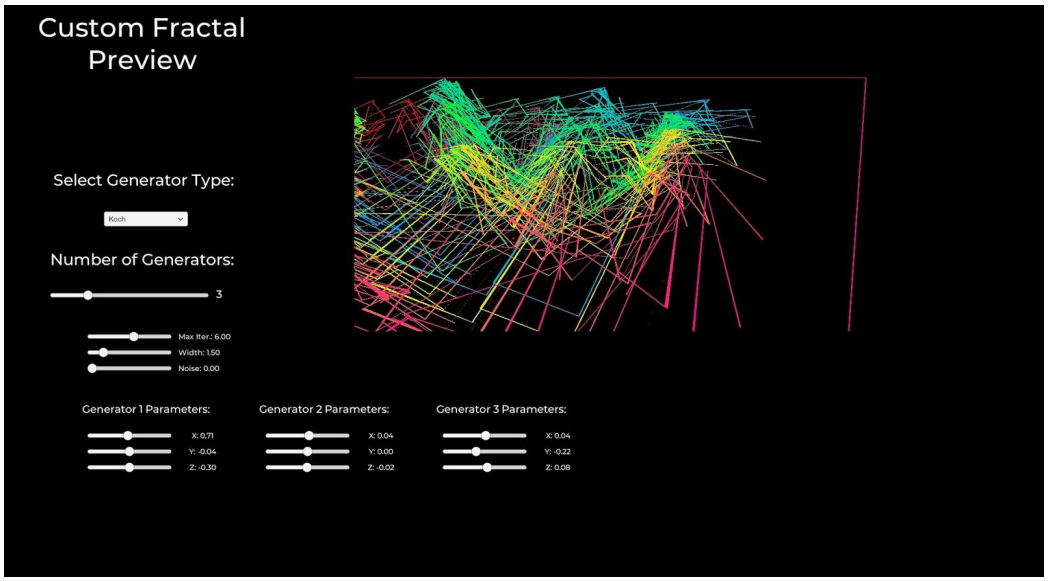
The Main Menu



Mandelbrot with no projection



Mandelbrot with projection



Custom Fractal Creator