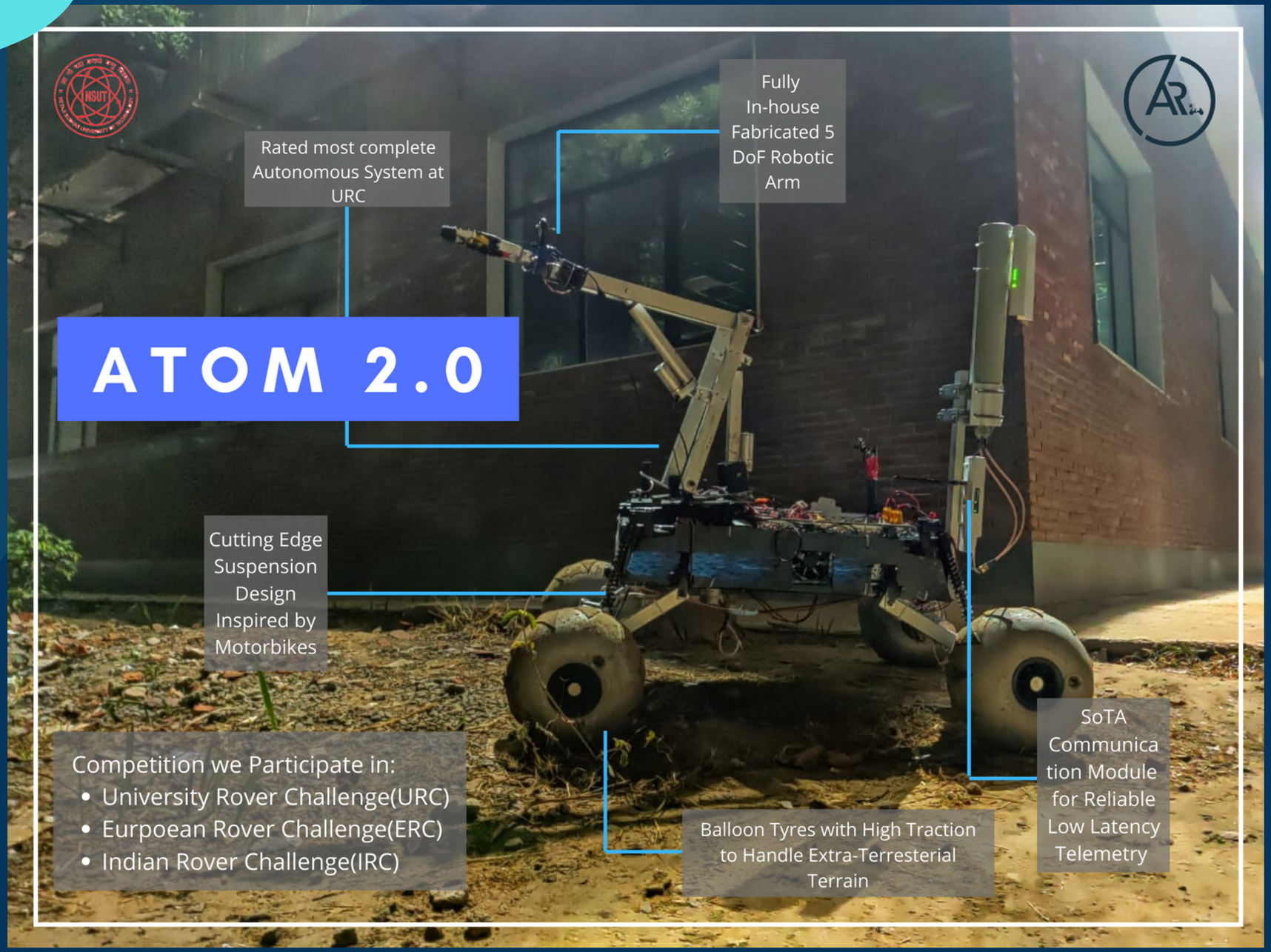
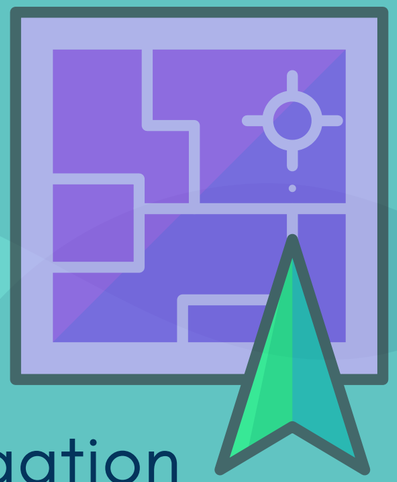
INDOOR NAVIGATION SYSTEM

PROBLEM STATEMENT NUMBER CK139

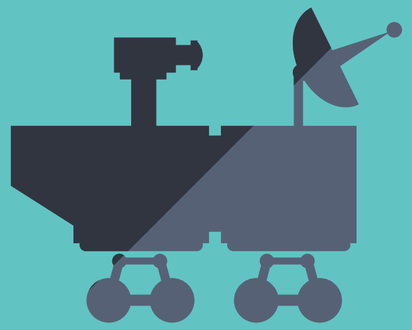
TEAM NAME: ARES101

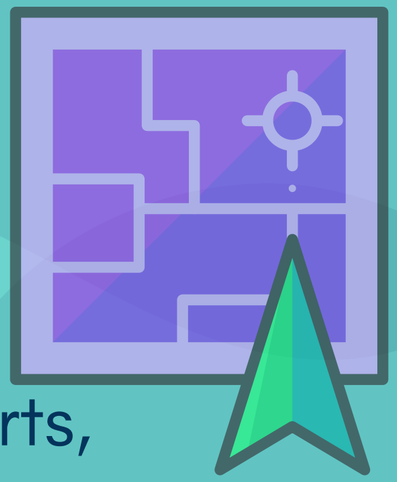

Rated most complete Autonomous System at URC
Fully In-house Fabricated 5 DoF Robotic Arm
ATOM 2.0
Cutting Edge Suspension Design Inspired by Motorbikes
Competition we Participate in:
• University Rover Challenge(URC)
• Eurpoean Rover Challenge(ERC)
• Indian Rover Challenge(IRC)
Balloon Tyres with High Traction to Handle Extra-Terresterial Terrain
SoTA Communication Module for Reliable Low Latency Telemetry



PROBLEM

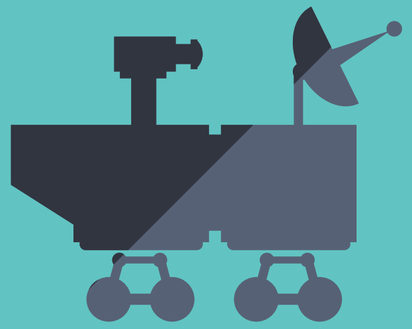
- Many navigation apps like Google map available for navigation
- None of them support navigation
- Challenge is to create an app that would show a navigation path in the real world on your mobile device screen.





PROBLEM SCOPE

- Provides solution for millions of passengers who visit Airports, Railway Stations etc.
- Allows easy navigation through terminals with minimal infrastructure requirement
- Will facilitate navigation through complexes such as passport offices and malls.



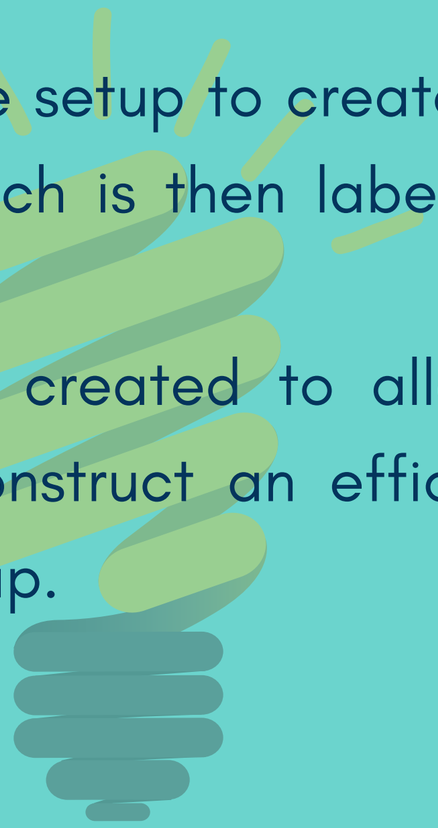
MARKET SIZE

There are a lot of place which require an indoor navigation system like Hospitals, Airports, Schools, Universities, Malls etc.

OUR APPROACH

- **Two Parts to our solution**:

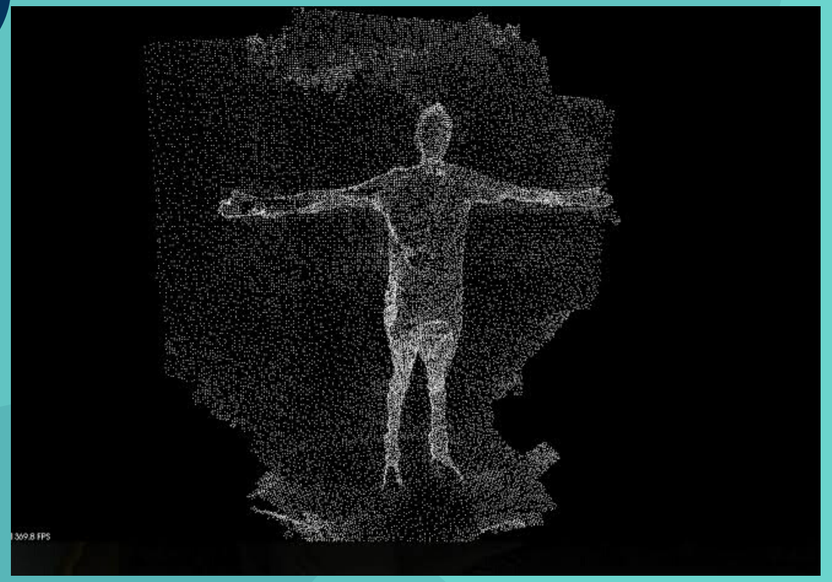
1. **Mapping**: We use our hardware setup to create a 3D Point Cloud Map of the facility to be navigated which is then labelled to identify the various structures in the building.
2. **Localisation:** A mobile app is created to allow users to localize their position in the 3D Map and construct an efficient path to any labelled destination in the Point Cloud Map.



REALSENSE D435I AND T265 CAMERA

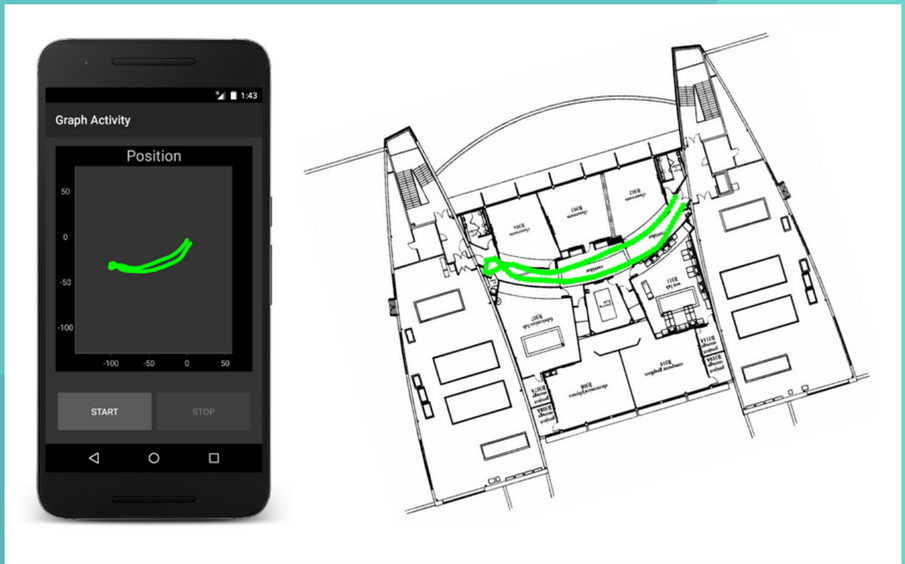
- Intel RealSense D435i RGB-D Camera outputs image with color and depth information.
- Intel RealSense Tracking camera T265 is used to get the IMU information.
- Information from both cameras fused to get the 3D map of the building.
- 3D Map labelled to identify lifts, rooms, floors etc.

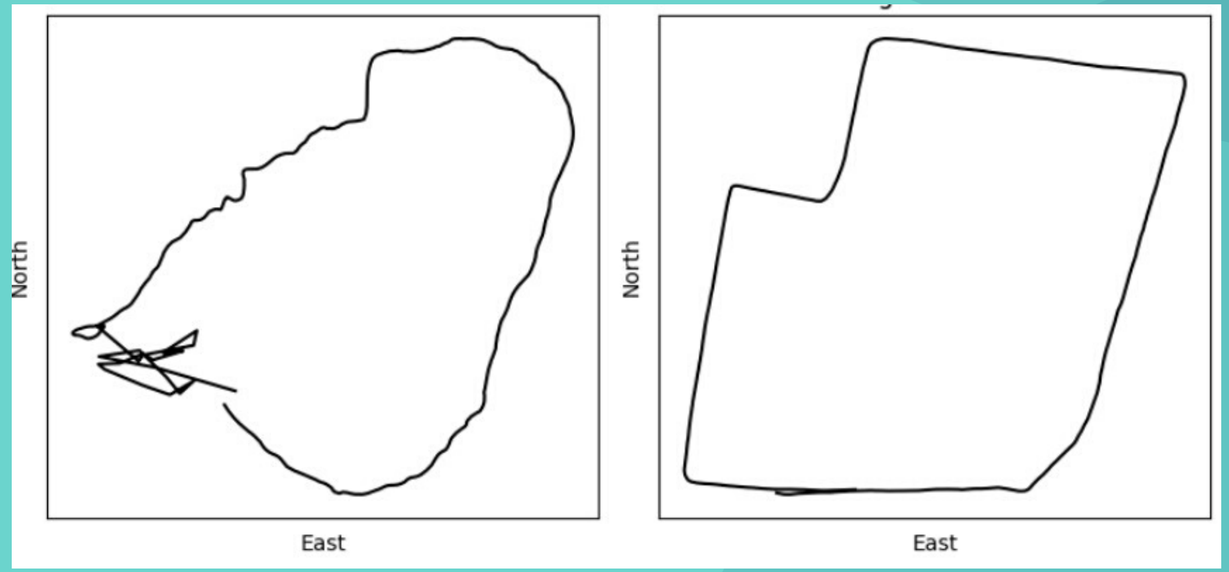
POINT CLOUD MAPPING



- Real-Time Appearance-Based Mapping software package for 3D mapping with RGB-D Cameras.
- Point Cloud sectioned with labels - added manually and automatically via AI
- User's localized position on the 3D Map used to navigate to desired destination of choice.

MOBILE LOCALISATION





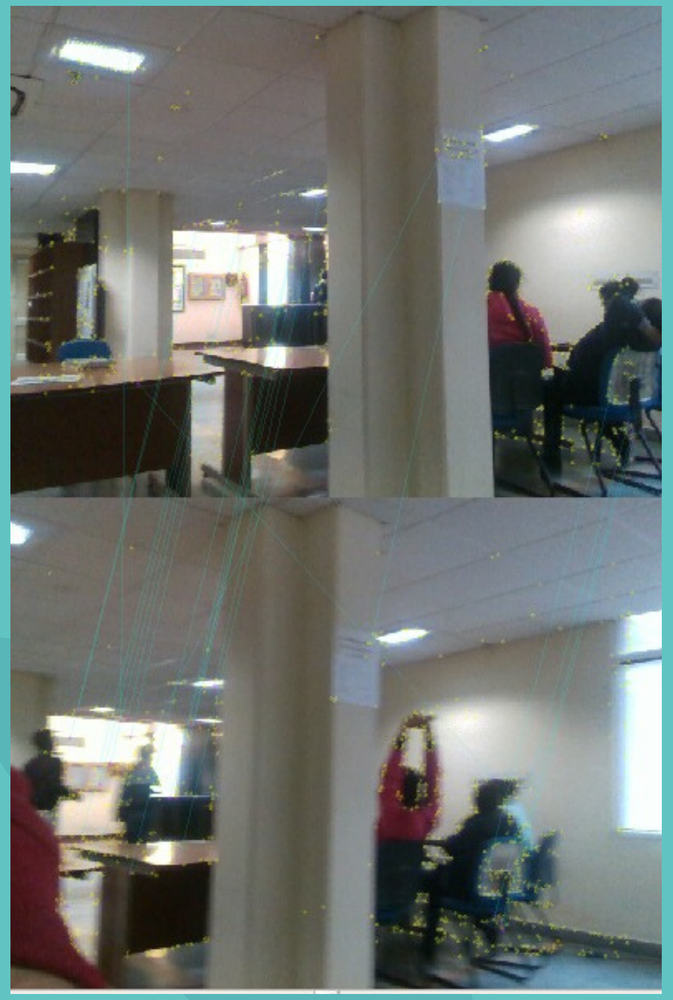
- App allows users to independently navigate through the building.
- Uses a combination of Odometry sensors available in most smartphones.
- Determines initial position of the user by analyzing magnetic field and gravity data.
- The change in heading and distance travelled define a position vector which is applied to the last recorded location to calculate the current location.

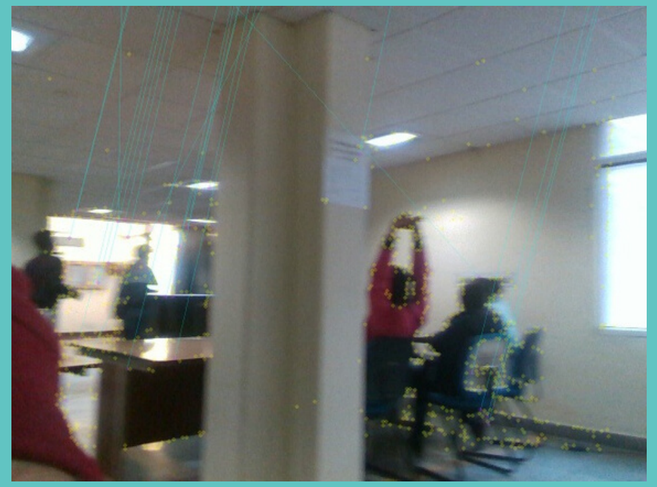
PROOF OF CONCEPT

- Demonstration done by mapping the ground floor of University Library.

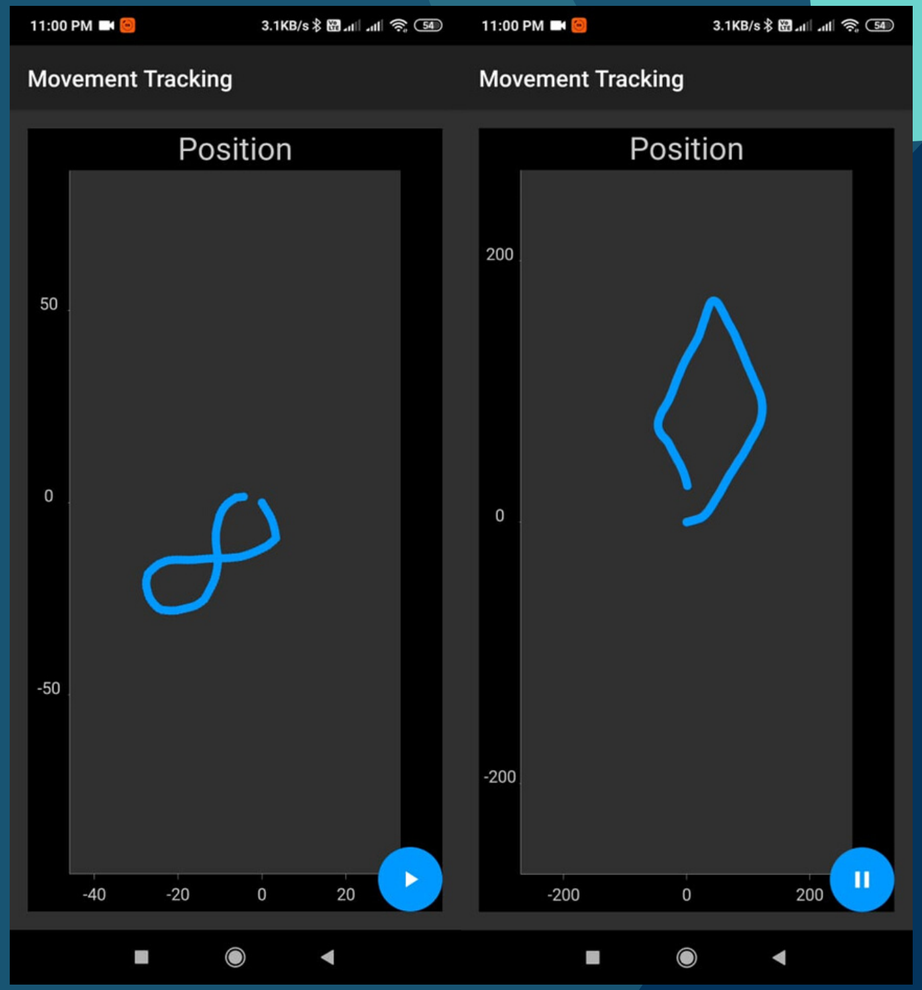
1. **Point Cloud Formation:** Various sections of Library Ground Floor were mapped using our **RGB-D** camera setup.

2. **Compilation and 2D Projection:** The different Point Cloud Maps were labelled to identify structures such as lifts, lobby etc. Finally the separate maps were merged and compiled into a 2D map of the library.





3. **Mobile Localisation & Tracking:** Android app was tested by making a person move through the facility and verifying that his movement was tracked by the smartphone with high accuracy and precision (within 30cm).



IS OUR IDEAPATENTABLE?

- Other Indoor navigation solutions use bluetooth beacons or wifi to calculate the current location of the person inside the building.
- We are using IMU data to find the location of the user. The IMU data is a combination of a number of sensors availabe in modern day smartphones like gyroscope, magnetometer, Accelerometer and Proximity sensor.
- We are using depth and tracking cameras to map a building which then is converted into an octomap.
- With the map built using the cameras and the sensors in the smartphone we get the location of a person inside the building.