Development Plan
Digital Twin Forest

Team 8

Jiacheng Wu, Yichen Jiang, Tingyu Shi, Bowen Zhang, Junhong Chen

March 7, 2023

Table 1: Revision History

Date	Developer(s)	Change
Sept 17, 2022	All team members	Revision 0
Sept 26, 2022	All team members	Modify technology

1 Team Meeting Plan

- Time
  Every Thursday from 1:30 PM to 3:30 PM.

- Location
  If the team needs to work with Dr. Gonsamo's lab members, the meeting room will be the lab of room 316 of General Science Building. Otherwise, the meeting will be hosted in H.G. Thode Library.

- Frequency
  Weekly. (Multiple meetings will be held within one week if necessary.)

- Contents of meeting
  The contents of meetings include discussion, implementation, assigning works outside the meetings and reporting working progress. All the decisions and modifications should be recorded and updated by the end of the day of meetings.

- Roles
  Bowen Zhang: Host all the meetings and gather participants' ideas.
  Tingyu Shi: Record and document meeting contents.
  Jiacheng Wu: Participant.
  Yichen Jiang: Participant.
  Junhong Chen: Participant.

- Rules for agendas
  An agenda is supposed to be made before every meeting. The following are rules for meeting agendas:

  - All team members are supposed to attend the meetings. If any member cannot attend the meeting, he/she needs to tell the other teammates at least one day before the meeting.

  - Topics must be determined before every meeting.

  - The length of meeting time shall be determined before the meeting.

  - There is only one chair/leader in the meeting.

  - Conflicts in the meeting shall be recorded and solved before the next meeting.

  - All members should communicate respectfully during the meeting.

  - All members shall be assigned a "take home" work after the meeting. The estimated time of the work of each member shall be close.

  - First topic will be reviewing the agenda.

  - Assess all team members' contributions in every meetings.

2 Team Communication Plan

Communication within our group will be completed through weekly in-person meetings, Microsoft Teams, emails, and informal daily communications.

3 Team Member Roles

- Jiacheng Wu: Developer, UI designer, C Sharp expert

- Yichen Jiang: Developer, Lead Tester

- Tingyu Shi: Developer, Latex Expert, Unity Expert

- Bowen Zhang: Developer, Liaison, Group Leader

- Junhong Chen: Developer, Git Expert

4 Workflow Plan

- We will use Unity for majority of the modelling part. And we will use git to deliver, store, and synchronize the Unity packages. Specific division of workload should be discussed in the weekly meetings. And then each member pushes his or her own share of work into the git, which should include folders of assets, packages, project settings, user settings, and related license. We will use co author methods to push.

- For the documentation required in the development, we will follow the template provided in GitHub of the course. For any documentation, we will use overleaf and hold online meetings to realize real-time communication and synchronized collaboration. After the documents are finished, we push documents into git and sign every team member as a co-author.

5 Proof of Concept Demonstration Plan

5.1 Risks:

- The accuracy of measurement and modelling strongly depends on the reality with different weather.
  Solution: Choose the timing with better condition.

- The ideal process of scanning and modelling would be scan an entire plot at once, while this process is limited by the scanning device we use, which would be cell phone and iPad.
  Solution: Scan single trees and splice the models in Unity.

- The trees might be too high to scan all aspects of the trees or result in a poor precision.
  Solution: Employ drones to scan the pictures.

The following are revised Risks for POC Demo.

- Creating huge amount of trees efficiently.

- The virtual representation should be close to the real forest.

- How to simulate the first perspective of a real person to view the forest.

- Different assets used in Unity may require different Unity versions or rendering pipelines.

- As the plant density increases, it uses more and more draw calls which is not affordable.

5.2 POC Demonstration contents

- The POC demonstration should include a virtual representation of a limited amount of trees, along with a simple version of user interface. The data displayed shall or shall not be close to the real forest data, this depends on the data collection process by Dr.Gonsamo's lab.

- POC should include virtual representation of a limited amount of trees with qualified devices like laptops scanned by mobile devices with LiDAR like iPhone or iPad. This can prove that modelling and a virtual representation of forest could be realized.

3

- ~~POC should include trees higher than 5 meters to provide a proof of adequate measurement and modelling.~~

- POC should include the demonstration of our project prototype that can operate properly.

- POC should demonstrate a way to simulate first perspective of real persons to view the forest.

6 Technology

- programming language: The whole project will be implemented in C Sharp language.

- linter tool: The team will use Visual Studio 2019 as the main IDE.

- unit testing framework: VS2019 will be used for the unit test. The team will create a unit test project (.NET Framework) that contains MSTest unit tests.

- code coverage measuring tools: The JetBrains dotCover is a code coverage tool that integrates with VS2019. It can execute and run coverage analysis for unit tests in Visual Studio.

- CI plans: We will not use continuous integration in our project, because majority of our project will be finished in Unity. For each iteration or any change, we would choose to test the packages in Unity instead of using the automatic testing. We need to make sure the latest version of model can be loaded and give a satisfying view of forest, so the automatic testing may not satisfy our requirements in this project.

- performance measuring tools: Unity will be used to record the number of frames per second of the final project.

- Libraries: We will import several Unity packages for modelling and post processing. Possible plug-ins may include unity terrain tools package and universal render pipeline.

- Tools: iPad Pro LiDAR and multi angle smart phone scans with photogrammetry technique will be used for 3D scanning. Agisoft metashape and 3D Scanning App will be used to generate 3D models and photogrammetric data.

7 Coding Standard

7.1 Program File Names

The file names will be written in Pascal style and the titles will be descriptive.

7.2 C Sharp

The coding style of the C sharp language that the team will adopt is the [Microsoft C# Coding Conventions](). The variable names will be short but descriptive. All variables will be written in camel case. For example, the height of a tree should be written as $treeHeight$.

7.3 Unity File Names

Unity files such as images, videos, prefabs and scene files will be written in lowercase. The team will use − to replace the spaces in file names for readability.

8 Project Scheduling

- Technology: Shared MS Excel Gantt Chart

- Major Milestones:

  - SRS Rev0 (October 5)
  - Hazard Analysis 0 (October 19)
  - V&V Plan Rev0 (November 2)
  - POC Demo (November 14-25)
  - Design Document Rev0 (January 18)
  - Demonstration Rev0 (February 6- 17)
  - V&V Report Rev0 (March 8)
  - Final Demo (March 20 - 31)
  - Final Documentation (April 5)

- Task Decomposition Plan:
  This plan will be discussed with Dr. Gonsamo and his lab members first. Then the team leader will allocate tasks according to team member roles. Our current plan is decomposing this project into three parts, which are measuring data, modeling and coding.

- Please check our project schedule here.