Digital Twin Builder Project Plan

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I. Introduction

Research Question: How can an application transform feature location data into a 3D model to aid visualisation and development planning?

Deep learning models have been used to interpret satellite images and plot points of interest. This data can easily be used to show locations of these points on a map. Visualising how this interacts with elevation and understanding the scene is difficult from a 2D representation. An interactive, 3D visualisation of an area and the existing features of interest could be used by designers and councils to plan developments. This project aims to investigate the development of such an application.

II. Context and Objectives

This project will be developed by an individual student in partnership with Edward Wong from Eagle Technologies, and supervised by Ben Adams from the University of Canterbury.

Eagle Technologies represent Esri Technology in New Zealand and the South Pacific. Esri develops solutions using geographic information systems (GIS), location intelligence, and mapping. This project will be built using ArcGIS, Esri's web based mapping software A. This can be used to display 3D locations with elevation data, creating a base on which features can be placed.

Eagle Technologies have trained some deep learning models to recognise windmills from satellite imagery. This project will use the data from those deep learning models to generate 3D visualisations of these windmills and the surrounding area.

The aim of this project is to create a pipeline that can be used to take feature location data and generate an interactive 3D model. This model should allow users to view and edit the scene, to understand what changes they can make. This project will start with using windmill location data for testing and development, but will be designed to be able to be used for other features as well.

III. Risk assessment

The most likely risk in this project is that the work takes longer than expected, and therefore is not able to be completed in the time frame. This could be because of poor time management, or other factors such as loss of files, events that prevent work on the project, or tasks being more complicated and time consuming than expected. The effect of this on the project will be that less progress will be made than was planned.

This is mitigated in two ways.

First, by making a project plan, it is easier to see what has to be done, and judge whether development is on track. Development progress will be tracked using the online tool Trello A.

Secondly, the project has been split into two stages. The first stage is the most essential stage, while the second stage is less critical. In the middle of the year, the progress on the first stage can be evaluated, and the plan for the second stage can be adjusted if the first stage has not been completed. Some milestones are less important and can be dropped in favour of more important features.

The risk of work being lost or deleted will be mitigated by using git as a version control system and keeping a repository on github A.

There is a risk that the project is not completed, either because it takes too long or because something causes it to end early. In this case, it should be possible for someone else to pick up and continue with the project if required. The code should be clear and well documented to make it easier for someone else to work with.

IV. Milestones

A. Stage 1: 3D model generation

(March - May)

The first stage of development will focus on making an HTML and Javascript application that can read in data files of feature locations and display those features with a 3D model. This development stage will run from the start of March until the end of May. The milestones during this stage are as follows:

Milestone 1: Place 3D objects on a map. (31 March)

Outcome: an HTML and Javascript application that uses the ArcGIS Javascript SDK to display a 3D scene of a location with elevation data. This application should display simple polygons in the scene. The purpose of this is to understand how to use the tools and start building the application.

Milestone 2: Investigate model file types. (16 April)

Outcome: an assessment of different file types that can be used for 3D models, and a chosen file type to be used. Test models made using Blender A. Code written that can read in 3D models of the chosen file type.

This milestone will be developed during the midterm break and so has a longer time to account for reduced availability.

Milestone 3: Display custom models. (28 April)

Outcome: an application that can display custom models from model files.

Milestone 4: Read features from a file and display on map. (10 May)

Outcome: an application that can read in a file of windmill locations and display windmill models at those locations in a 3D scene. This should use real data outputted by the deep learning model.

Milestone 5: Display multiple feature types. (17 May)

Outcome: an application that can display multiple different types of features on a map. Each feature type should have a distinct 3D model. These features will likely be cars, trees, or buildings.

Milestone 6: Display information about features. (26 May)

Outcome: an application that allows users to see extra information about features. Users can view and hide this information when it is relevant to them.

This milestone is less important than the other milestones, and so may be dropped if there is not enough time to complete it.

B. Mid-Year Evaluation

(29 May - 2 June)

During the last week of Semester 1, the progress on stage 1 of the project will be evaluated and the plan for stage 2 will be finalised. This will allow flexibility in the plan so that if development has not progressed as expected, this can be accounted for.

During this process, user stories will be developed that give a clear direction on how the final project should be used. This will allow stage 2 of the project to have a greater focus on the user's experience rather than on the model development.

No other development is planned for this week, to allow time to work on the interim report and work for other subjects that are finishing up. If any milestones from stage 1 have not been completed, some work could also be done during this week, but should not be relied on as an option.

The month of June contains Semester 2 exams and then the mid-year break. No development should be planned for exam weeks. The mid-year evaluation will decide whether it is necessary to work during the mid-year break, depending on how much progress has been made. Stage 2 will be expected to start in July.

Milestone 7: Interim report (2 June)

Outcome: a report detailing the project objectives, progress, evaluation of progress, and detailed plan for the rest of the project.

Milestone 8: User stories (2 June)

Outcome: a list of user stories to guide the development of stage 2 of the development.

C. Stage 2: Model editing and user interface

(July - September)

The plan for stage 2 will be decided during the mid-year evaluation. The milestones listed here therefore do not have expected dates, and may be subject to change. This stage should be completed by the end of September, so that October can be used for creating the poster, final report, and demonstration.

Milestone 9: Users can move and delete models in the scene.

Milestone 10: Users can add models to the scene.

Milestone 11: Users can import custom models.

Milestone 12: Users can edit the height, shape, and colour of models.

Milestone 13: Users can edit the elevation of the ground.

D. End of project reports and presentations

(October)

Milestone 14: Showcase abstract (15 September)

Outcome: an abstract that describes the project to be used for the showcase programme.

Milestone 15: Poster (2 October)

Outcome: a poster displaying the project.

Milestone 16: Showcase Presentation (12 October)

Outcome: presentation slides and script for presenting the process and results of the project at the showcase day.

Milestone 17: Final Report (20 October)

Outcome: a final report writing up the entire project process and details.

V. Evaluation

The success of the project will be judged on how well it completes the objective. This will be assessed with the use of user stories that were developed during stage 2. The evaluation will also involve working closely with the industry partner to make sure that the project accomplishes the goals they had going in. Measuring how well the project outcome implements the user stories and matches the industry partner's expectations will allow us to evaluate the success of the project.

Appendix A
Tools used

1) Code repository stored at https://github.com/m-bastia/SENG402_DTB
2) Trello used for keeping track of tasks and progress. (https://trello.com)
3) ArcGIS Map SDK for Javascript used to access and display map data. (https://developers.arcgis.com/javascript/latest/)
4) Blender used to create custom models. (https://www.blender.org/)