An ALife Demonstrator

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Introduction

The aim of this project is to develop a virtual world inhabited by evolving autonomous animal-like creatures. The creatures are to be displayed using 3D graphics in real time moving about and interacting with each other ant their environment. The environment is to be a virtual terrain composed of hills, valleys, trees and plants, with its own seasons, climate, day and night. The purpose of the world is to demonstrate the principals of evolution and natural selection at work.

The project is based upon a SCOPE proposal to develop an educational artificial life demonstrator for children. Although the SCOPE proposal named the world 'herbivore' world, at present this project is provisionally named 'Monsters II'. 'Monsters I' was a personal project of the author, to demonstrate population dynamics. It was simpler and less ambitious then 'Monsters II', the monsters having limited ability to evolve, and the application using 2D bitmapped graphics [1].

Background

The project's initial aims are to create a rendering engine for a working virtual world. The rendering engine must be able to:

- Display a variety of different looking worlds.
- Allow the user to move about the world in either flying or walking modes.
- Provide for collision detection between the viewer and the terrain, and any plants or animals on the terrain.
- Handle the changing look of the world between day and night and variation due to temperature.

Creating a world

New worlds may be created using the WorldMaker program, a simple console application where the user is prompted for various parameters. Here you can choose almost all of the parameters that affect a worlds appearance, including the length and breadth of the world, the height of the water table, the seasonal temperature range, the colour of the fog used, and how 'hilly' the terrain will appear.
The world terrain is created using a recursive fractal terrain generation method [2], where the height of a point is the modified mean of the heights of its four nearest neighbours, as follows:

If the distance between the points is greater then one:

$$H = U + g * d^{2*f} \tag{1}$$

If the distance is less then one:

$$H = U + g * d * \sqrt{f} \tag{2}$$

Where H = new height, U = mean height, g = random from a gaussian distribution between -1 and 1, f = fractal dimension and d = distance

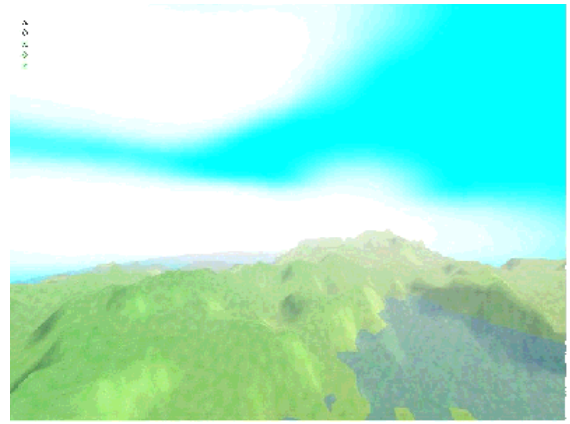
This produces terrains that look similar to naturally occuring landscapes. The fractal dimension in the above equation is a variable the world creator sets, with higher numbers producing more hilly terrains.

The world creator is in almost complete control of the world's appearance, including the textures applied to the water, sky and terrain. The look of the world can be completely changed just by using a different 'base' texture. The user can also change the angularity of the world's appearance by altering the behaviour of the vertex normal sharing. To smooth the world most of the points on the surface share the same normal vector. However this can lead to lighting artifacts, as the lighting is calculated based upon the interaction of the light rays and the normal. The alternative, to have unique normals, gives a severe and unrealistic angular appearance. As there is no easy solution to this problem, only a compromise, it is left up to the user to choose how the world looks.

The WorldMaker program produces a directory structure that will contain the world's data, and html pages containing the worlds settings, and its file dependancies.

The project at present

Currently worlds may be created and viewed, but time, seasonal variation, day and night are not yet implemented. Much work needs to be done to make the world appear appealing to the end user. Shown below is an early version of the world.



The world

The world is composed of a grid of squares which wraps in both directions, producing an infinite terrain. Graphically, each square is represented by eight triangles. A square can support only one plant at a time. The world is to have a working biology, the basis for the foodchain. Each plant will 'synthesise' a limited variety of nutrients and vitamins, which are required by the monsters to live. The hope is to produce a system of sufficient complexity that the monsters will evolve and diversify over generations, finding ecological niches in the environment. The world has both an arctic and equatorial region running along its X axis. This will allow the world's inhabitants to adapt to different temperature ranges. Temperature and humidity also varies with altitude.

The worlds flora

There will be two different types of plants. The first will appear as flowers or patterns on the worlds ground. These will be created by applying a second texture to the surface. The other will be 3D plants, such as trees and bushes. The plants will be sensitive to the environmental parameters such as temperature, humidity and proximity to water. They will reproduce by seeding nearby squares. Each plant species will have its own textures, a desirable climate range, and rules governing how it reproduces.

The worlds fauna

The creatures which will inhabit the world are still a long way off. However, it is hoped they will be autonomous virtual machines, capable of examing their environment using sight, smell and hearing. They will take decisions based upon their personal 'pyramid of needs'. These decisions will take into account their experiences in life so far.

Each monsters appearance will be unique, although it will be a variation on their the look of their species. All monsters of the same species will have a common colouring pattern (implemented by having them share a texture). Their body shape will be a variation on a common body template of 3D data. Each monster will have 'genes' which code for its look and affect its behaviour. The modifications will also be reflected in the monsters abilities, and its characteristics, so that larger monsters will have a greater volume and expend more energy in movement.

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This is the second project the author worked on over ten weeks at the EPCC. The first project, to package up and expand on work done in a previous 'Jinigrid' project was found to be unworkable. The decision was made in week six to change projects. The work on this project has been done in the last four weeks of the SSP.

References

1. http://www.solosnake.fsnet.co.uk/main/applications.htm#monsters
2. Booth, S., Xmountains fractal terrain generator, http://www.epcc.ed.ac.uk/~spb/xmountains/about_xmountains.html