Milestone 2:

LiDAR-assisted Wi-Fi Heatmap Generation

Group 106:

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Major Components of Design

Project Management

LiDAR Sensing

Wi-Fi Measurement & Heatmap

UI/UX

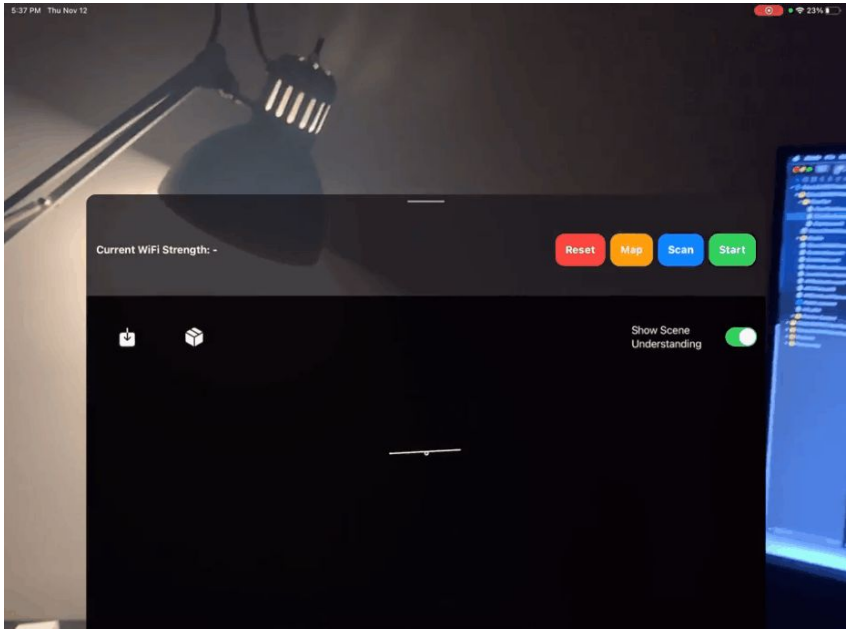
Verification & Validation

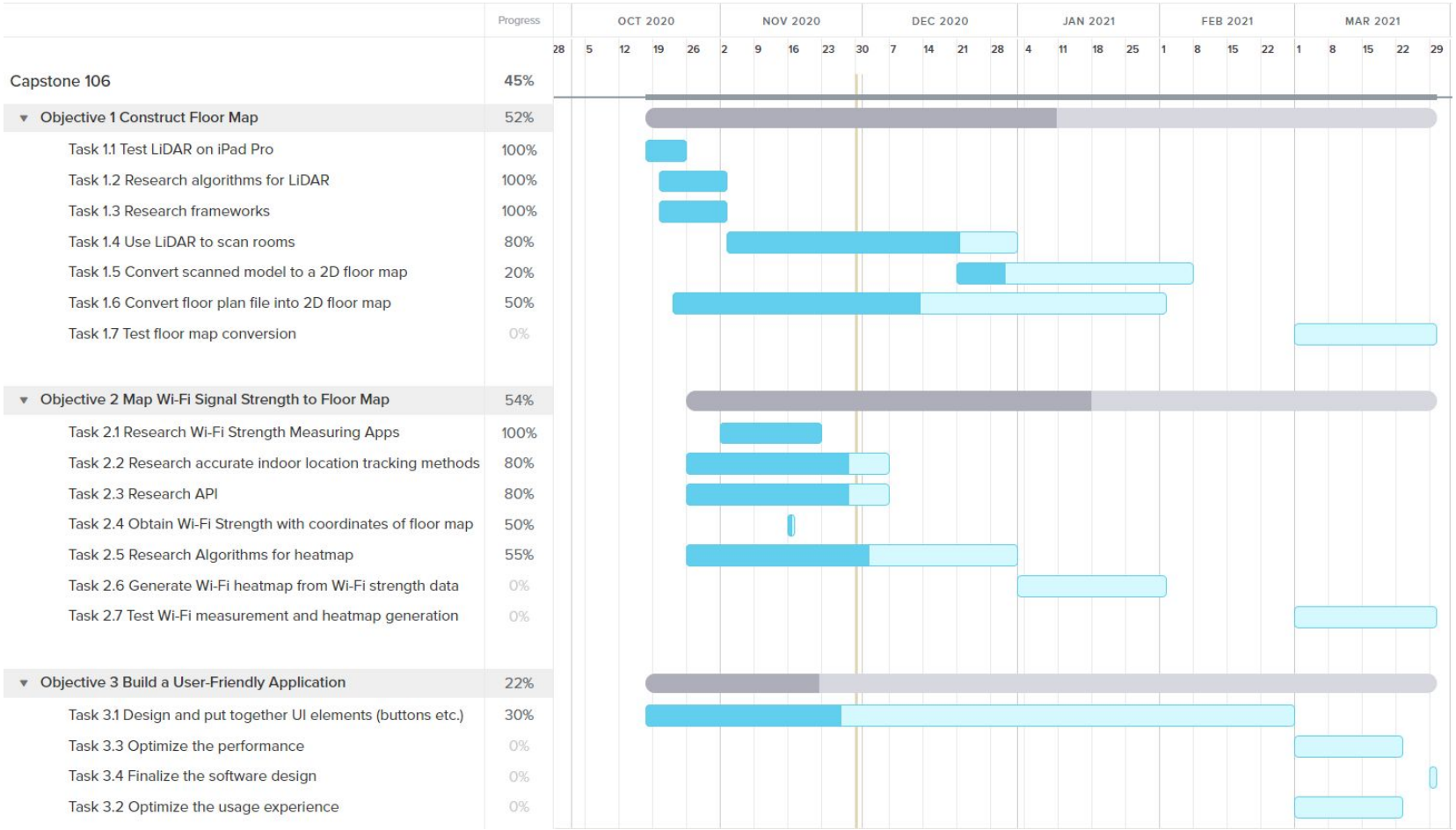
Major Components of Design

1. LiDAR floor map generation
2. Wi-Fi measurement and heatmap generation
3. Mobile app experience

Management

- Mostly on track with task completion
  - Good progress with **Objective 1**: LiDAR floor map generation
  - Minor setbacks with **Objective 2**: Wi-Fi measurements




Progress
OCT 2020
NOV 2020
DEC 2020
JAN 2021
FEB 2021
MAR 2021
28 5 12 19 26 2 9 16 23 30 7 14 21 28 4 11 18 25 1 8 15 22 1 8 15 22 29
Capstone 106 45%
Objective 1 Construct Floor Map 52%
Task 1.1 Test LiDAR on iPad Pro 100%
Task 1.2 Research algorithms for LiDAR 100%
Task 1.3 Research frameworks 100%
Task 1.4 Use LiDAR to scan rooms 80%
Task 1.5 Convert scanned model to a 2D floor map 20%
Task 1.6 Convert floor plan file into 2D floor map 50%
Task 1.7 Test floor map conversion 0%
Objective 2 Map Wi-Fi Signal Strength to Floor Map 54%
Task 2.1 Research Wi-Fi Strength Measuring Apps 100%
Task 2.2 Research accurate indoor location tracking methods 80%
Task 2.3 Research API 80%
Task 2.4 Obtain Wi-Fi Strength with coordinates of floor map 50%
Task 2.5 Research Algorithms for heatmap 55%
Task 2.6 Generate Wi-Fi heatmap from Wi-Fi strength data 0%
Task 2.7 Test Wi-Fi measurement and heatmap generation 0%
Objective 3 Build a User-Friendly Application 22%
Task 3.1 Design and put together UI elements (buttons etc.) 30%
Task 3.3 Optimize the performance 0%
Task 3.4 Finalize the software design 0%
Task 3.2 Optimize the usage experience 0%

Risks

- Use Speed Test as Wi-Fi quality indicator
  - Result of Apple Wi-Fi API request being rejected
  - Further research and testing still required to determine feasibility
  - Affects **Objective 2**: Wi-Fi measurements
- Not all members are able to develop for LiDAR
  - Second iPad Pro approved to help
  - Aid in progress of **Objective 1**: LiDAR floor map generation

"Apple does not want to provide signal strength APIs for cellular and Wi-Fi"
- *Apple Developer Relations*

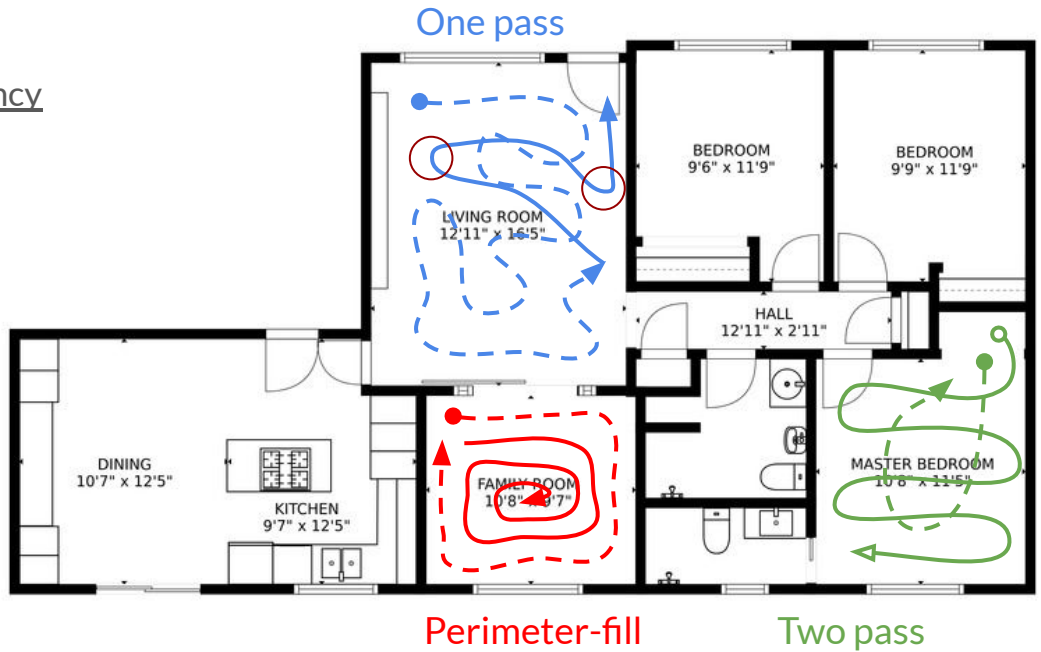
App guided

Unguided

LiDAR Sensing - Pathing Methods

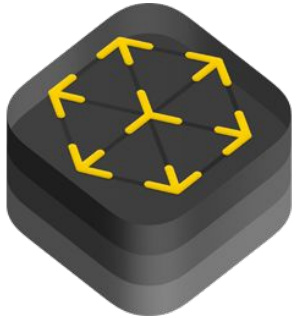
Trade-off between data accuracy, time efficiency and user experience

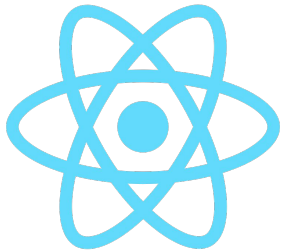
- One Pass
  - Intuitive but not efficient
- **Two Pass**
  - **Efficient but less user friendly**
- Perimeter-Fill
  - Hybrid



LiDAR Sensing - Software Frameworks

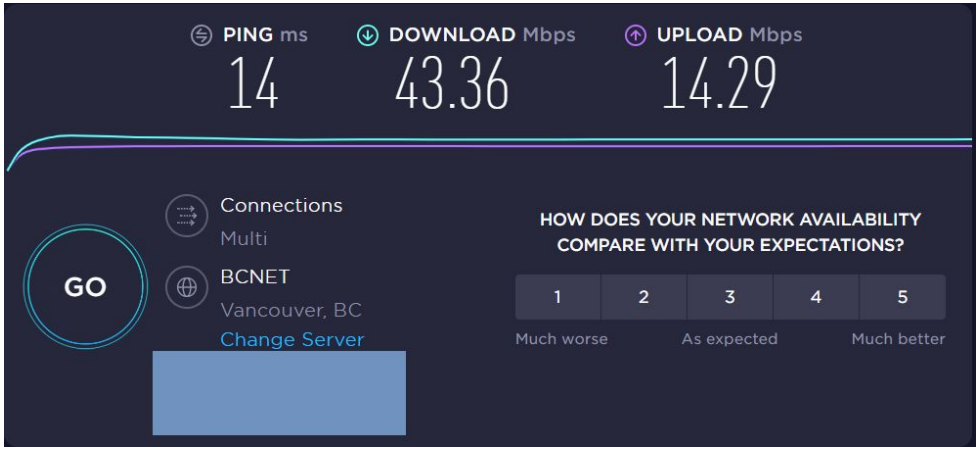
- Unity
  - Advantages: Cross platform, AR integration
  - Limitations: Documentation, Plugin
- **ARKit**
  - **Advantages: Native support, high level functions**
  - **Limitations: iOS/iPadOS only**
- React Native
  - Advantages: Cross platform, shallow learning curve
  - Limitations: Functionality, Performance





Wi-Fi Measurement

- Original Wi-Fi Signal Strength
- Download Speed (Precise)
- **Download Speed (Monte Carlo)**



Ookla speedtest

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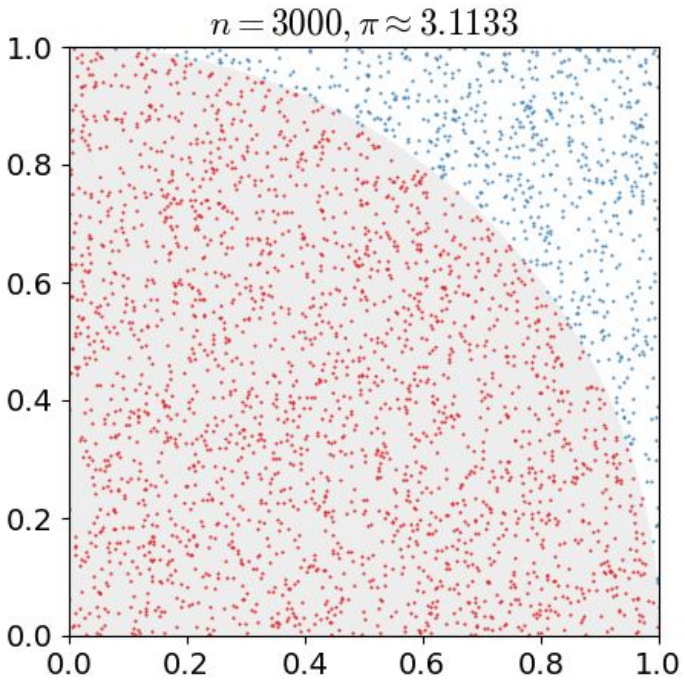
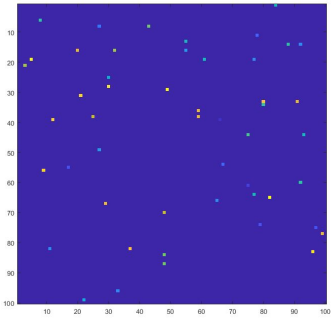


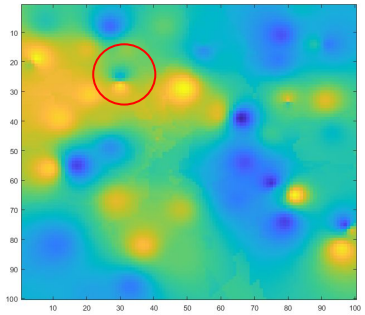
Monte Carlo approximation of pi

Data Processing and Heatmap Generation

How to interpolate raw Wi-Fi measurements?

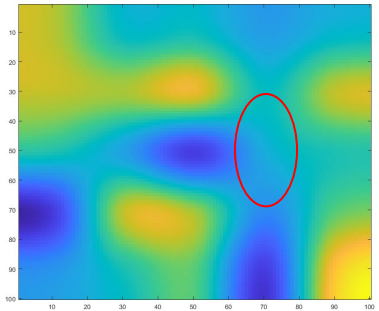


Input Dataset



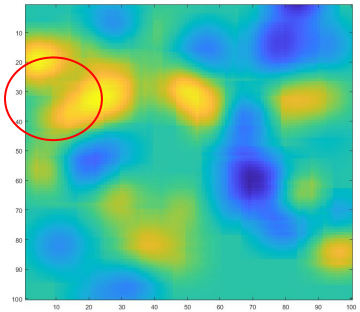
k-Nearest-Neighbour

(k=10)



Bicubic Resampling

($N^2 = 25$)

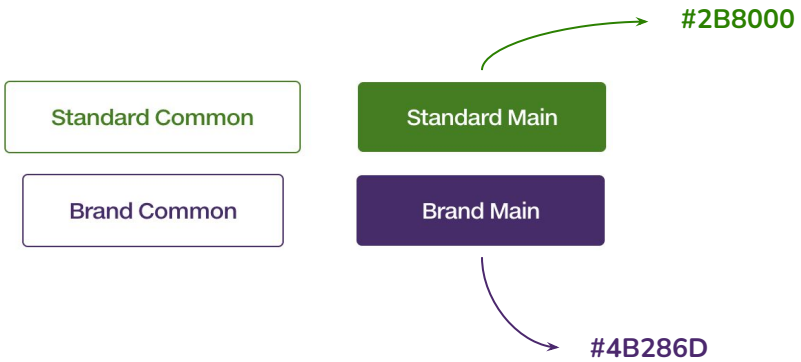


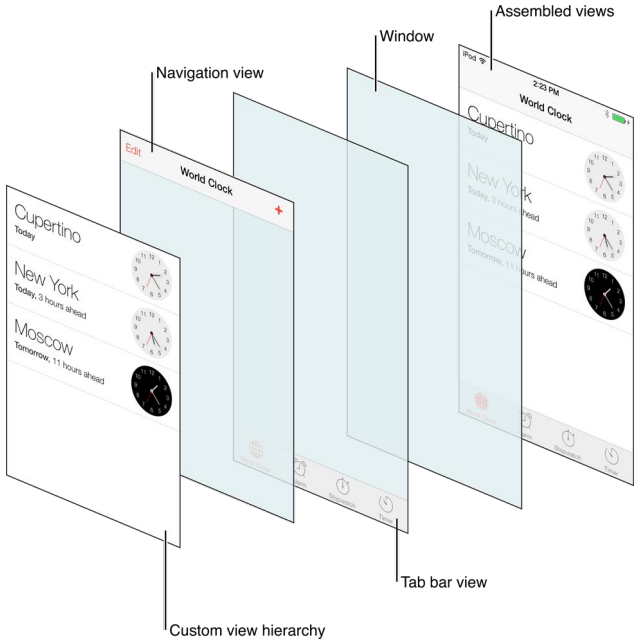
Gaussian Blur

(σ=7)

UI/UX

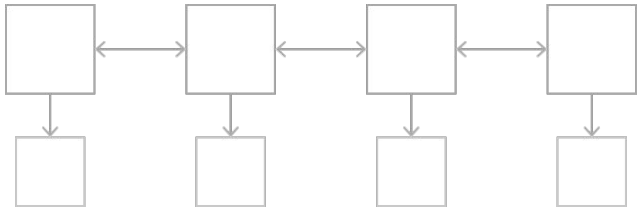
- TELUS Design System (TDS)
- Apple Human Interface Guidelines



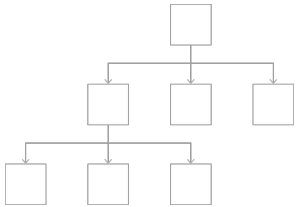


UI/UX

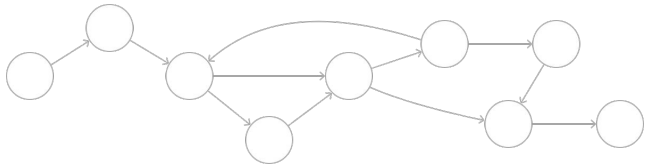
Flat Navigation

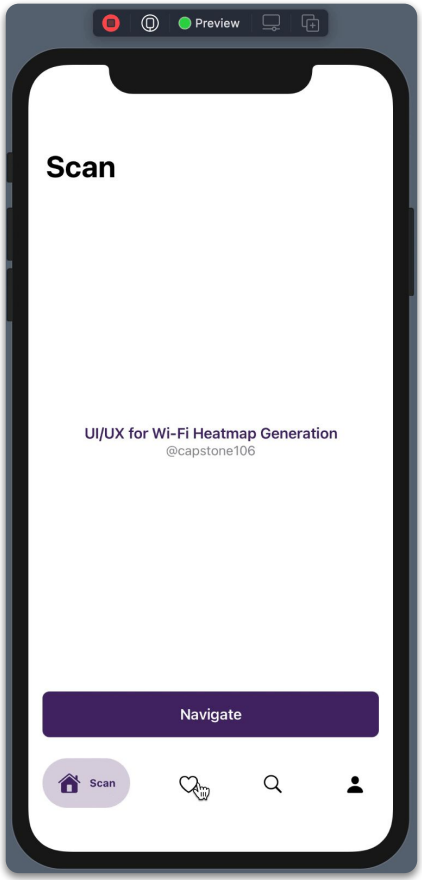


Hierarchical Navigation



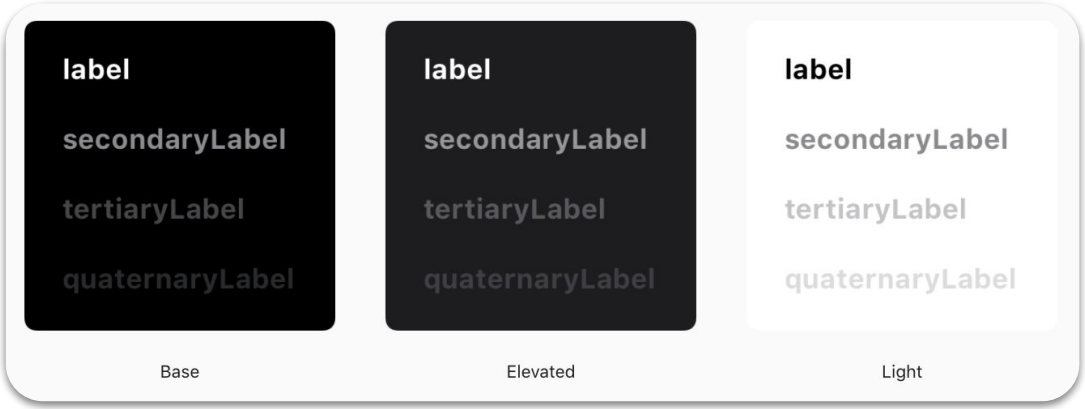
Content-Driven Navigation





Other Visual Features

- App Icon
- Adaptive Layout
- Launch Screen
- Dark Mode

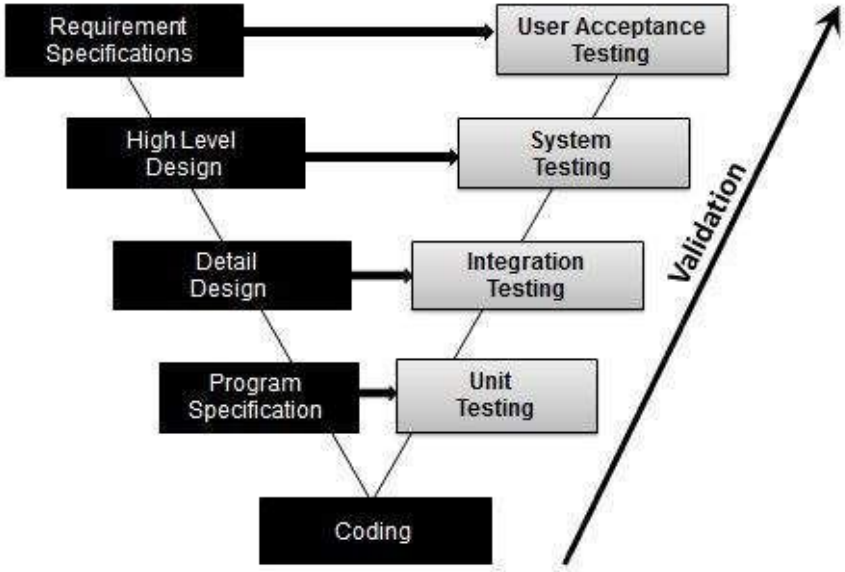


Verification

Objective	Requirement	Criteria
Obj1: Construct floor map	*Req1.1*: Convert LiDAR information to floor map	Compare generated floor map with rooms scanned
	Req1.2: Convert floor map file to floor map	
Obj2: Wi-Fi and Heatmap	*Req2.1*: Record strength of Wi-Fi with respect to coordinates on floor plan	Compare measured strength to a seperate Wi-Fi strength app
	Req2.2: Generate heatmap using Wi-Fi data and coordinates	How much of the floor plan is covered
	Req2.1N: Minimize scan time	User tests out scanning functionality
Obj3: Mobile App	*Req3.1*: Include intuitive and interactive instructions	User tests the whole user interface
	Req3.2: App should be well-optimized and responsive	Test app speeds
	Req3.1N: App should use appropriate visual components	Compare with other apps from TELUS

Validation

- Validation testing using V-model
  - Unit Testing
  - Integration Testing
  - System Testing
  - User Acceptance Testing



Deliverables

1.0 Documentation

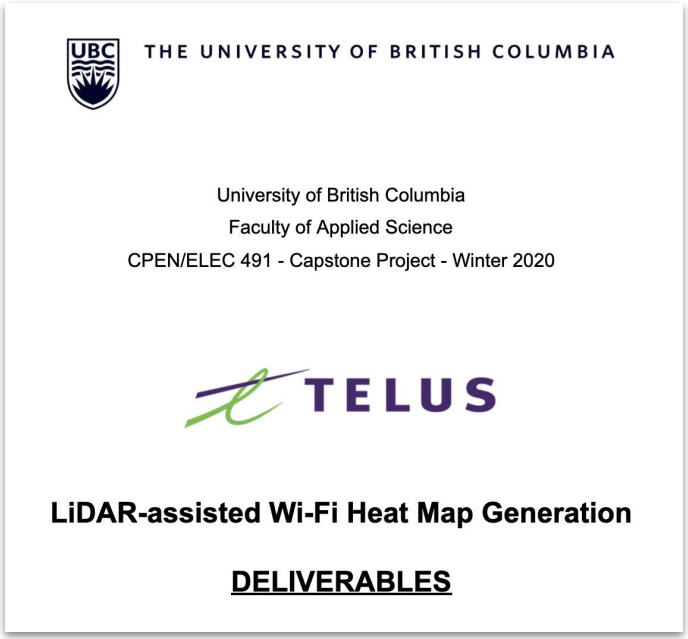
1) **Proposal**
2) **Requirements Document**
3) **Project Design**
4) **Management Plan**
5) **Validation & Verification**
6) **Retrospective**

2.0 Final Product

1) **iOS/iPadOS Application**
2) **Source Code**
3) **User Guide**
4) **Product Video**

3.0 Additional Specifications

1) **Presentation Slides**
2) **List of Purchases**
3) **Test Suites**



Next Steps

- ***Switch*** *to Wi-Fi speed test*
- ***Map*** *Wi-Fi data to generated floor plan*
- ***Integrate*** *LiDAR scanning and other functionalities to the view controller*

Questions