COMP4003 Project Plan

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Course: COMP4003

1. Project title. Augmented Reality in The Hounsfield Facility

2. Statement of the research problem.
This project aims to develop an augmented reality application to help Hounsfield personnel and tourists comprehend plant root structures.

The issue is that plant roots often grow invisibly in the soil. It can cause harm if its origins need to be studied. An X-ray scanning can help with this issue and provide the root structure. However, the standard commonly used to describe and collect plant root data is RMSL (Lobet et al., 2015), and a large amount of data has created certain obstacles for researchers to use. This tool could help with that.

2.2 Hounsfield Facility

Understanding plant and soil interactions and their reactions to environmental challenges is the primary goal of the Hounsfield Facility, a premier multidisciplinary research institute. The Schools of Biosciences incorporate scientists from a wide range of fields.

This facility is made up of the glass house and the research room. A completely automated greenhouse operated by a laser-guided robot feeds the 1 m long, 80 kg samples to the biggest scanner. The glass greenhouse component of the research area is planted with weeds. The research room also houses many departments for different research projects, one of which is relevant to this experiment and has X-ray imaging research gear. The device makes it possible to quantify materials at spatial scales between <1μm to 150 μm>.

An X-ray CT scanner that has been cited in several experimental research is used to scan materials in the lab. It has the advantage that it may be used in this way without resulting in sample loss. The sample structure makes gaps and converts the scanned 2D projection into a 3D volume to acquire data about the sample (Wilson et al., 2021). It also provides a framework for studying how plant roots respond to various soil components. (Zhongming et al., 2021)

2.3 Motivation
First, the Hounsfield Facility is home to several diverse experimental initiatives that will provide significant data. However, there is no effective way to link the data with the actual plants; the typical presentation and processing methods display the data on the computer screen by summarizing and comparing.

2.3 Answer / hypothesis
As a technique, AR can create 3D models using image recognition and be used on mobile devices for mobility. We may use the smartphone to scan the QR code to create the relevant plant model. This allows us to contrast how the root systems of various plants evolve. Botanists are given a fresh viewpoint and method of data presentation in this manner.

2.4 Desktop

While AR may offer mobile and data presentation, desktop software may be used for more data display and research. Botanists can benefit more from the thorough inquiry on the desktop terminal and the observation on the mobile terminal, thanks to stronger connectivity between the two platforms through TCP/IP.

3. Related work

3.1 Early application of mobile AR in Botanical Species Identification

In order to search, compare, and identify plants side by side, they (White et al., 2006) created a plant management system that employs mobile AR devices. By holding a marked voucher and moving the head horizontally and vertically to pick the sample item to be presented, the user may view the specifics of the chosen outcome.
This demonstrates the dependability of augmented reality technology when used with head-mounted displays and in the context of distinguishing between various plants. This article offers a foundation for integrating botany and augmented reality and aids in the programme interface design. Furthermore, it can facilitate the later use of HoloLens glasses.

3.2 Application of mar system with Vuforia extension in city exhibition map

They demonstrate how a MAR system and Vuforia may cooperate (Peng & Zhai, 2017). The programme uses target recognition technology based on photo-matching to create a three-dimensional building model to display a stereoscopic building model on a standard city map using a mobile AR device. Here, various features of Vuforia are displayed, including the ability to identify multiple targets in challenging environments, dependable target tracking abilities unaffected by equipment, and targets with excellent coverage in low light.

3.3 X-ray CT reveals 4D root system development and lateral root responses to nitrate in soil

In this investigation (Griffiths et al., 2022), μCT imaging was utilised to describe the root system architecture of wheat seedlings across time. This technique demonstrated how plant roots responded to environments with high or low nitrate feeding in lateral and vertical development. The development of plant roots is also predicted using OpenSimRoot. The two approaches indicated above may be used in this programme to generate the root model of deplaning, and some temperature and soil data from this experiment may be used to increase the display data for a later programme.

This application is comparable to Peng's illustration and may be used to create an image-based recognition display using Vuforia. The distinction is that, as a trigger mechanism, several samples of related plant leaves will be provided, after which the corresponding plant root model will be built.

3.4 housefield facilty

Understanding plant and soil interactions and their reactions to environmental challenges is the primary goal of the Hounsfield Facility, a premier multidisciplinary research institute. The Schools of Biosciences incorporate scientists from a wide range of fields.

The glass house and research room make up this facility. The glass greenhouse portion of the research room is planted with weeds, and a fully automated greenhouse manned by a laser-guided robot is used to feed the 1 m long, 80 kg samples to the largest scanner. The research room also includes various research project departments related to this experiment and X-ray imaging research equipment. The apparatus enables the quantification of materials at spatial scales ranging from <1μm to 150 μm>.

4. Methodology.

First, because each flower pot has a QR code to identify it, we will use Vuforia's image recognition technology to trigger the model.

4.1 3-detention model

We will attempt to create a Python tool that converts RSML (Lobet et al., 2015) files.OBJ files (3-dimension). The model will be edited using the blender programme. VR applications will be created using the 3d models produced in this part. The software will utilise the example appropriately to prevent the failure of the earlier tool development from impacting the later design. OBJ files are created concurrently.

4.2 interface

Following a description of picture recognition, several plant samples will be identified using various QR code scans. The design interface will have a comparable drop-down menu to swap samples as default. This application uses Unity's Vuforia image identification.

The current sample name will be shown above the model, and the model's left and right sides will have buttons for rotating it. The model will be presented in the centre of the program's interface. The interface will also have buttons for zooming in or out of the current model and for resetting the model's position. The design of the next section will concentrate on the model's components. The RMSL analysis will allow the plant model to display more in-depth.

In order to conduct the initial evaluation, participants were first tested in a plant pot, and then multiple targets testing in the same setting. The experiment's goal may be accomplished if the plant's root model is positioned correctly and certain parameters can be appropriately shown. Finally, the application is evaluated by several researchers, and the user interface is improved by keeping track of the impact of the user experience.

4.3 design platform

Designed on the Apple platform, first tested through the computer's camera, then tested on the iPad and iPhone.

5. Programme of work.

The task is broken down into six sections, each with a unique Milestone.

Work Package 1 (WP1) - Literature Review. Conduct secondary research into persuasive technologies for behaviour change using relevant sources. Make notes on key papers, particularly for gaps in the research and write-up. Milestone 1 (M1) – Literature review chapter of a dissertation completed.

Work Package 2 (WP2) – Knowledge. View the Unity and Vuforia usage flow, the experiment evaluation flow, and the program's schematic diagram. Collect examples of how plants and AR apps interact for interface design, knowledge of plant models, and the causes and consequences of relevant data. Milestone 2 (M2) – The project background knowledge understanding and collection are completed.

Work Package 3 (WP3) – Prototype 1. Design and complete a mode to identify the current plants by scanning pictures or QR codes to ensure that there is a means to determine the one-to-one correspondence between samples and models. Milestone 3 (M3) – Prototype 1 is completed.

Work Package 4 (WP4) – Prototype 2. Create software that scans plant components outside the soil and displays a matching three-dimensional representation of the plant roots. Milestone 4 (M4) – Prototype 2 is completed.

Work Package 5 (WP5) – 'Testing'. Test individual and multiple objects, record user feedback on them and make software enhancements. Milestone 5 (M5) – User evaluation test results chapter of thesis written.

Work Package 6 (WP6) – 'Further design'. Based on the original program, more information on plant roots is expanded, such as the concentration of elements in the soil, the moisture of the soil, and the changes in the roots and leaves of the plant compared to the previous day. It also leaves room for porting to Microsoft HoloLens. Milestone 6 (M6) – Subsequent parts of the extension are done.

6. Time plan.

	Task	Assigned To	Start	End	Dur	%	2022		
							Jul	Aug	Sep
	Project		1/7/22	9/9/22	51				
1	Literature Review		1/7/22	6/7/22	4				
2	Milestone 1 (M1) – Literature review chapter of dissertation completed.		6/7/22	6/7/22					
3	Knowledge		6/7/22	9/7/22	3				
4	Milestone 2 (M2) – The project background knowledge understanding and collection are completed.		9/7/22	9/7/22					
5	Prototype 1		1/7/22	15/7/22	11				
6	Milestone 3 (M3) – Prototype 1 is complete		15/7/22	15/7/22					
7	Prototype 2		16/7/22	30/7/22	10				
8	Milestone 4 (M4) – Prototype 2 is complete		30/7/22	30/7/22					
9	Testing		1/7/22	1/8/22	22				
10	Milestone 5 (M5) – User evaluation test results chapter of thesis written.		1/8/22	1/8/22					
11	Further design		1/8/22	5/8/22	5				
12	Milestone 6 (M6) – Subsequent parts of the extension are done.		5/8/22	5/8/22	1				
13	Submit dissertation and any supplementary material		9/9/22	9/9/22					
14	Project plan		5/7/22	5/7/22					