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:

We plan to implement the following core features to guide navigation and enhance learning within the Evan's Library:

- 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:

- Scanning/Generating Area Targets:
  - Vuforia Creator
  - Vuforia Area Target Generator
- 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: Vuforia
  - 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*)

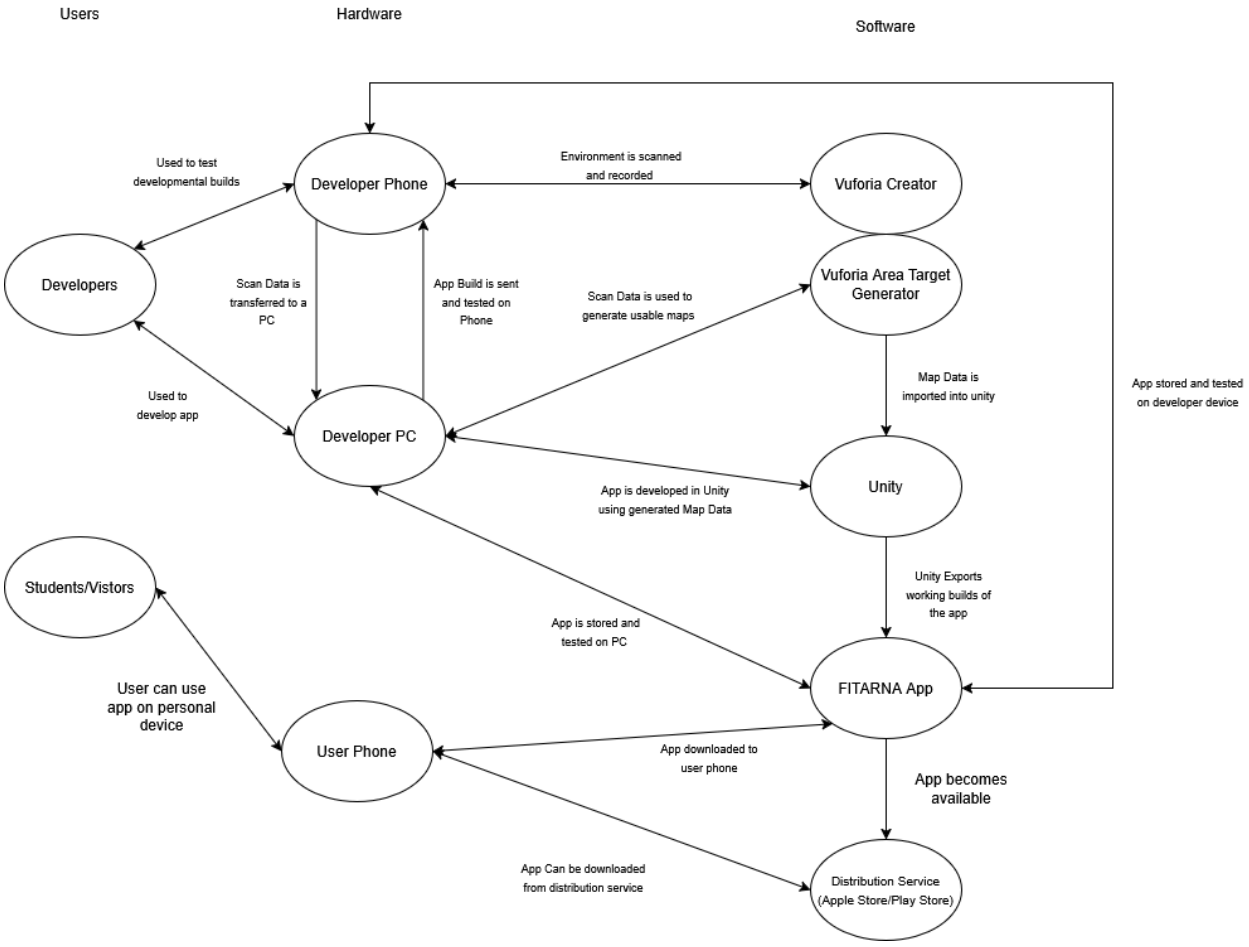
Technical Challenges:

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 an 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.

Design:



The components of the software system are the User Interface, Tour Manager, Navigation Manager, Pop-up System, AR Systems, and stored data.

User Interface will be responsible for the Main Menu, Navigation UI, Tour UI, Pop-up UI, and Search UI. The Tour Manager will be responsible for the Tour Controller, Progress Tracker, Quiz Handler, and Voting Handler. The Navigation Manager will be responsible for the Path Calculator and Route Updater AR System will be responsible for managing and utilizing Unity data, AR location, and navigation. Stored Data will be responsible for storing all app data locally. The Pop-up System will be responsible for providing and managing the Pop-up data.

Evaluation:

Some success metrics are:

- The system shall calculate and display the route to their destination within 4 seconds of the user selecting their destination.
- The system shall maintain AR anchor accuracy within 2 feet (under normal conditions).
- The system must stay under 200 MB of data.

- The app must comply with Section 508 of the U.S. government if it is to be officially released by FIT.
- The system shall provide an intuitive user interface that requires no external help to understand.
- The system shall handle errors gracefully.
- The system shall be designed for easy updating and maintenance for future use.

Progress Summary:

Module/Feature	Completion	To do
Library Scans	50%	Finish scans of floors 2, 3, and 4
Pop-ups	25%	Floor 2, 3, and 4 popups.
Navigation Mode	20%	Implement destinations and navigation algorithm
Tour Mode	5%	Implement tour

Milestone 4:
Finish scans of floor 2, begin scans of floor 3 and 4.
Implement pop-ups for floor 2, and begin adding pop-ups for floor 3.
Implement the navigation algorithm and add destination/pathways for floor 1, and begin the process for floor 2.
Add tour mode to the main menu.
Finalize tour mode plan.
Demo navigation mode.

Milestone 5:
Finish all library floor scans.
Finish pop-ups for all floors.
Implement navigation functionality for floors 2 and 3.
Implement tour mode through floors 1 and 2.
Demo tour mode.
Conduct evaluation and analysis results.
Create a poster for the senior design showcase.

Milestone 6:
Finalize Navigation Mode
Finish Tour Mode
Test/demo of the entire system
Conduct evaluation and analyze results

Create user/developer manual
Create a demo video

Task Matrix for Milestone 4

Task	Dathan	Ethan	Jacob	Vincenzo
Finish scans of floor 2, begin scans of floor 3 and 4.	50%	0%	0%	50%
Implement pop-ups for floor 2, and begin adding pop-ups for floor 3.	25%	25%	0%	50%
Implement the navigation algorithm and add destination/ pathways for floor 1, and begin the process for floor 2.	0%	50%	50%	0%
Tour Mode	30%	30%	30%	10%
Add tour mode to the main menu.	33%	33%	33%	0%
Finalize tour mode plan.	0%	0%	25%	75%

Description:

Faculty Advisor Signature: _____ **Date**: _____