Development of Augmented Reality Navigation Application

SS017

Introduction

Current problem

Manpower shortage during large-scale school events

Limited studies on navigation framework

Current navigation tools

Short-range
Simultaneous Localisation and Mapping (SLAM)

Long-range
Global Positioning System (GPS)

Aim

GPS + **SLAM**

↓

Framework + **Application**

Methodology

1. Development of a **framework** for the implementation of Augmented Reality (AR) navigation application
2. Development of the **mobile application** to demonstrate the proposed framework

Software

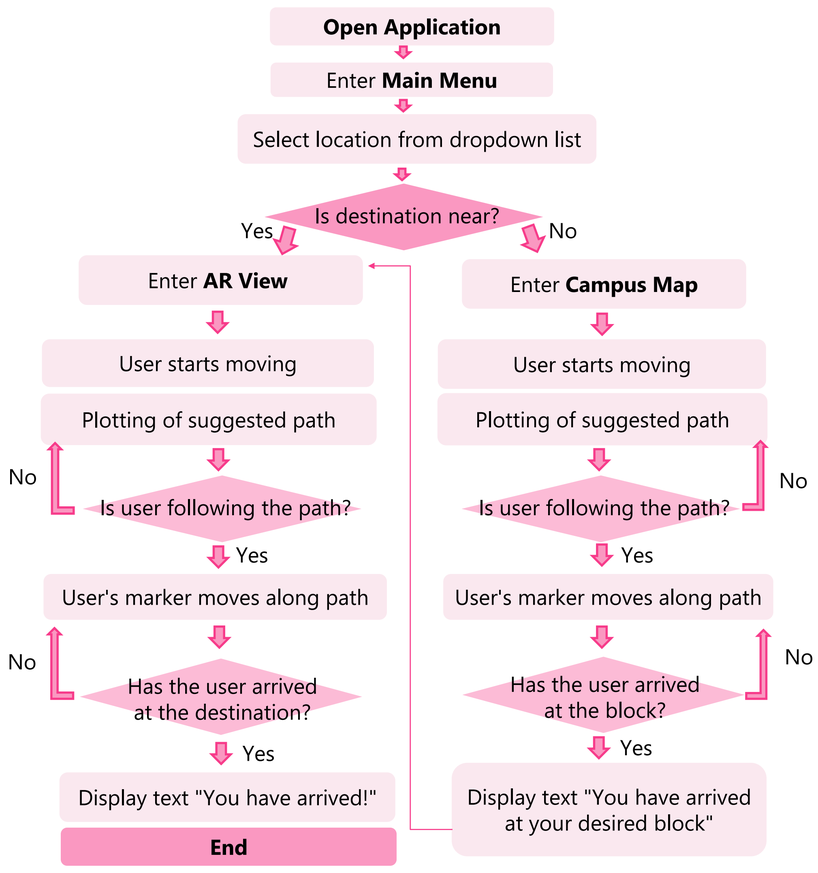
Unity 3D 2018.3.14
- Main software for application
- Supported on both Android and iOS

Google's ARCore SDK v1.12
- AR visualisation
- SLAM functions supported

Mapbox SDK v2.1.1
- Custom-designed maps
- Route generation

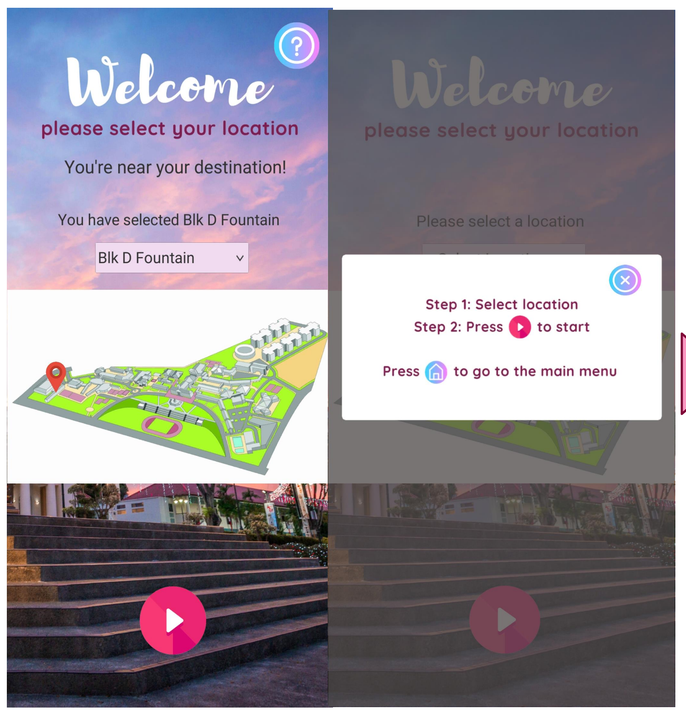
Proposed Framework

Unified Modelling Language (UML) Activity Diagram



Final Prototype

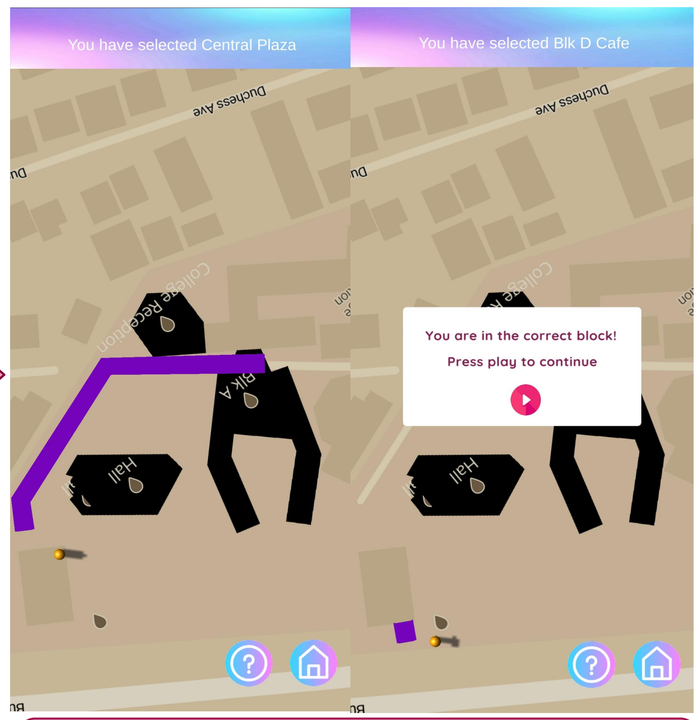
Main Menu



Raycasting algorithm
Determines the location of the user

1. **GPS coordinates** of an area are plotted to form a polygon
2. Check against **user's current GPS location**

Campus Map

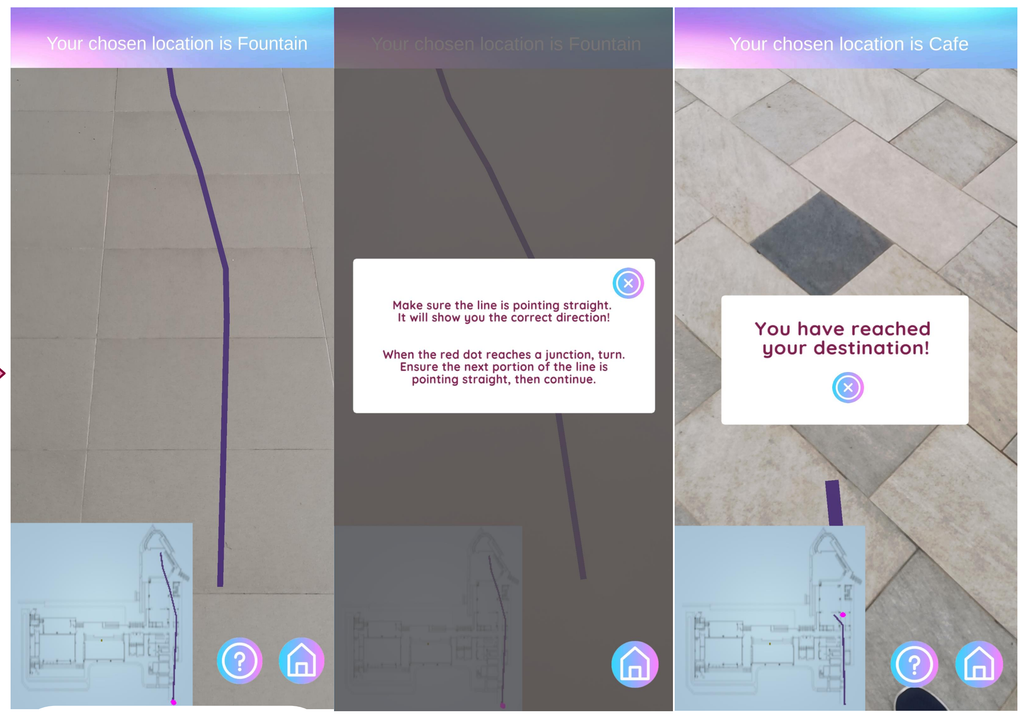


Mapbox SDK Directions API
User localisation and route generation

Use of GPS
Streamlines navigation process while meeting **desired accuracy**

Kalman Filter
Reduces noise due to fluctuations in GPS values

Augmented Reality View



ARCore's SLAM
Track user's movement with respect to known starting location

→ **Unity NavMesh**
Route generation

→ **ARCore's AR Camera**
Line rendering

GPS + **SLAM** → **smooth** and **accurate** user experience

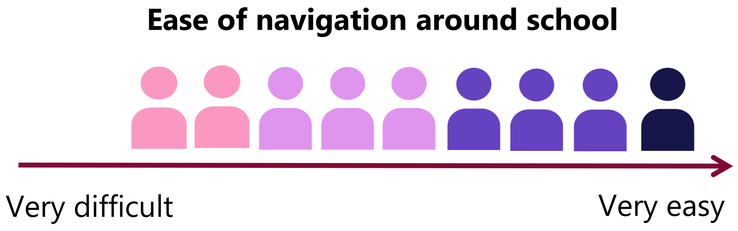
Results and Discussion

Section 1: Pre-Testing Phase Questions

Respondents

8 Year 1 students, 1 school staff

Ease of navigation around school



Analysis focuses on the **qualitative response**
To gauge the **feasibility** of proposed framework and techniques

Section 2: Testing Phase Questions

System Usability Scale: Application scored 62.5

Usability

Functionalities **well-integrated**

Effective for navigation

Learnability

- Slightly **cumbersome** with some inconsistency
- **Easy to use** but some appear uncertain during initial AR navigation
- Some felt it was unnecessarily **complicated**

Analysis

Potential in utilising **GPS and SLAM** to enhance user experience

Occasional misalignment of guiding line due to error accumulation

Visualisation of guiding line affected user's learning experience

Section 3: Post-Testing Phase Questions

Ease of navigation with application

Usefulness of application

- **Potential** in **effectively** and **efficiently** guiding visitors and new staff
- **Overall functionality** is good

Future Extension

- Improved **visualisation** using arrows
- Improved **algorithms** for smoother implementation
- Integration of **audio** instructions
- **Short-range communication** systems like MQTT for information transmission

Conclusion

- Proposed framework could be **easily adapted** to various campuses
- Application is **user-friendly** and **effective**
- **Potential** for actual implementation

References

1. G. Gerstweiler, E. Vonach, and H. Kaufmann, "HyMoTrack: A Mobile AR Navigation System for Complex Indoor Environments," Sensors, vol. 16, no. 1, p. 17, 2015.
2. L. C. Huey, P. Sebastian, and M. Drieberg, "Augmented reality based indoor positioning navigation tool," 2011 IEEE Conference on Open Systems, 2011.
3. Lewis, James R., and Jeff Sauro. "The Factor Structure of the System Usability Scale." Human Centered Design Lecture Notes in Computer Science, 2009, pp. 94–103., doi:10.1007/978-3-642-02806-9_12.
4. G. Bresson, R. Aufrere, and R. Chapuis, "Improving SLAM with Drift Integration," 2015 IEEE 18th International Conference on Intelligent Transportation Systems, Aug. 2016.

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