INITIAL PLAN: GENERATING AND VISUALISING REALISTIC PLANTS

FINAL YEAR PROJECT - CM3203 - 40 CREDITS

BSc COMPUTER SCIENCE

Supervisor:
Yukun Lai

Author:
Yao Xiao

Moderator:
Sylwia Polberg

February 6, 2022

Ethics

In this project, there is no typical private dataset that needs to be collected. Therefore, the project does not need ethical approval.

Project description

Plants come with complicated structures and abundant details. 3D virtual plant requires combination of plant morphology, computer science, and rendering techniques. It requires to abstract the morphological structure and to analyze the expanding and branching progress of real plants. By modelling the structure and growth progress of plants, computer can visualize virtual plants with certain shape. Furthermore, to generate and visualize plants with random structure which makes it more natural.

Plants morphology is very important in terms of describing physical form of plants and visual identification of plants. It explains the physical form of plants and being very useful in identification of plants visually [1]. More specifically, by studying plants' topological structure and observing plants, the parameters that control the shape of virtual plants as well as the form of them can be extracted, which can offer a way for user to change the structure of plants. Branching ways of plants are also important in this project. It determines the general mode of plants' growth rule and general shape.

Visualization or rendering is the second step of the project. By drawing unit shape like lines, repeatedly according to the shape data of a plant, a basic structure shape can be shown. Furthermore, we may change the unit shape into other 3D model like real branches and trunk, we can attach texture which makes the plants more realistic.

In this project, I would like to focus on generating and visualizing 3D plants with random shapes by a program automatically. By using a game engine called unreal 4, texture of plants can be attached when the plants have been generated. Moreover, the program can also dynamically read any texture file that the user wants, and export generated 3D plants as 3D model files, providing a convenient way to make 3D plant models which are close to the natural plants for any artistic or design usages.

Aims and Objectives

- Learn and gain deeper understanding on plants morphology, including plants' topological structure and growth rules.
    - Picking a specific type of plant with certain branching methods to research
    - Extract the essential parameters that control the shape of the plants.
- Research L-system, one of the most common methods to simulate plants that was introduced and developed in 1968 by Aristid Lindenmayer [2].
    - Understand the essential mechanism of L-System.
    - Learn the proper implementation procedures of L-systems.
- Learn and practice how to use a game engine called unreal 4 and develop a system.
    - Be able to implement L-system on unreal 4 platform, simulating a typical kind of plant by L-system, which includes generating data and rendering an 3D model.
    - Develop an interface for user to operate the system.
    - Users can adjust any parameter that will affect the shape of the plant.
    - Users can upload and adjust textures of plants.
    - Users can export outcome as 3D model file for future usage.

Work Plan

Supervisor Meeting

My supervisor Yukun Lai and I decided to arrange weekly meetings during this term at specific times on teams. In weekly meeting, I will discuss any problems that might occur in the future and give it an update for my supervisor about my progression. Weekly meeting will be arranged through outlook emails.

Millstones

- Week 1: 31/01/22 – 06/02/22
    - Learning and gaining basic background knowledge of plants morphology, plants branching methods and simulating methods
    - Research API of unreal 4 to confirm if project is feasible
    - Meeting with supervisor and discuss the initial plan
    - Writing and submit the initial plan

- Week 2: 07/02/22 – 13/02/22
    - Continue to learn plants morphology by researching academic paper and additional material
    - Learn and research L-system
    - Confirm a specific type of plant and branching model
    - Learn how to use unreal 4 engine

- Week 3: 14/02/22 – 20/02/22
    - Learn more about plants' structure and try to extract parameters that control the shape and growth rule of plants
    - Try to implement L-system on unreal4 platform
    - Design a user interface on unreal 4

- Week 4: 21/02/22 – 27/02/22
    - Try to visualize 2D plants on unreal 4
    - Try to add variables that can control the shape of plants
    - Implement user interface on unreal 4

- Week 5: 28/02/22 – 06/03/22
    - Polishing the code for generating 2D plants
    - Implement all possible variables and try to generate different shapes of plant

- Week 6: 07/03/22 – 13/03/22
    - Discover a way to convert 2D version of plants into 3D version
    - Looking for appropriate 3D model for unit model of 3D plant

- Week 7: 14/03/22 – 20/03/22
    - Visualizing 3D plants model and try to attach texture onto the plants
    - Develop function that system can read any texture file

- Week 8: 21/03/22 – 27/03/22
    - Continue 3D plants visualizing and polishing the code
    - Develop function that system can export 3D plants model as .fbx file

- Week 9: 28/03/22 – 03/04/22
    - Continue to develop system
    - If time allows, try to improve performance of system

Easter break

- Week 10: 25/04/22 – 01/05/22
    - Writing a first draft of final report
    - Reviewing codes and adding comments

- Week 11: 02/05/22 – 08/05/22
    - Continue finishing the final report
    - Proofreading the whole report and refactor the code if necessary

- Week 12: 09/05/22 – 13/05/22
    - Continue to focus on proof reading and revise the whole project including code and final report
    - Submit the final report as well as the source code and supporting materials

Reference:

[1] www.omicsonline.org. (n.d.). *Plant Morphology | Journal of Plant Biochemistry and Physiology*. [online] Available at: https://www.omicsonline.org/plant-morphology-peer-reviewed-open-access-

[2] Wikipedia. (2021). *L-system*. [online] Available at: https://en.wikipedia.org/wiki/L-system.