Software Requirements Specification

Indoor Navigation Using Augmented Reality

Group 10

Version 1.0 approved

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1. Introduction

1.1 Document Purpose

This document defines the software requirements for an **Indoor Navigation System Using Immersal SDK**. The system allows users to navigate within indoor spaces by utilizing visual positioning, waypoints, and AR navigation overlays. It's our first priority and if it doesn't work we will switch to QR code.

1.2 Project Scope

- The system determines user location using either:
  - **Immersal SDK**: Visual positioning by matching real-world camera images with a pre-scanned visual map.
  - **QR codes**: Users scan QR codes placed in key locations to determine their position.

- Users select their **destination** from a list.

- The system calculates the **optimal route** and displays **AR-based navigation overlays**.

- Ideal for environments like **malls, airports, hospitals, and campuses**.

1.3 References

- **Immersal SDK Documentation:** https://immersal.com/docs
- **Unity AR Foundation:** https://docs.unity3d.com/Packages/com.unity.xr.arfoundation
- **Video Reference:** https://youtu.be/Ra5XwXDXlLw?si=6T3YYL9XOtnYaQAt

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2. Overall Description

2.1 Product Perspective

This system is designed to provide indoor navigation using **visual localization** technology. It eliminates reliance on external positioning systems and offers **real-time AR-based navigation**.

2.2 User Classes and Characteristics

- **General Users:** Visitors navigating indoor spaces.(example: Students navigating ITU)
- **Administrators:** Manage the system's waypoints,QR code placement, and environment mapping.

2.3 Operating Environment

- **Platform:** Unity Engine with AR Foundation

- **Hardware:** Smartphone with a camera (Android/iOS)

- **Software:** Immersal SDK, ARCore (Android) / ARKit (iOS)

- **QR code:** ZXing.net extension for unity.

2.4 Assumptions and Dependencies

- **For Immersal SDK**:
  - Users must have a camera-enabled smartphone.
  - The indoor environment must be pre-mapped using the Immersal mapping tool.
- **For QR Code Navigation**
  - QR codes must be strategically placed within the indoor environment.
  - Users must scan QR codes to determine their position. The QR code would be placed on the doors or walls of every single location point. Like a node in a graph.

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3. System Features

3.1 Visual Positioning and Localization

- **Immersal SDK**: Determines user location by comparing real-world camera images with a pre-scanned visual map.
- **QR Code Navigation(optional)**: Users scan QR codes to update their position within the indoor space.

3.2 Waypoints and Pathfinding

- **Description:** The system uses pre-defined waypoints to calculate the shortest path to the selected destination. For example from LT1 to LT5 it will give us the path in real time.
- **Stimulus/Response:** Once a user selects a destination, the system determines the best route using A* pathfinding algorithm.

3.3 AR Navigation Overlays

- The system displays real-time AR arrows and indicators to guide users.
- The navigation path updates dynamically as the user moves **(for Immersal SDK)**.
- **For QR codes**, navigation updates when a new QR code is scanned.

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4. Data Requirements

4.1 Visual Map Storage and Processing

- Pre-scanned indoor maps are stored and processed by the **Immersal SDK.**

- The system retrieves and matches real-time camera input with the stored map. It will give the current position of the user. In case we are not able to get the information we will shift towards **QR codes** which can also be used if we want to get our current location.

4.2 Waypoint and Route Data

- **Waypoints are predefined** based on the mapped environment.
- **The pathfinding algorithm**, in this case **A***, determines the optimal navigation route.

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5. External Interface Requirements

5.1 User Interface

- **Camera View:** Displays real-time environment and AR overlays.

- **Destination Selection:** Allows users to choose their desired location. Which includes all of **level 6** i.e, all LTs, grey carpet, one window, library etc…

- **Navigation Screen:** Shows AR guidance in the indoor space.

5.2 Software Interfaces

- **Immersal SDK**: For visual positioning.
- **Unity AR Foundation**: For AR rendering.
- **QR Code Scanner**: For QR-based location updates.

5.3 Hardware Interfaces

- **Smartphone Camera:** Required for real-time positioning.

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6. Quality Attributes

6.1 Usability

- Intuitive UI with minimal user interaction.
- AR overlays provide clear navigation instructions.

6.2 Performance

- **Low latency positioning** for real-time navigation.
- Optimized rendering for **smooth AR guidance**.

6.3 Security

- **No personal data stored**; Application does not ask for any personal data , only location mapping is used.
- **Secure API communication** with Immersal SDK and QR code storage.

Conclusion

This document outlines the requirements for an **Indoor Navigation System Using Immersal SDK**. The system leverages **visual positioning, waypoints, and AR overlays** to provide a seamless navigation experience.

This innovative solution sets a new benchmark for indoor navigation, driving future advancements in AR and spatial computing.

There are two ways to determine your location. The **first method** uses the **application's camera** to determine your current position. The **second method** uses **QR codes** to determine your current location.

In simple words there are two ways to do this project. One is complex but the outcome is satisfying and the other is easy but the end result is not as good as the first one.

Our first priority is definitely to get the user's location through scanning **(Immersal SDK)**. As **Sir Shereyar** mentioned, progress matters not the final product.