TED UNIVERSITY

CMPE 491 Senior Project

Project Specifications Report

"GuidAR"

Spatial Computing for Indoor Navigation

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Project Page URL: https://mediverse.framer.website/landing

NOTE: The project topic has been changed and the project website will be updated accordingly, with the **Backlog** section included.

1. Introduction

1.1 Description

This project proposes an Augmented Reality (AR) Indoor Navigation System that utilizes Simultaneous Localization and Mapping (SLAM) to provide real-time, accurate navigation inside indoor environments such as university campuses, museums, airports, and hospitals.

The system integrates the device camera, Inertial Measurement Unit (IMU), and SLAM algorithms to generate a dynamic 3D map of the surroundings by overlaying virtual elements such as directional arrows, labels, and paths onto the real environment through AR. This allows users can easily find their way to specific destinations without relying on external GPS signals.

Using mobile devices or AR glasses, users will get to interact with a visual guide directly in their field of view. The interface will highlight important landmarks, indicate turning points, and adapt dynamically as users move or deviate from the original path.

The primary goal of the project is to enhance indoor spatial awareness, reduce cognitive load during navigation, and demonstrate the potential of AR-based interfaces in real-world, context-aware applications.

1.2 Constraints

The project will be developed under the following constraints:

Hardware: Requires AR-capable mobile devices or headsets with camera and IMU sensors.

Environment: Tracking accuracy may decrease in low-light or texture-free areas.

Network: Optional online mode for map data updates or building layout downloads.

Computation: Real-time SLAM and AR rendering require optimized performance to prevent overheating or frame drops.

Data Privacy: Visual data from the camera should not be stored unless anonymized or required for mapping.

Performance: Real-time navigation feedback with minimal latency.

1.3 Professional and Ethical Issues

Privacy: Must ensure that video streams and mapping data are processed locally and anonymized.

Accessibility: Design for diverse users, including non-technical and mobility-impaired individuals.

Accuracy and Responsibility: Misleading navigation could cause real-world safety risks.

2. Requirements

2.1 Functional Requirements

SLAM-Based Localization: Real-time user tracking and environment mapping using visual and inertial sensor data.

AR Navigation Interface: Overlay of virtual arrows, labels, and directions aligned with the real-world view.

Path Planning: Automatic route generation from current position to selected destination

Dynamic Path Updates: Recalculate navigation path if user deviates or environment changes.

Destination Search: User can search and select predefined locations such as, classrooms, offices.

- **Multi-Floor Support:** Handle vertical navigation through stairs or elevators.

2.2 Non-Functional Requirements

Usability: Intuitive AR interface with clear icons and gestures.

Simple destination input and real-time feedback.

Performance: Real-time SLAM updates and smooth AR rendering with minimal latency. Stable frame rate 60fps for responsive visualization.

Security: Local data processing; no external image transmission without consent.
Maintainability: Modular system architecture for easy updates. Extensible for integration with additional map providers.

3. References

1. Volpis. (2025, October 23). *A complete guide to developing augmented reality indoor navigation applications.* https://volpis.com/blog/guide-to-developingaugmented-reality-indoor-navigation-applications/
2. Google ARCore Documentation, *Geospatial and Indoor Mapping APIs.*
3. Apple ARKit Documentation, *Visual-Inertial Odometry and Room Plan APIs.*
4. Sukhareva, E., Tomchinskaya, T., & Serov, I. (2021). *SLAM-based indoor navigation in university buildings*. https://ceur-ws.org/Vol-3027/paper63.pdf

Project Backlog

Task Name	User Story	Sprint Ready	Priority	Status	Effort	Assigned to Sprint
Sprint 1	No	No	**High**	In Progress	24	Yes
Requirement Analysis and Use Case Definition	Gather detailed functional and non-functional requirements. Identify key user scenarios, define project scope and constraints.	Yes	**High**	Complete	4	Yes
Establish Contact with Potential Industry Partner or Customer	Identify and reach out to a company that can act as a customer to secure feedback or sponsorship for the project.	Yes	**High**	In Progress	12	Yes
Technology Stack Selection and Environment Setup	Choose suitable AR and SLAM frameworks, set up the development environment and version control (Git repository).	No	**Medium**	In Progress	8	Yes
Preliminary SLAM Feasibility Test	Conduct initial experiments using device sensors to verify that the chosen SLAM framework can track motion accurately in an indoor environment.	No	**Medium**	Not Started	0	No