HKUST Path Finder Android App with Augmented Reality

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Introduction

Augmented Reality (AR) is an interactive real-time perception of the real-world environment extended by computer-generated sensory inputs such as sound, video, graphics and GPS data.

The main purpose of integrating AR technology in applications is to magnify objects in the physical world by enriching existing information with additional digital contents so that mobile users can experience a mix of the real world and the virtual world.

Figure 1. Example of AR Mobile App

With rapid growth in extensive usage of powerful mobile devices, applications that exploit the mobile's surrounding context have become feasible. Understanding AR's wide variety of potential usefulness, our group decided to integrate AR in the indoor navigation tool for the HKUST campus to provide interactive and enhanced services.

Objectives

We aimed to achieve the following five main objectives:

i. Build a path advisory application for Android mobile devices.
ii. Make use of AR technology to provide visual aids on the graphical user interface (GUI).
iii. Provide indoor localization using the mobile device's camera and optical character recognition (OCR) engine to input room numbers.
iv. Find the shortest paths to destinations.
v. Add additional features to display information in AR.

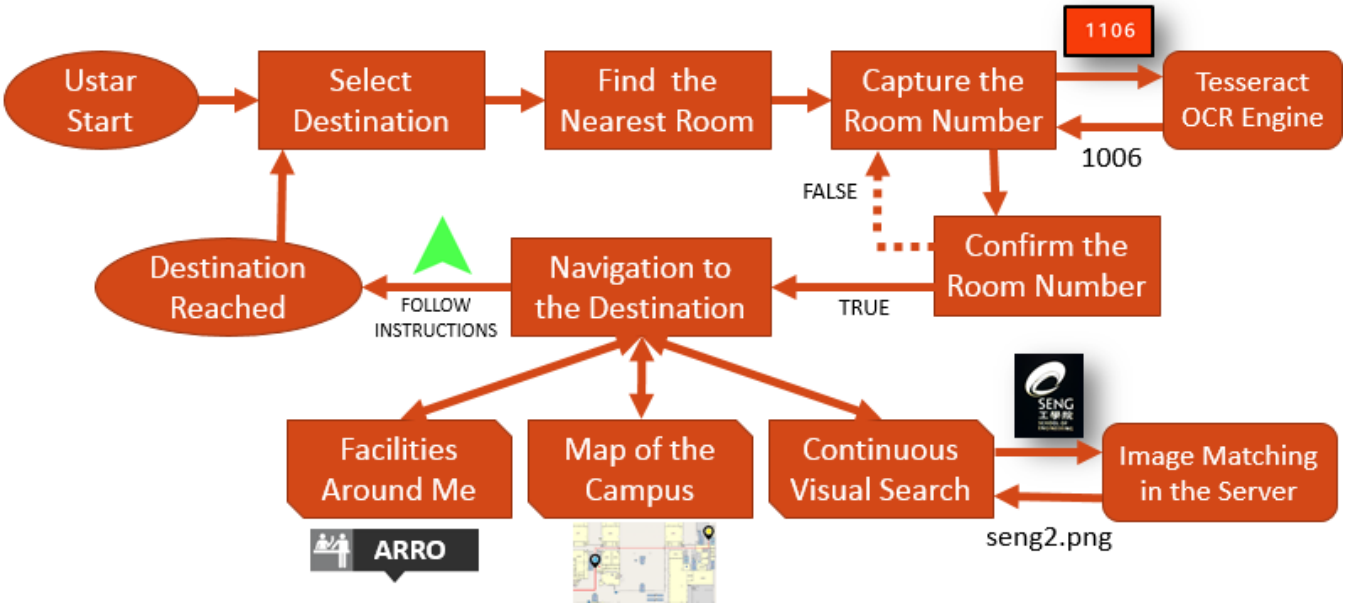

Figure 2. Ustar Run-Through Flow Chart

Design & Implementation

There are two phases in the sequence of the app: room number input phase and navigation phase. Once the room number is recognized using the Tesseract OCR engine, the user's current location (the resultant of the OCR) and the user's choice of destination are passed on to the next phase for the path finding computation.

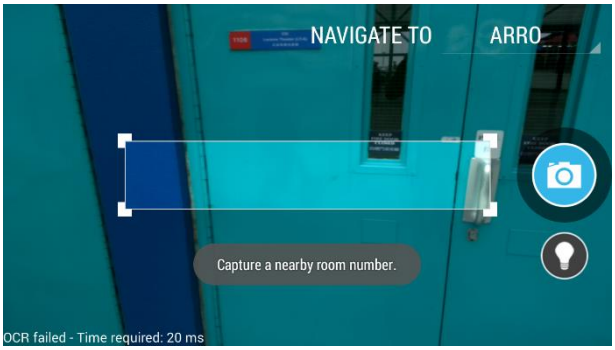

Figure 3. Phase I: OCR Room Number Input

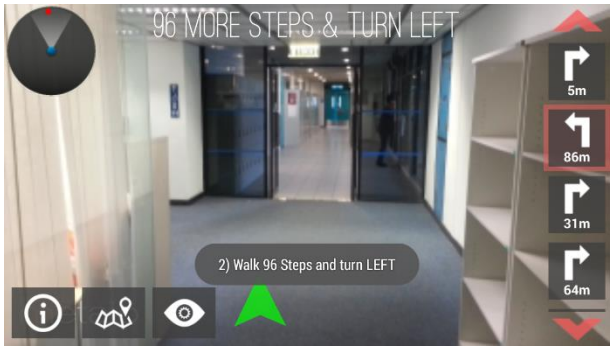

Figure 4. Phase II: Navigation

- Shortest path from the user's current position to the proposed destination is computed using the implemented Dijkstra's algorithm.
- Navigation by notifying to the user with a direction arrow and spoken speech of instructions.
- Accelerometer-based pedometer concurrently tracks user's position.
- Provides the HKUST map with important indications like the paths and positions (refer to Figure 5).
- Visual localization of the facilities and information around the user (refer to Figure 6).
- Visual Search mode to display additional information using the integrated Metaio Continuous Visual Search (CVS) functionality (refer to Figure 7).
- Preferences related to pedometer and additional features can be modified to add personalization.

Figure 5. Navigation on the HKUST map

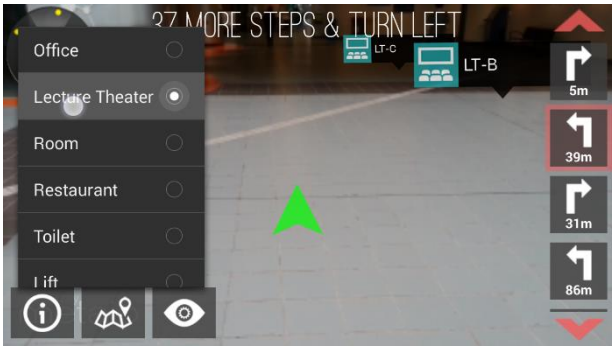

Figure 6. Visual Display of Facilities

Figure 7. Playing video in AR using Metaio CVS

Testing and Result

- Unit Testing: Activity unit tests to ensure that the output from the shortest path algorithm is valid, and the fetching of the database records is done correctly.
- GUI Testing: Interface tested with 26 test cases to ensure that the correct output is returned in response to a sequence of user actions such as pressing buttons.
- Accuracy Testing: Tesseract OCR can successfully translate a room number image between brightness of -80% and 80% with average accuracy of 92% and above. Accelerometer-based pedometer performs with minimum error rate of 7% with a 50m walk test. These results indicate the reliability and robustness of the app.
- Result of the conducted survey (Figure 8) implies that the app suggests a unique paradigm in path finding, and provides useful services in a user-friendly and well-defined interface.

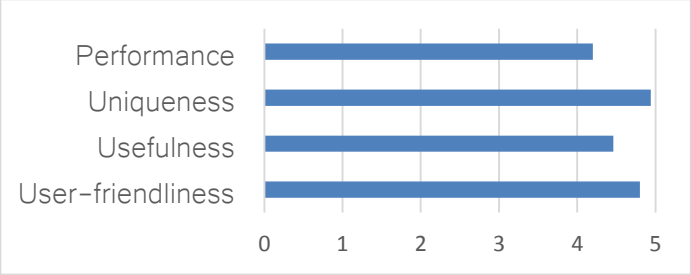

Figure 8. Result of the Survey from 37 HKUST Students

Conclusion

To sum up the major accomplishments of this project, we have successfully managed to integrate different functionalities into one whole application in a user-friendly manner. In order to achieve all the objectives, we have done much literature survey and studied different open source engines and SDKs. Each functionality was implemented in different phases, and merging them together was done afterwards.

Integration of such technology is not restricted to school campus but can be extended to other indoor spaces like airports and shopping malls. Thus, this project truly portrays the potentiality of using AR in providing navigation and other useful information.