Scotty Maps

Jeff Chen, Ifeanyi Ene, Weelie Guo

18500 Capstone / Team B7

Use Case

Problem

Students waste time finding rooms in buildings

Current navigation software utilizing GPS only works outdoors

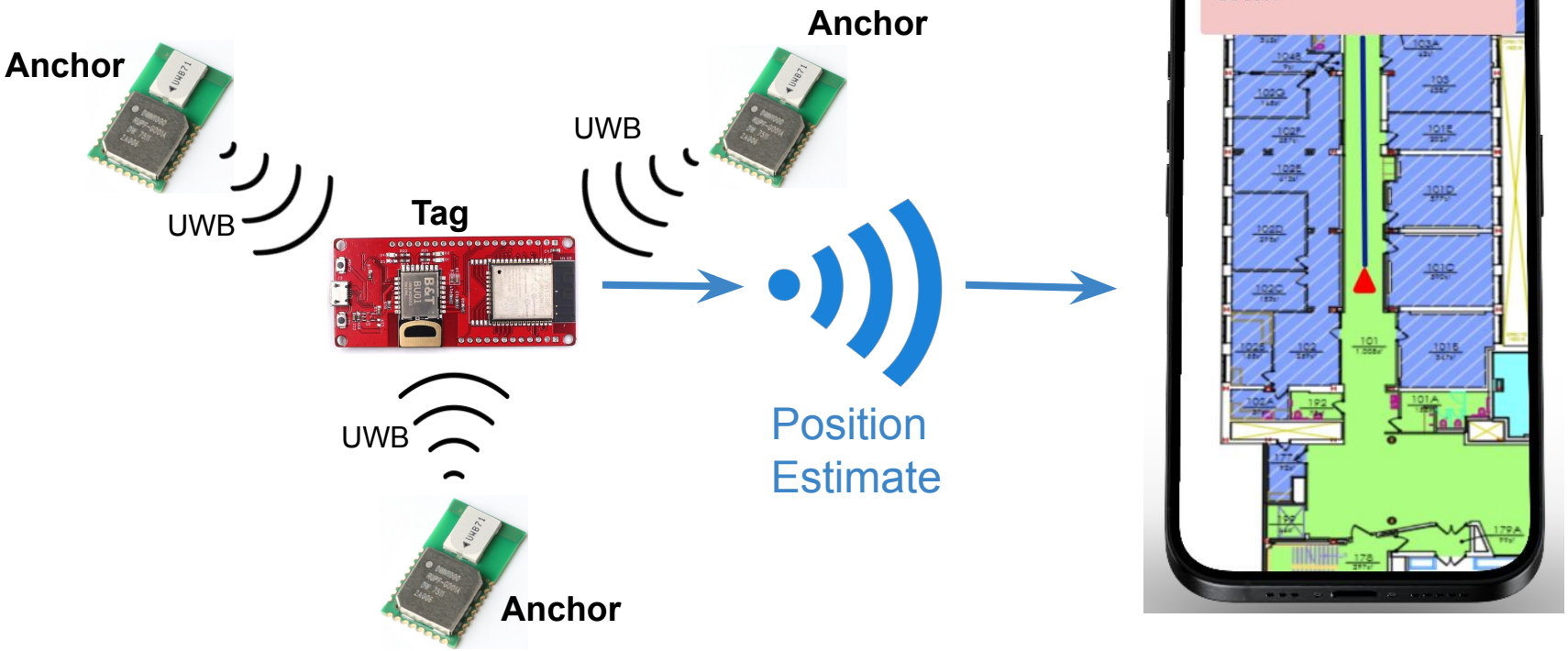
Solution

An indoor localization and navigation system that guides students to specific rooms in buildings

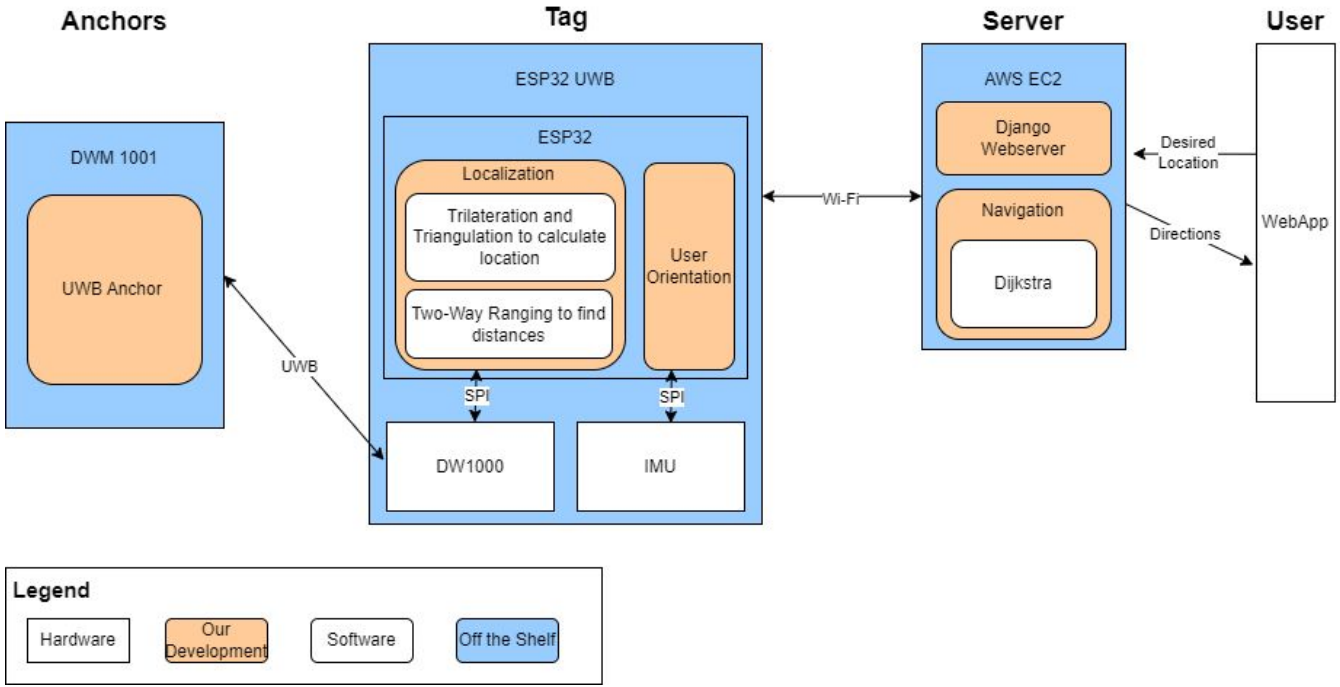
Design Requirements

Use Case	Design requirements
Accurate localization	< 1 meter
4 hour battery life of device	> 2500 mAh
Responsive tracking	> 2 Hz update frequency
Price	< $75

Solution Approach



System Specification



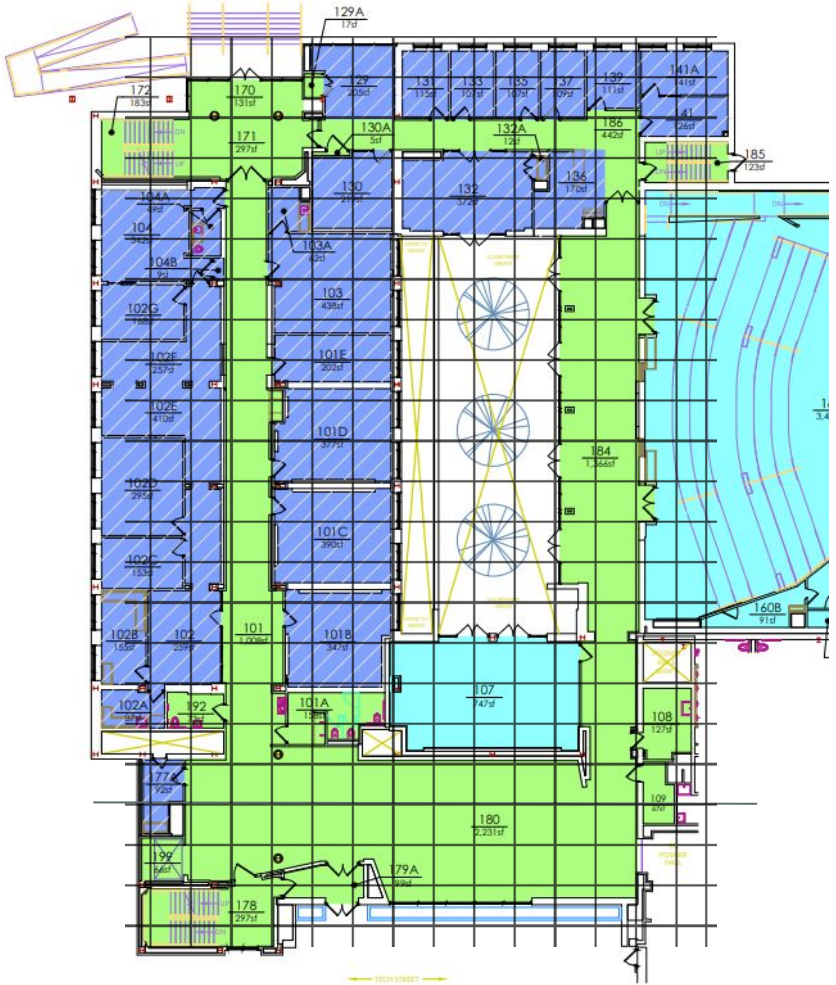
Trade Study: Localization Technologies

Technology	Accuracy	Best Case Range	Cost
Wi-Fi	<3 m	<150 m	Low
BLE 5.1	<1 m	<50 m	Medium
UWB	<0.3 m	<300 m	High

Source 1, Source 2 , Source 3, Source 4

Mapping

- Transform a floor of a building into a 2D grid
- Dijkstra's Algorithm for pathfinding



Implementation Plan

Items to Purchase

- DWM 1001
- ESP32 UWB
- IMU
- 18650 Batteries

Items to Develop

- Time of arrival protocol
- Localization algorithms
- User Orientation
- Django Webapp
- Navigation algorithm

Failure Handling

Test	Risks/Tech Issue	Failure Contingencies
Programming Devices	Difficulties in programming DWM1001-DEV	Utilize different microcontrollers
UWB Proof of Concept	UWB radios lack range or accuracy	Pivot to different technology

Testing, Verification, Validation

Test	Inputs	Passing
Range of Anchors and Tags	Maximum communication range within a closed space	> 25 m
Localization Accuracy	Compare predicted location with the actual location	< 1 m
Position Update Frequency	Measure latency of distance calculating algorithm	> 2 Hz
UI Latency	Measure latency of UI updates	< 2 sec

Testing, Verification, Validation

Test	Inputs	Passing
Battery life of tag	Measure average power consumption of device	> 4 hours < ~2 Watts
Navigation algorithm	Varying starting and ending locations	Shortest paths found 100% of time
User Experience	Qualitative feedback from clients for quality of directions	Directions were helpful

Project Management

Scotty Maps

18500 Capstone / Team B7 / Development Schedule

Project start: Sun, 2/4/2024

Display week: 1

TASK	ASSIGNED TO	PROGRESS	START	END
Planning				
Ideation	All	100%	2/4/24	2/7/24
Proposal Slides	All	100%	2/1/24	2/4/24
System Design research	All	100%	2/4/24	2/8/24
Research design of receiver	Weelie, Jeff	100%	2/10/24	2/17/24
Research design of nodes	Ifeanyi, Jeff	100%	2/10/24	2/17/24
Development				
Django app Setup and models	Jeff		2/18/24	2/21/24
Frontend display building	Jeff		2/22/24	2/24/24
Create Graph of a Building	Jeff		2/25/24	2/28/24
Dijkstra's algorithm	Jeff		2/29/24	3/3/24
Navigation with Instructions	Jeff		3/11/24	3/17/24
Test DVM1001-Dev boards	Weelie, Ifeanyi		2/18/24	2/24/24
Localization Algorithms	Weelie		2/25/24	3/3/24
Setup ESP32 + IMU	Ifeanyi		2/25/24	3/3/24
Mapping out a building	Ifeanyi		3/11/24	3/17/24
Communication from tag to we	Weelie, Jeff		3/11/24	3/17/24
Slack	All		3/18/24	3/24/24
Refinement of Localization	All		4/1/24	4/8/24
Testing and Validation				
Test, troubleshoot localization	All		3/25/24	3/31/24
Full Scale Testing	All		4/9/24	4/14/24
Slack	All		4/15/24	4/21/24
Deliverables				
Design Presentation	All		2/13/24	2/19/24
Design Document	All		2/19/24	3/1/24
Interim Demo	All		3/2/24	4/1/24
Final Presentation	All		4/2/24	4/21/24
Final Documents			4/22/24	4/24/24