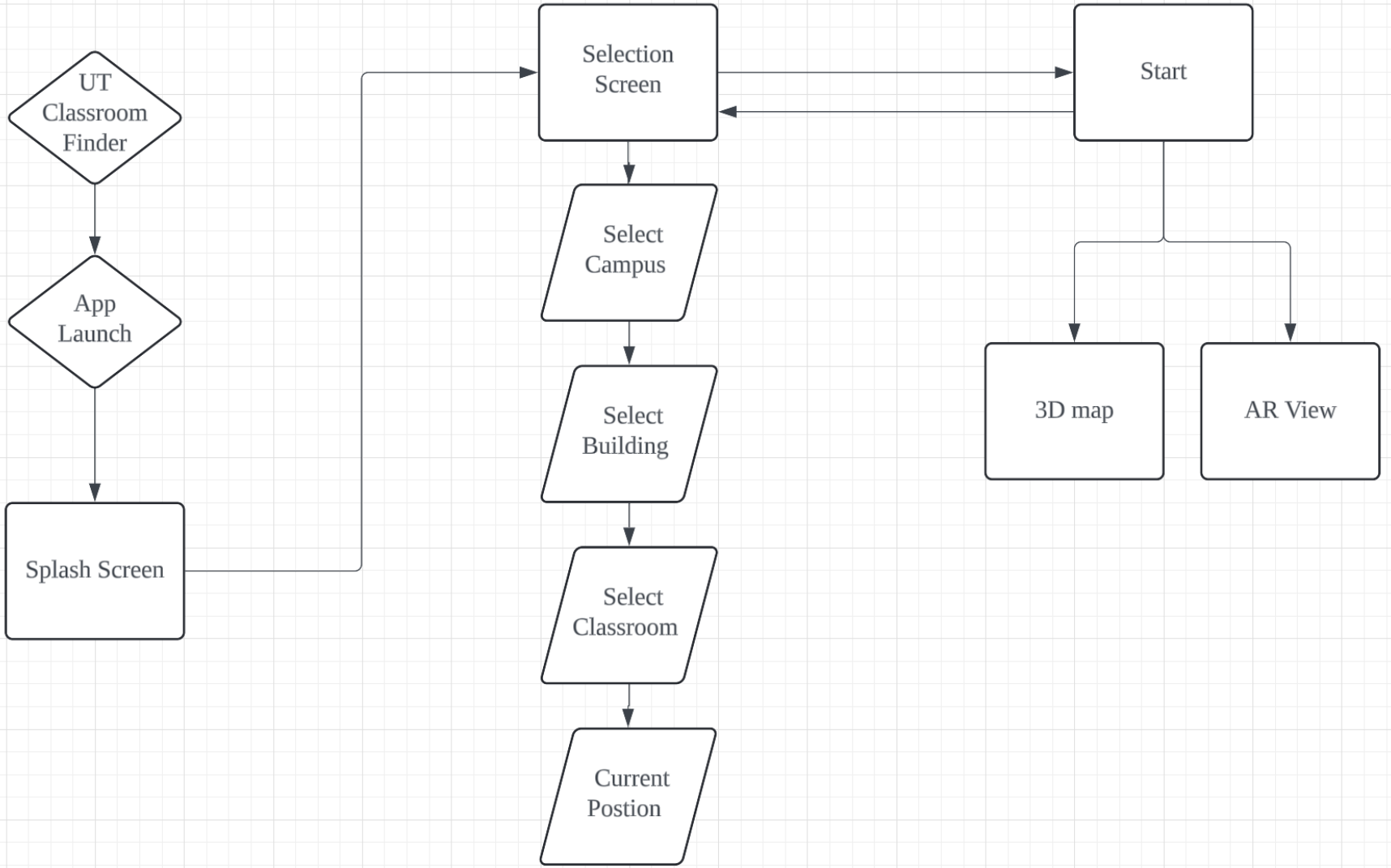
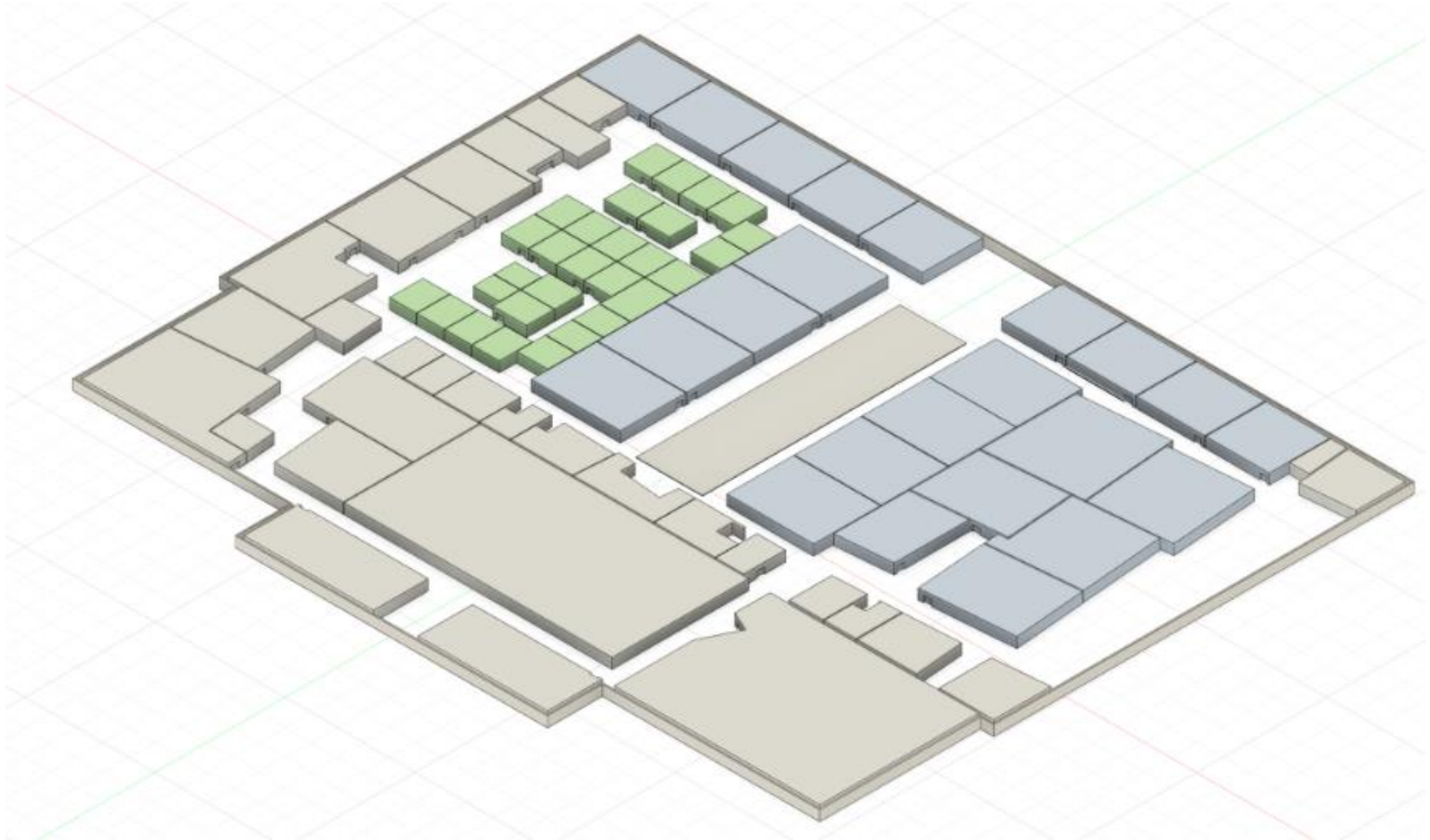
Flowchart



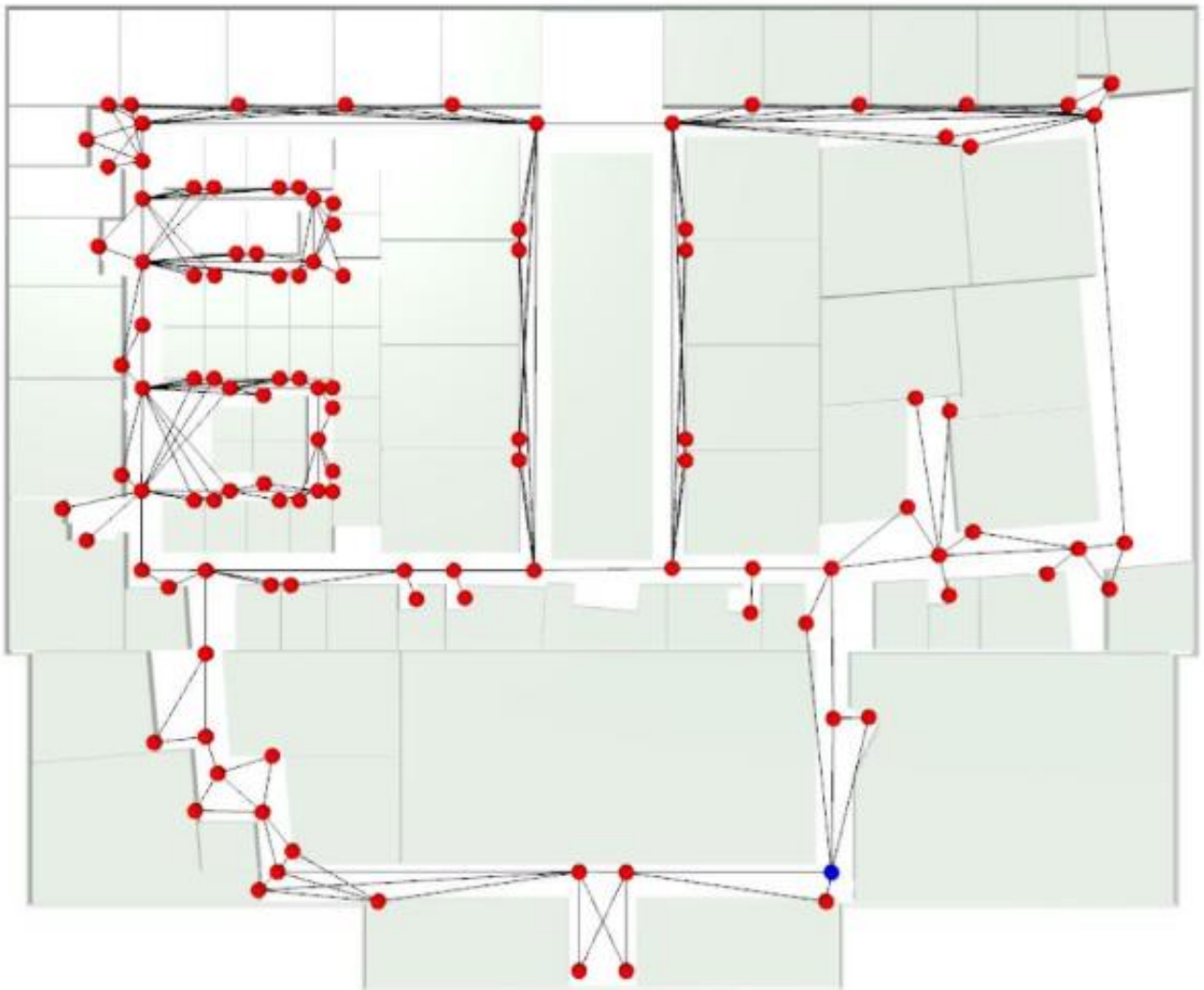
Application Process

1. Launch App
2. Select current position
3. Select destination
4. Generate route
5. AR Navigation
6. 3D Map view

3D Map Modeling

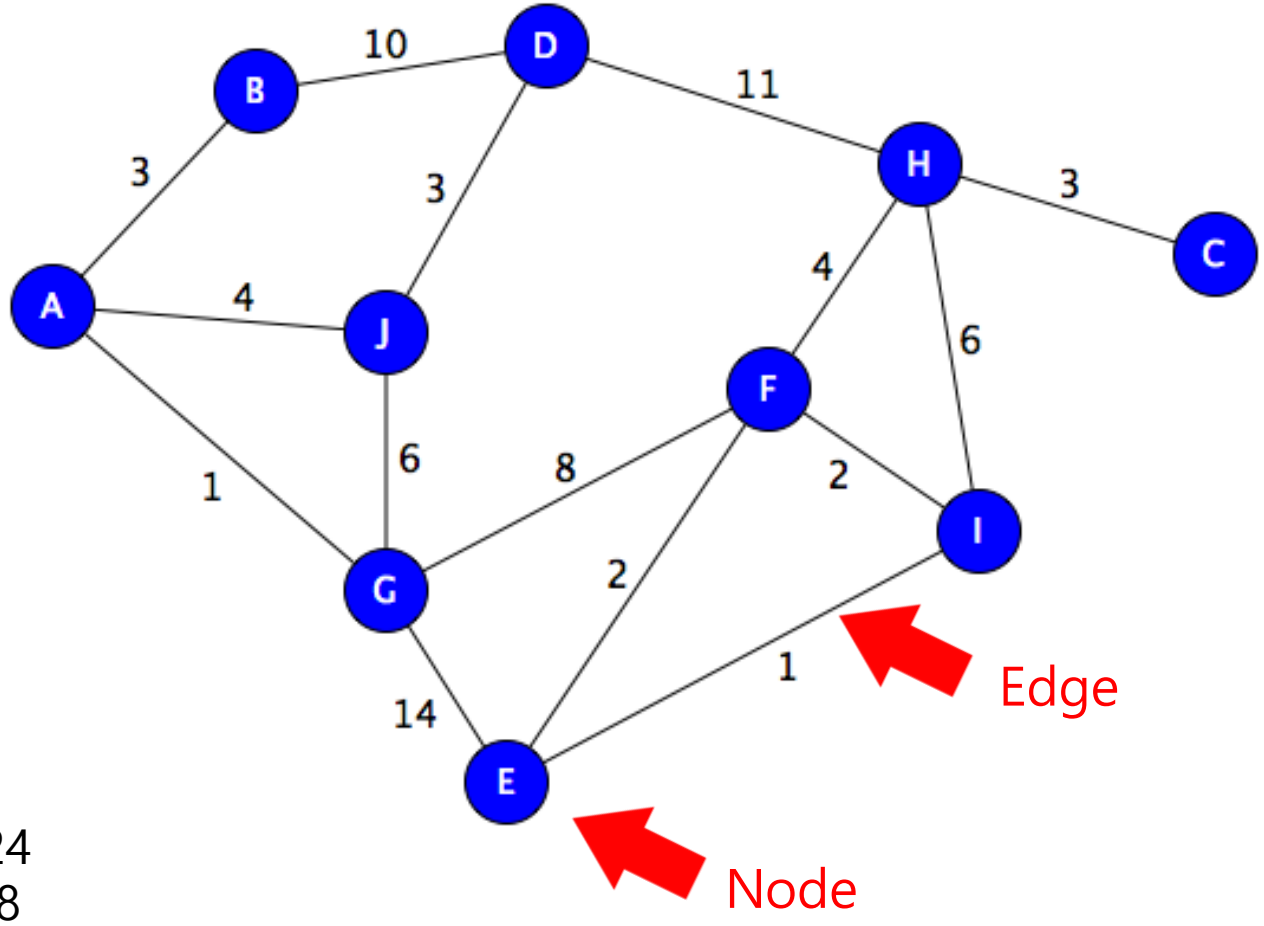


Creating nodes & edges



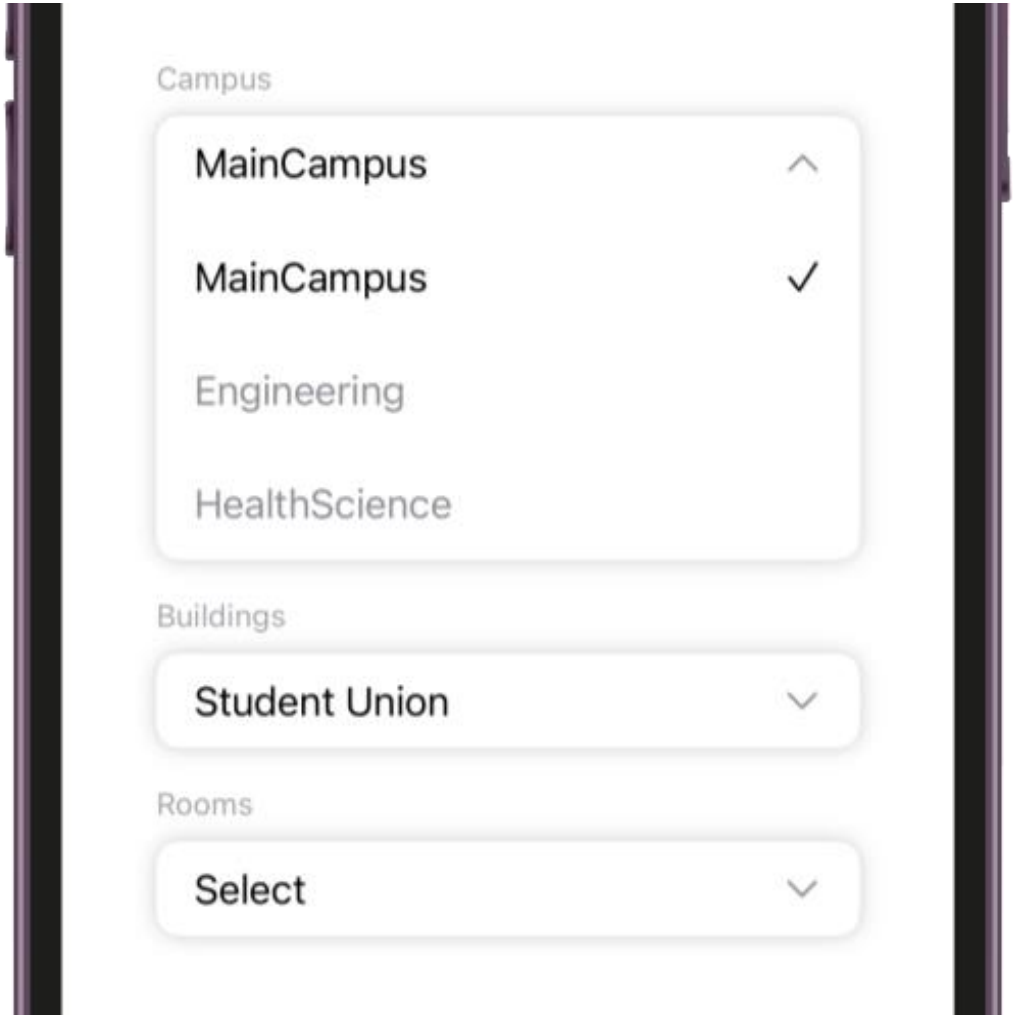
```
let FHnodes: [nodes] = [
    nodes(name: "Restroom 1020", x: 6.347, y: -0.383, z: 0.2),
    nodes(name: "Room 1030", x: 4.444, y: 1.549, z: 0.2),
    nodes(name: "Room 1040", x: 4.42, y: 1.806, z: 0.2),
    nodes(name: "Room 1050", x: 4.233, y: 1.972, z: 0.2),
    nodes(name: "Room 1060", x: 3.808, y: 0.485, z: 0.2),
    nodes(name: "Room 1080", x: 4.722, y: -2.114, z: 0.2),
    nodes(name: "Room 1090", x: 4.815, y: -3.15, z: 0.2),
    nodes(name: "Room 1100", x: 4.77, y: -4.238, z: 0.2),
    nodes(name: "Room 1110", x: 3.885, y: -2.486, z: 0.2),
    nodes(name: "Room 1120", x: 3.884, y: -3.00, z: 0.2),
    nodes(name: "Room 1140", x: 2.646, y: -4.584, z: 0.2),
    nodes(name: "Room 1150", x: 3.585, y: -0.54, z: 0.2),
    nodes(name: "Room 1180a", x: -0.869, y: -1.365, z: 0.2),
    nodes(name: "Room 1180b", x: 1.374, y: -1.365, z: 0.2),
    nodes(name: "Room 1190", x: -0.66, y: -0.72, z: 0.2),
    nodes(name: "Room 1200", x: 1.121, y: 1.355, z: 0.2),
    nodes(name: "Room 1210", x: 1.121, y: 1.613, z: 0.2),
    nodes(name: "Room 1220", x: 1.121, y: 3.977, z: 0.2),
    nodes(name: "Room 1230", x: 1.121, y: 4.23, z: 0.2),
    nodes(name: "Room 1240", x: -1.039, y: 4.234, z: 0.2),
    nodes(name: "Room 1250", x: -1.039, y: 3.976, z: 0.2),
    nodes(name: "Room 1260", x: -1.039, y: 1.613, z: 0.2),
    nodes(name: "Room 1270", x: -1.039, y: 1.362, z: 0.2),
    nodes(name: "Room 1280", x: -1.039, y: -0.772, z: 0.2),
    nodes(name: "Room 1290", x: -3.634, y: -0.591, z: 0.2),
    nodes(name: "Room 1295", x: -4.084, y: -0.588, z: 0.2),
    nodes(name: "Room 1300a", x: -0.588, y: -1.365, z: 0.2),
```

Implementation of Dijkstra's Algorithm



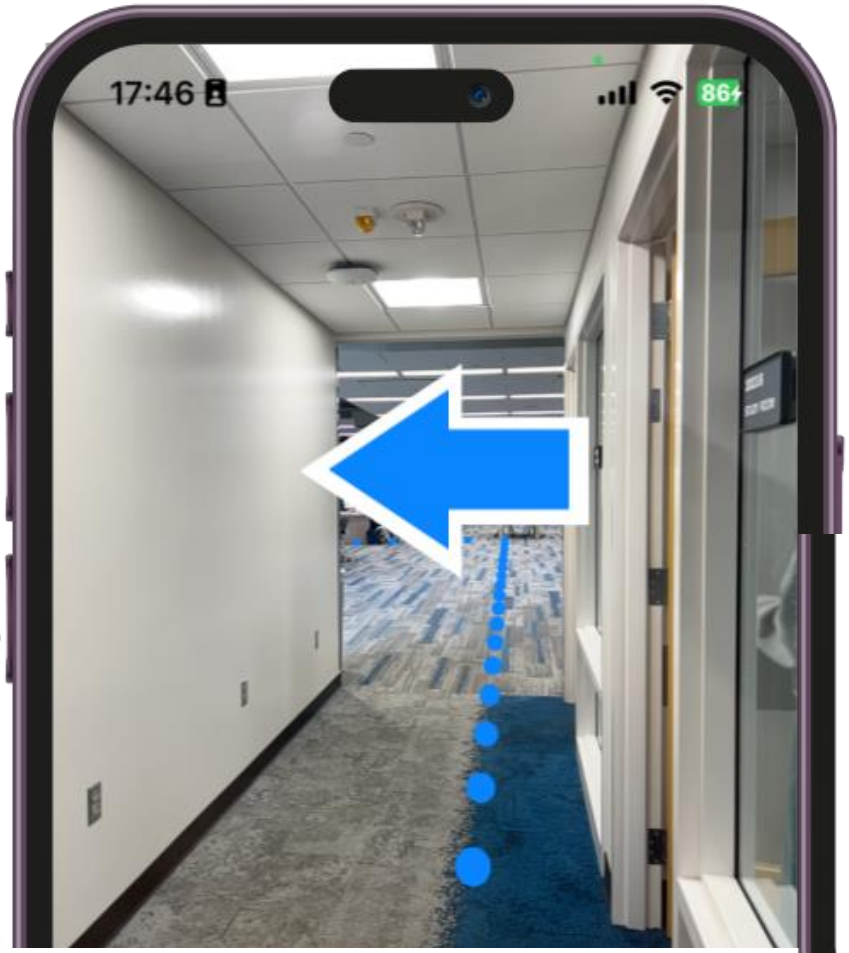
A -> B -> D -> H = 24
A -> J -> D -> H = 18
A -> G -> F -> H = 13 <- Shortest route!

Users input the current position & destination room #'s

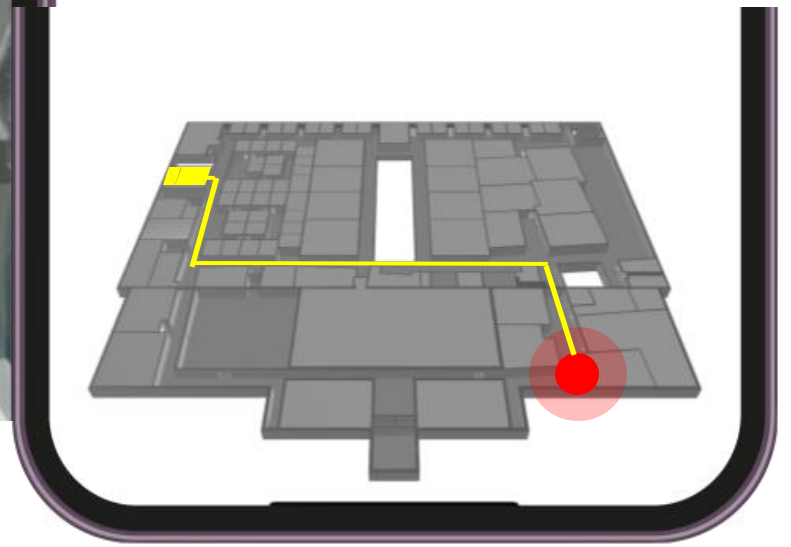


AR dots & an arrow

```
503
504     func addArrowNodeToScene() {
505         if self.arrowNode != nil { return }
506         guard let arrowNode = loadArrowModel() else { return }
507         arrowNode.name = "ArrowNode"
508         arView.scene.rootNode.addChildNode(arrowNode)
509         self.arrowNode = arrowNode
510     }
511
512     func updateArrowNodePosition() {
513         guard let arrowNode = self.arrowNode,
514               let currentNode = self.currentNode,
515               let pointOfView = arView.pointOfView else { return }
516
517         let cameraTransform = pointOfView.simdWorldTransform
518
519         let forward = simd_float3(-cameraTransform.columns.2.x,
520                                   -cameraTransform.columns.2.y,
521                                   -cameraTransform.columns.2.z)
522
523         let cameraPosition = simd_float3(cameraTransform.columns.3.x,
524                                          cameraTransform.columns.3.y,
525                                          cameraTransform.columns.3.z)
526
527         let arrowPosition = cameraPosition + forward * 0.2 + simd_float3(0, -0.1, 0)
528         arrowNode.simdPosition = arrowPosition
529
530         let lookAtConstraint = SCNLookAtConstraint(target: currentNode)
531         lookAtConstraint.isGimbalLockEnabled = true
532         lookAtConstraint.worldUp = SCNVector3(0, 1, 0)
533
534         lookAtConstraint.influenceFactor = 1.0 // only move y axis
535         arrowNode.constraints = [lookAtConstraint]
536
537         let currentEulerAngles = arrowNode.eulerAngles
538         arrowNode.eulerAngles = SCNVector3(0, currentEulerAngles.y, 0)
539     }
```



3D map



Expo Brochure

Expo Poster

Group A-06
UT Classroom Finder

Project Problem

Students find it **challenging to find their classrooms** at the beginning of each semester

Goal

Develop an AR-based **indoor navigation app** that leverages 3D virtual mapping and advanced algorithms **to guide users efficiently to their destinations within campus buildings.**

Project Solution

- User selects their initial and destination classroom numbers.
- **Dijkstra's Algorithm** calculates the **most efficient route**.
- The route is shown both in **AR and on a 3D map**.
- **A dotted line and arrow in the AR** view will guide users directly to their destinations.

Key Features

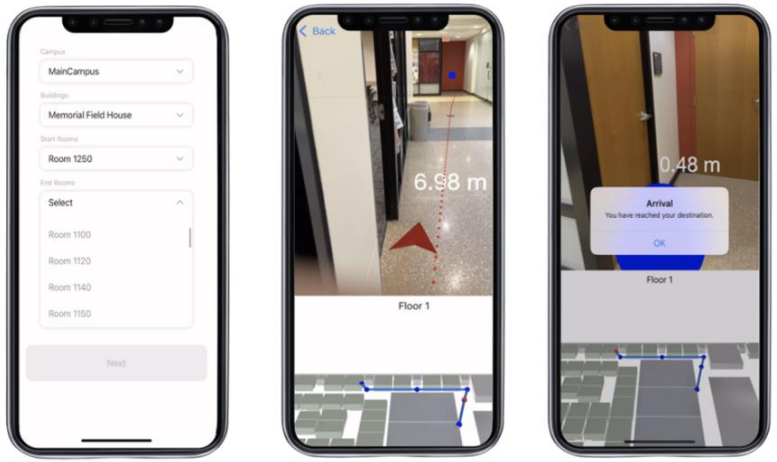
Augmented Reality Navigation
- Real-time guidance with a pointing arrow and AR components

Dijkstra's Algorithm for Pathfinding
- Efficient route calculation using algorithms for shortest-path navigation

3D Map Integration
- Enhanced visualization with 3D building models

3D Virtual Coordinate Mapping
- Location reliability through the pre-mapped node and edge coordinates

App Snippet



1. Select destination 2. Show the shortest route 3. Arrive!

Target

University of Toledo faculty and students finding their classrooms

Tools Used

Swift
- Programming language for building an iOS app

ARKit
- Apple's augmented reality(AR) framework

Xcode
- Integrated development environment to create iOS software

AutoDesk Fusion
- 3D modeling software for creating maps

Team Members

Sanghak Ryu (CSET)
Seungyoun Lee (CSET)
Seokhyun Hong (CSET)

Faculty Advisor

Dr. Hong Wang

Gantt Chart

	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8	Week 9	Week 10	Week 11	Week 12	Week 13	Week 14	Week 15
	8/26 - 8/30	9/2 - 9/6	9/9 - 9/13	9/16 - 9/20	9/23 - 9/27	9/30 - 10/4	10/7 - 10/11	10/14 - 10/18	10/21 - 10/25	10/28 - 11/1	11/4 - 11/8	11/11 - 11/15	11/18 - 11/22	11/25 - 11/29	12/2 - 12/6
Project Management															
Team Formation															
Advisor Selection															
Project Selection															
Topic Proposal															
Topic Memo															
Proposal Presentation															
Final Report															
Brochure Creation															
Faculty Evaluation															
Senior Desgin Expo															
Application Development															
Research Implementation Options															
Logo Creation															
App Development															
Create 3D Map of the Building															
Place Nodes and Edges on the Map															
Display Arrow on AR for Direction															
Develop Shortest Path Algorithm															
Product Testing															