

FIT AR Navigation App (FITARNA)

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Client: Florida Tech Library

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Goals and Motivations:

The goal of this project is to provide a fast and simple method of navigating Florida Tech's various buildings for those unfamiliar with the layout and purpose of the buildings. Currently, locating specific rooms inside buildings can be confusing for anyone unfamiliar with the buildings, and while staff could help with this, they may not be around or available to guide those in need. This becomes especially difficult when a user has a specific objective without knowing many of the room's features. Maps may help those familiar with them navigate, but they can be overwhelming for someone who isn't. Our project will help users navigate these unfamiliar spaces quickly and effectively, or allow the user to become familiar with the space themselves. Our project will achieve this through AR Navigation to desired destinations within buildings, AR Tours for acquainting ourselves with all the most important information around the buildings, and AR Pop-ups for many Points of Interest (PoI) around the space. Our project will start by incorporating one of the more complex buildings, Evan's Library, for users to use.

Approach:

- Navigate to Any Room With Ease
 - Choose any room from a dropdown list or search by name/ room number. Follow AR directional overlays straight to the destination. Start navigation anywhere in the library and discover points of interest along the way with AR pop-ups that share context and history.
- Take an Interactive Self-Guided Tour
 - Explore the Evan's Library's most important features, such as the Digital Scholarship Labs, reservable private rooms, offices, and more. Learn the history and functionality of each stop through a series of interactive AR pop-ups that'll teach and quiz you as you go. Pause the tour anytime and resume when ready.
- Learn About the Library As You Walk
 - During tours and navigation, pop-ups will appear and feature relevant information, teaching context, and history. Click on pop-ups during tours to advance, and click on links in pop-ups to access the link. Some pop-ups during tours will show a question; click on your answer to advance and receive feedback.

Novel features/functionalities:

- Informational AR Pop-ups
 - Appear next to locations like offices and places of interest like statues or resource desks during navigation travel
- AR Navigation of Evans Library
 - AR Navigation will provide a new way for students and visitors to navigate the library
- Self-Guided Tours of Evans Library
 - Currently, the only way for students/visitors to get a tour of the library is with a tour guide, which isn't present normally

Algorithms and tools:

- Languages:
 - C# (Unity + plugins)
 - TypeScript (Backend)
 - Swift (iOS)
 - Kotlin (Android)
- Data Formats:
 - JSON (floor graphs)
 - YAML (Github Actions CI)
 - Bash (Scripts)
- Engine: [Unity](#)
 - Unity has mature tools for modeling 3D objects and effects.
- AR Framework: [AR Foundation](#)
 - Single AR API surface that is supported by Android/ iOS and integrates with the Unity Engine.
- SDKs: [Google ARCore](#) (Android) / [ARKit](#) (iOS) (XR Plugins)
- Crash Reports/ Logging:
 - Firebase Analytics and Crashlytics (Unity SDK)
- Algorithms:
 - Map modeling
 - Localization
 - Calibration/ Alignment
 - Pathfinding (A*)

Technical Challenges:

Limited experience with AR and Mobile Development

Our team has never developed a mobile application or worked with AR technology. The biggest challenge this presents is a learning curve on 3D object placement, device sensors (localization and tracking), and session management. This makes our work susceptible to having a poor foundation, be it in faulty scans, unstable anchors, or buggy base code. This can only be overcome by practice and reading documentation/and watching videos. The most efficient way to do this is to split the challenges into subjects and have each group member take on the responsibility of becoming a SME (Subject Matter Expert) on their assigned/ chosen topic.

Scanning Limitations (Hardware)

The budget for our project is currently zero. This presents a potential problem with scanning the library into Unity. When scanning large spaces with a phone camera, the quality of the scan may suffer. If we are not able to get a scan of sufficient quality with our phones if the room may be too large to properly scan. If this happens, we will use GPS or Geofencing to determine where the user is until they reenter an area that is scanned.

Integrating Backend and Pathfinding into AR (Unity)

Connecting the A* algorithm, calculating the path to the frontend that takes in the surroundings and displays the correct path forward, introduces the challenge of managing data flow, maintaining a reliable network, and syncing coordinates together.

Milestone 1: Small room with an AR pop-up

- Compare and select technical tools: the Engine, AR Framework, SDKs, languages, and Data Formats.
- Resolve technical challenges and learn about them in detail, such as:
 - The extent and possibilities of previously built AR SDKs and development kits.
 - How to Implement an AR SDK.
 - How to construct and compile an app compatible with popular Android Phones.
 - How to track a user using the app, or how to reset their position accurately.
 - Possible unfamiliar coding languages and libraries.
- Prepare a demo version of the Android app containing the following features:
 - Implementation of AR features in a small and simple room
 - Implementation of Informative pop-ups near points of interest
 - Basic implementation of Navigation to a chosen point of interest.
 - Basic interactable UI elements
- Basic outline of Evans Library containing data for rooms, services, sections, and more to serve as points of interest.
- Compare and select collaboration tools for software development, documents/presentations, communication, and task calendar.
- Create Requirement Document
- Create Design Document
- Create Test Plan

Milestone 2: Library Scan

- Expansion of UI to include:
 - A free roam test function to improve AR place pointing and location tracking.
 - A search option with a drop-down menu of all Points of Interest from a selected location.
 - Easy to read pop-ups for Points of Interest.
 - Auto Pop-up Setting: activate when near or activate upon click
- Improve AR Scan to recognize objects or Points of Interest
- Implementation of Evan Library's different floors as Selected Locations.
- Implementation of help options, including a report-making feature, and how to reach out.
- Fix any bugs as they arise.

- Separate pop-ups for room information and specific object information within a room.

Milestone 3: Tour Implementation

- Improve the Navigation Function from different points of interest.
- Finish implementing the Evans Library's different floors with compatible multi-floor support.
- Have Points of Interest fully implemented for every level of Evan's Library.
- Implementation of AR Tour: Visit all the highlights of Evans Library with a curated in-app guide.
- Fix any bugs as they arise.

Task Matrix for Milestone 1

Task	Dathan	Ethan	Jacob	Vincenzo
Compare and Select Technical Tools	Engine, framework, SDKs	Algorithms	Programming Language	Data Formats, crash reports/ logging
Demo Android App (1 Room AR Demo)	App	UI	AR/ Unity integration, scanning, and Localization	Nav
Resolve Technical Challenges	AR	Algorithms and Integration	Scanning	Localization / Mobile App Development
Compare and Select Collaborative Tools	Programs	Documents	Communication/ task calender	Presentation
Design Document	20%	40%	20%	20%
Requirement Document	20%	20%	20%	40%
Library Outline	25%	25%	25%	25%
Test Plan	40%	20%	20%	20%