

Meeting Materials for QDrone Project Regular Internal Meeting



Regular Internal Meeting for QDrone Project

Jan 7 2019
4PM at PSE 312

Participant: Jungwon Kang, Zahra Arjmandi, Kunwoo Park

Prerequisites for Pursuing Project

☐ Software

- Matlab
- C++
- Ubuntu
- ROS

☐ Theory (for backend: state estimation from sensor measurement)

- EKF
- MSCKF
- Smoothing

☐ Sensor

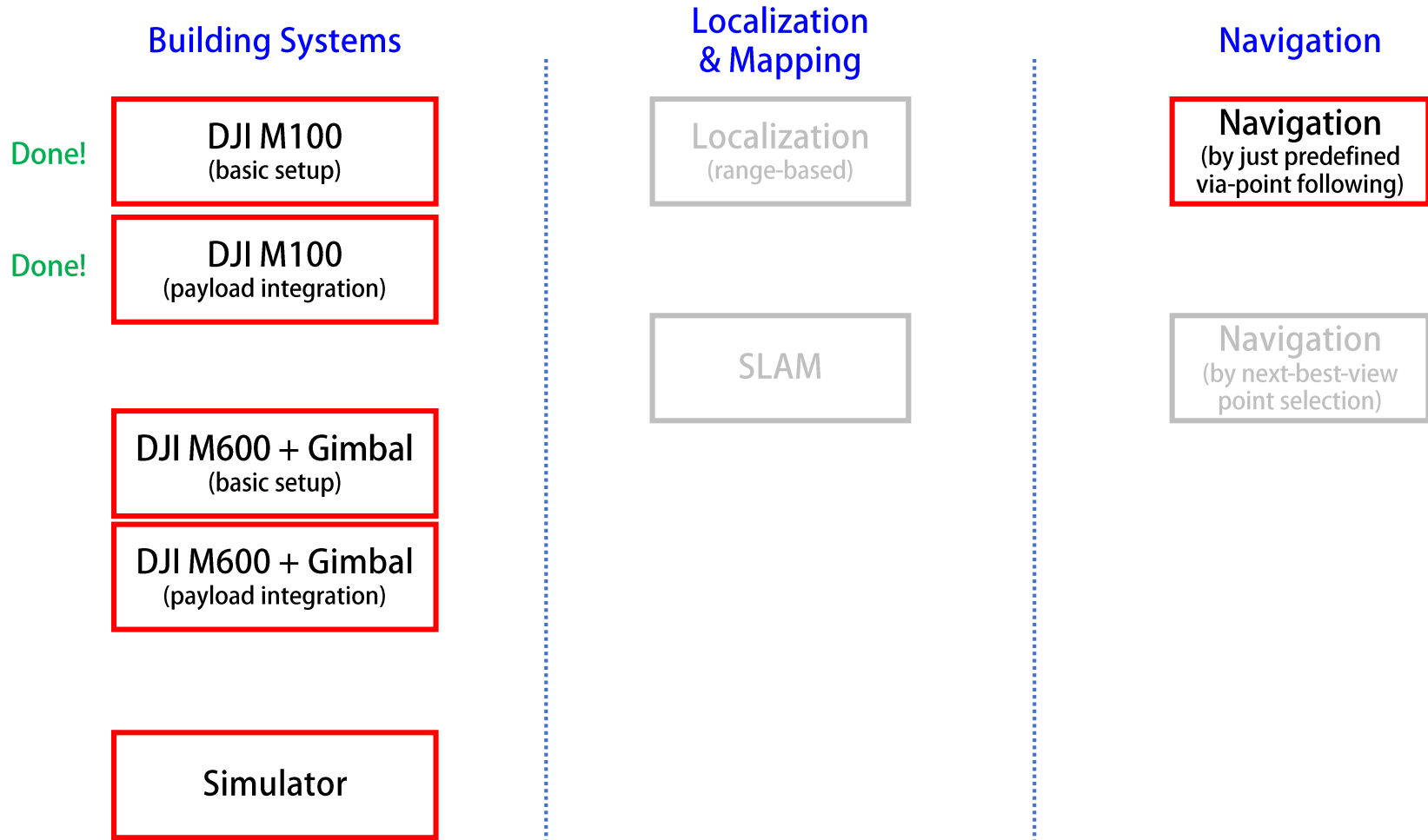
- GPS
- IMU
- Camera
- LiDAR

Tasks

- ☐ Task 0: Building Systems
- ☐ Task 1: Localization
- ☐ Task 2: SLAM
- ☐ Task 3: Navigation

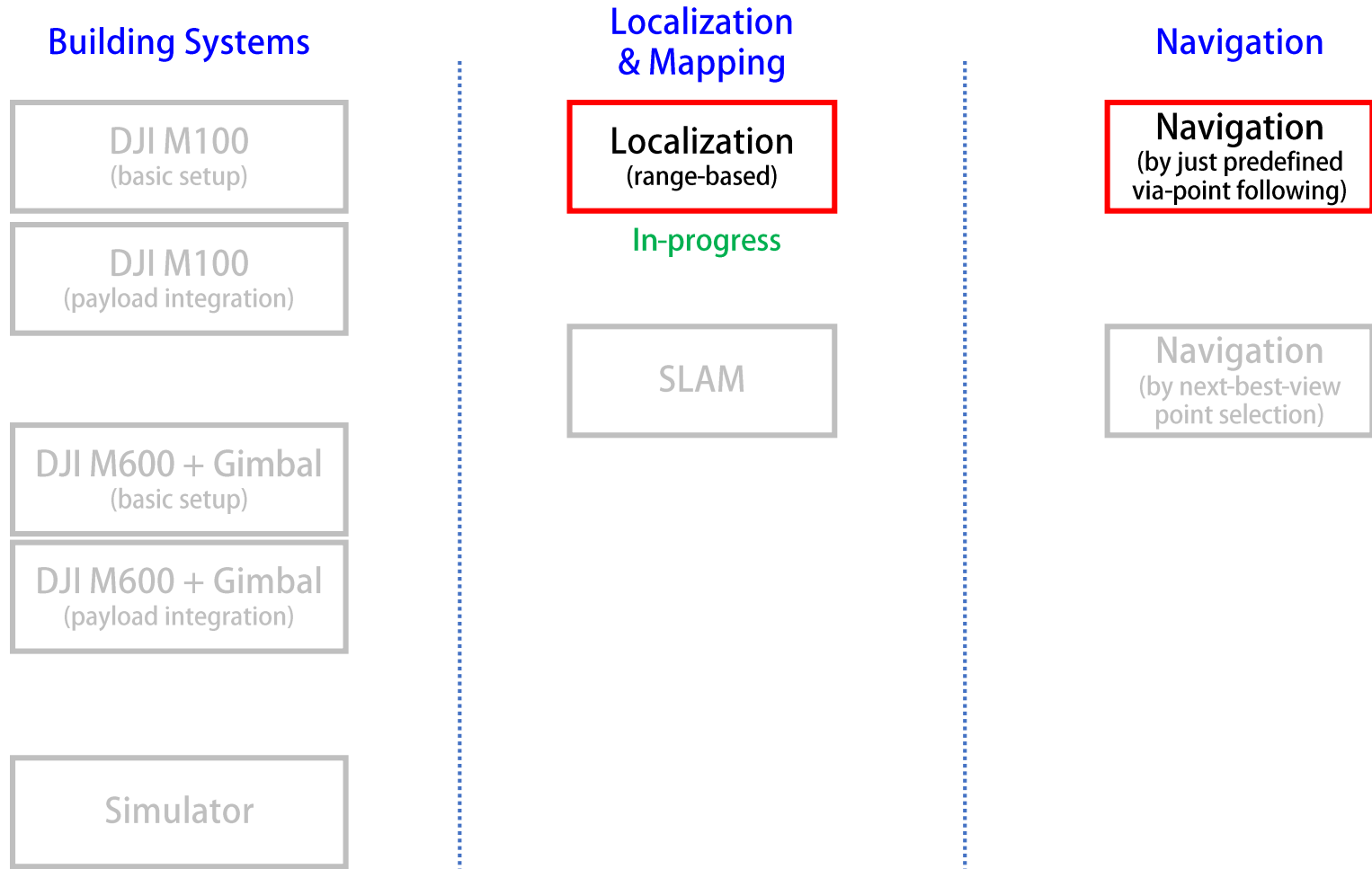
Task 0: Building Systems

❑ Building Complete Systems



Task 1: Localization

❑ Following Predefined Via-Points



Task 2: SLAM

❑ Building a Map

Building Systems

DJI M100
(basic setup)

DJI M100
(payload integration)

DJI M600 + Gimbal
(basic setup)

DJI M600 + Gimbal
(payload integration)

Simulator

Localization & Mapping

Localization
(range-based)

SLAM

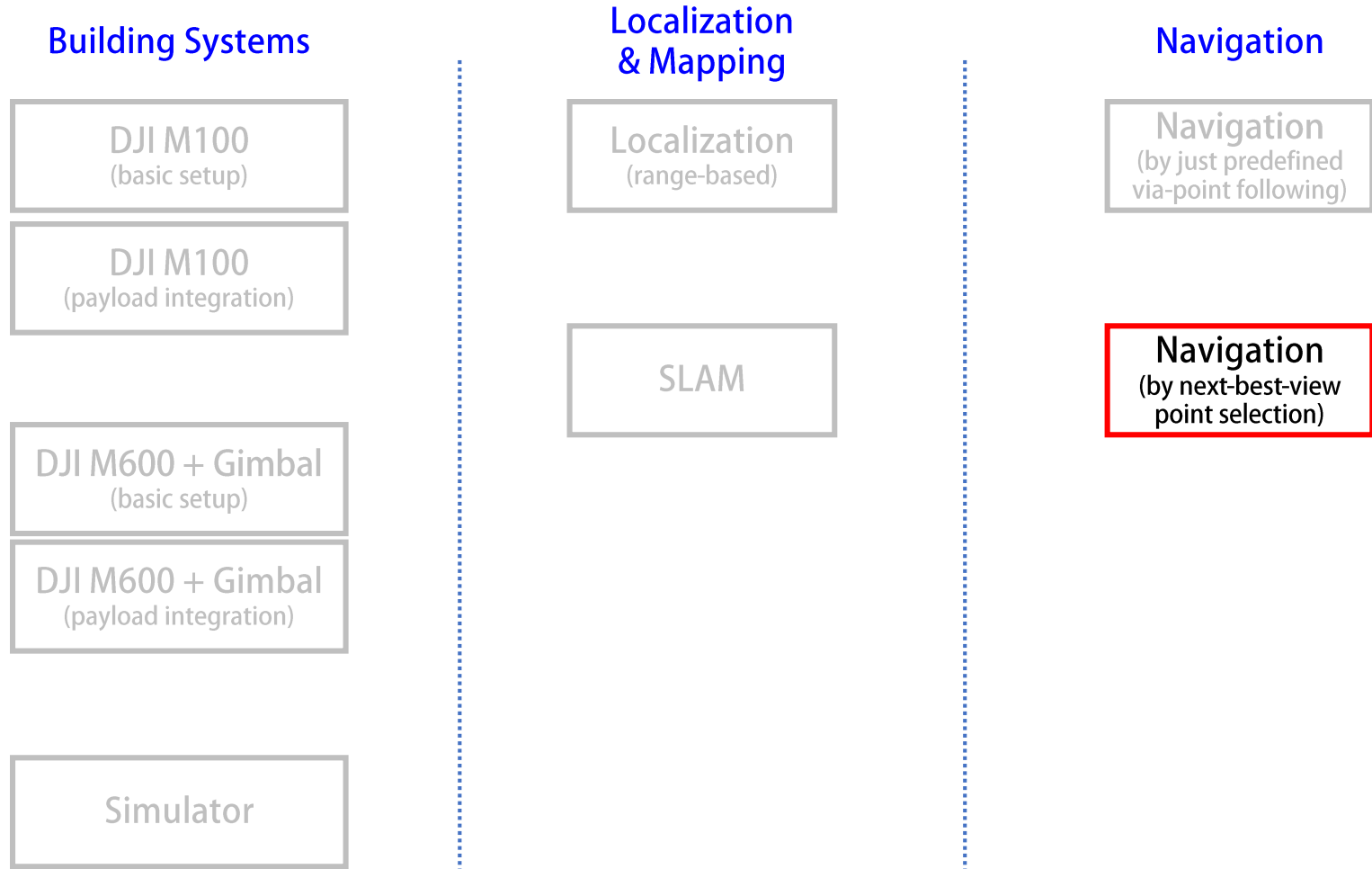
Navigation

Navigation
(by just predefined
via-point following)

Navigation
(by next-best-view
point selection)

Task 3: Navigation

❑ Building a Map by Next-Best-View Point Selection



Meeting Results: What to do

❑ Common

- Basic setup for 'DJI M600 + Gimbal' (primarily by Zahra & Kunwoo)
- Booking a PSE 4th floor room equipped with motion capture systems

❑ Zahra

- Understanding Kunwoo's EKF-based UWB localization code (including EKF)

❑ Kunwoo

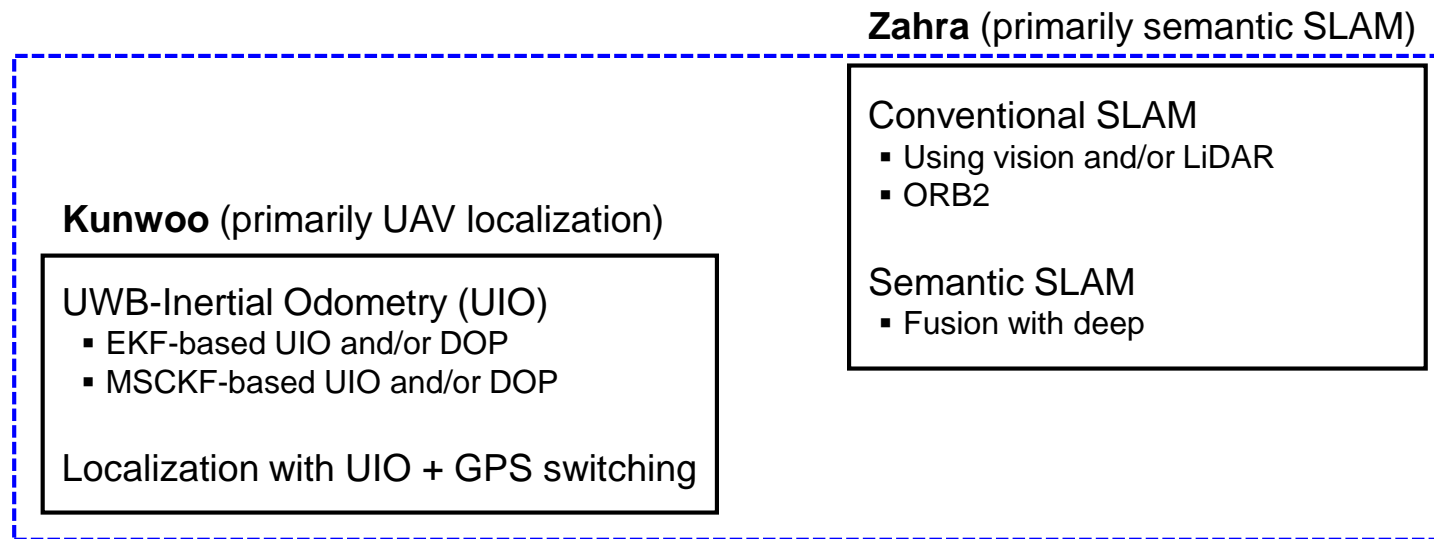
- Sending thesis and experiment plan to prof. Sohn
- Writing a paper for ISPRS Geospatial Week 2019

❑ Jungwon

- Writing a paper for IROS 2019

Future Plan

□ Jungwon's Rough Suggestion for Future Plan



Jungwon: supports Kunwoo & Zahra mainly in technical issues.



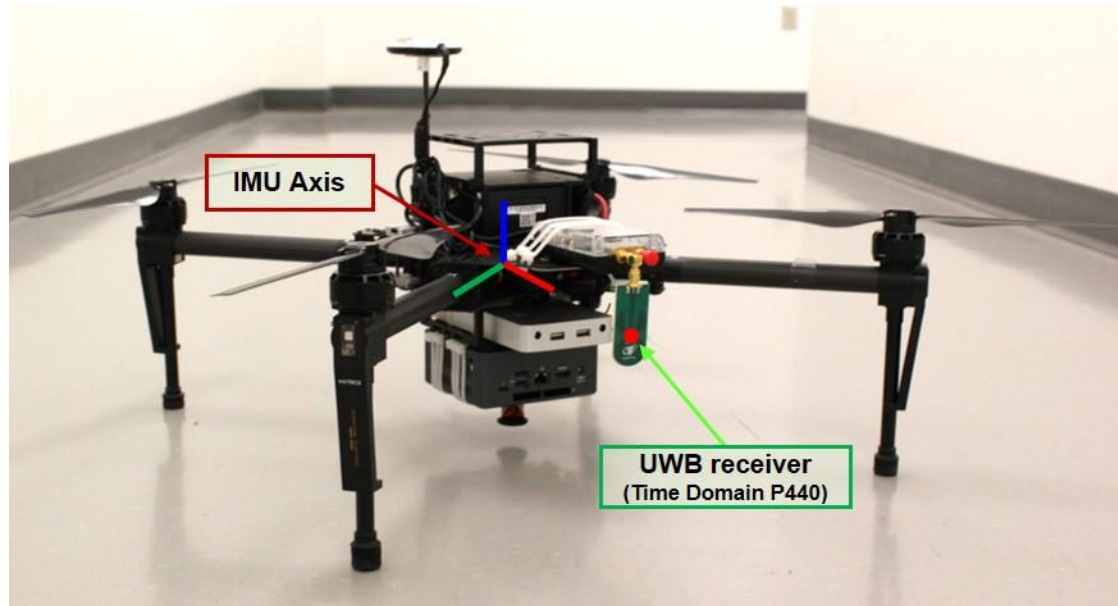
IMU Calibration Problem

Jan 24 2019

Participant: Jungwon Kang, Zahra Arjmandi, Kunwoo Park, Yujia Zhang

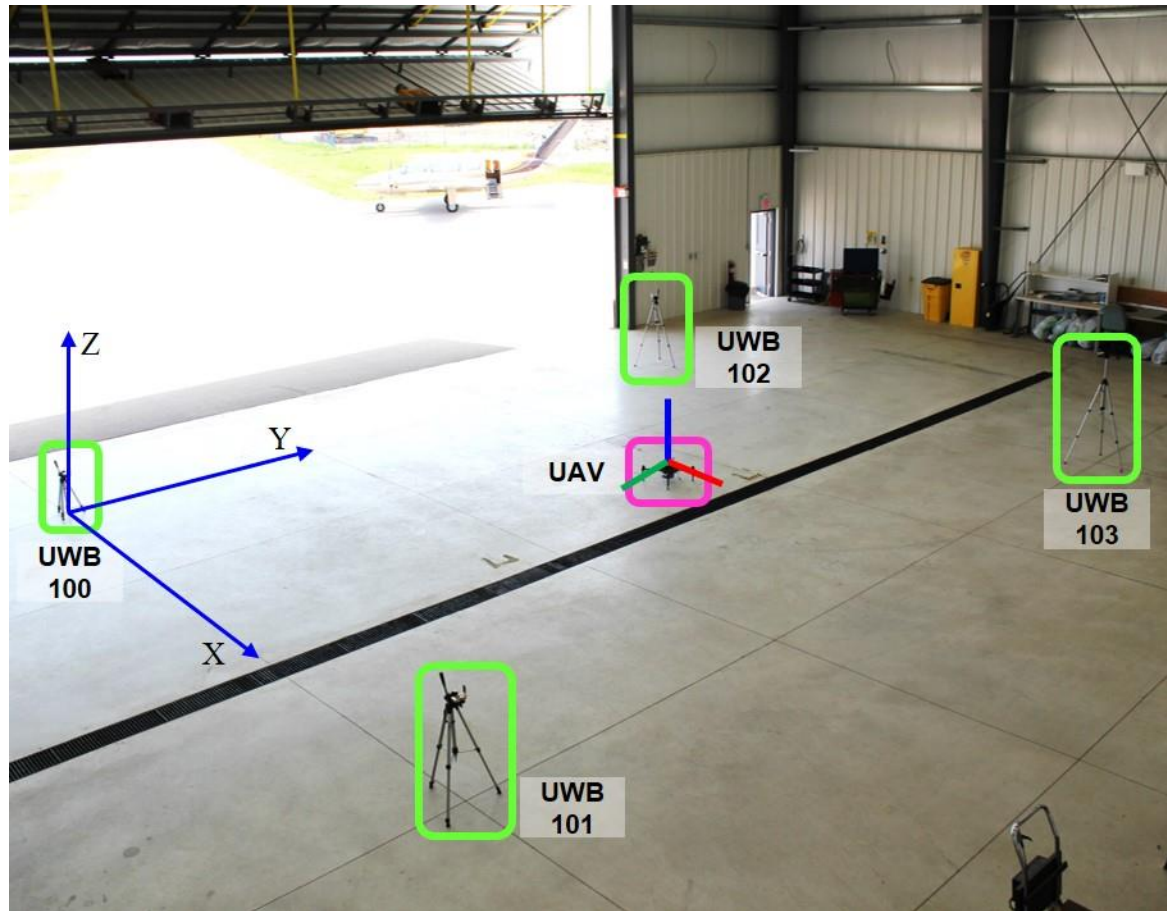
Problem 1

□ Where is the UWB receiver wrt IMU axis?



Problem 2

□ What is the initial R , T between UWB axis and IMU axis?





Plan for Year 2019

Feb 5 2019

Participant: Jungwon Kang, Zahra Arjmandi, Kunwoo Park

Plan for Year 2019

| | | Month | | | | | | | | | | | |
|------------------------|----------------------------|-------------------|------|---|---|---|---|---|---|---|----|----|----|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| Building System | Payload purchase | | | | | | | | | | | | |
| | Testing of M600 & Ronin-MX | | | | | | | | | | | | |
| | Individual test of payload | | | | | | | | | | | | |
| | Payload integration | | | | | | | | | | | | |
| UWB-aided localization | Kunwoo's Kalman filter | EKF / MSCKF / DOP | | | | | | | | | | | |
| | Jungwon's Smoothing | | IROS | | | | | | | | | | |
| Demo | Path following | | | | | | | | | | | | |
| SLAM | Semantic SLAM | | | | | | | | | | | | |

Payload

- Positioning sensor: Pozyx / Spatial / DJI-RTK
- Imaging sensor: ZED stereo / FLIR Duo R / Sony A7III
- Velodyne LiDARs: Puck LITE / Puck Hi-Res / HDL-32E



Current Progress & To do next

Mar 10 2019

Jungwon Kang

Current Progress & To Do Next

| Subject | Detailed Task | Current Progress | To Do Next |
|-----------------------|--|--|---|
| System building | Payload purchase | <ul style="list-style-type: none"> Received Velodyne Puck Lite & Hi-Res | <ul style="list-style-type: none"> Receiving the rest of ordered items (All items are listed at the bottom of page.) Need to buy a cabinet with lockers Making a list of items |
| | Testing M600 & Ronin-MX | <ul style="list-style-type: none"> Tested Ronin-MX Not tested M600 due to a broken battery The broken battery (TB48S) was delivered to the OmniView tech. | <ul style="list-style-type: none"> Need to order extra TB48S batteries. (Need \$2000 for six TB48S) |
| | Test of each payload | None | |
| | Payload integration | None | |
| Dataset release | UWB-IMU dataset generation & release | None | <ul style="list-style-type: none"> Need to do experiments Need to release the dataset to the public Need to submit a paper about the dataset |
| Localization solution | UWB multilateration-based localization | <ul style="list-style-type: none"> Implemented an initial version of multilateration in C++ | <ul style="list-style-type: none"> Need to implement LM non-linear optimization in C++ |
| | UWB-EKF-based localization | <ul style="list-style-type: none"> Implemented in MATLAB (by Kunwoo) | <ul style="list-style-type: none"> Need to implement in C++ Need to write a thesis draft by Kunwoo |
| | UWB-Smoothing-based localization | <ul style="list-style-type: none"> Implemented in MATLAB (by Jungwon) Submitted IROS paper | <ul style="list-style-type: none"> Need to implement in C++ |
| Navigation solution | Coverage path planning | <ul style="list-style-type: none"> Implemented in MATLAB (by Zahra) | |
| | Implementing in real systems | None | <ul style="list-style-type: none"> Need to implement in M100 & M600 |

Payload

- Positioning sensor: Pozyx / Spatial / DJI-RTK
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Current Tasks

Task 1. Testing & Labeling of Items

Task 2. Implementation of Waypoint Following

April 11 2019

Jungwon Kang

Task 1. Testing & Labeling of Items

Item List (Apr 11 2019)

| Type | Item Name | Components | Delivery State | Testing State |
|------------|----------------------|---|-------------------|----------------|
| Drone | DJI M600 Set | M600 body / Ronin-MX Gimbal / 2 RC / Batteries / RTK-GPS | | Partially done |
| Drone | DJI M100 Set | M100 body / RC / Propellars / Batteries / A3 FC / Lightbridge | | Partially done |
| Drone | DJI Mavic Air Set | | | Done |
| IMU | Spatial | | Not delivered yet | Not done yet |
| UWB | TimeDomain | 5 UWB modules / 5 Batteries | | Done |
| UWB | Pozyx | | Not delivered yet | Not done yet |
| LiDAR | GeoSLAM | Scanner / Data logger / Dongle USB | | Done |
| LiDAR | Velodyne Puck LITE | | | Not done yet |
| LiDAR | Velodyne Puck Hi-Res | | | Not done yet |
| LiDAR | Velodyne HDL-32E | | | Not done yet |
| Camera | Sony A7III | | Not delivered yet | Not done yet |
| Camera | FLIR Duo R | | Not delivered yet | Not done yet |
| Camera | ZED stereo | | Not delivered yet | Not done yet |
| Camera | RealSense Depth | | | Not done yet |
| Computer | Intel NUC1 | | | Done |
| Computer | Intel NUC2 | | | Done |
| Computer | NVIDIA TX2 | | | Not done yet |
| Sub-device | Wifi router | | | Done |
| Sub-device | Laser distance | | | Done |
| Battery | Large1 | | | Done |
| Battery | Large2 | | | Done |
| Battery | Payload silver | | | Done |
| Solid | Tripod | | | Done |
| Solid | Chair | | | Done |
| Solid | Table | | | Done |

Task 2. Implementation of Waypoint Following

Implementation of Waypoint Following (1/4)

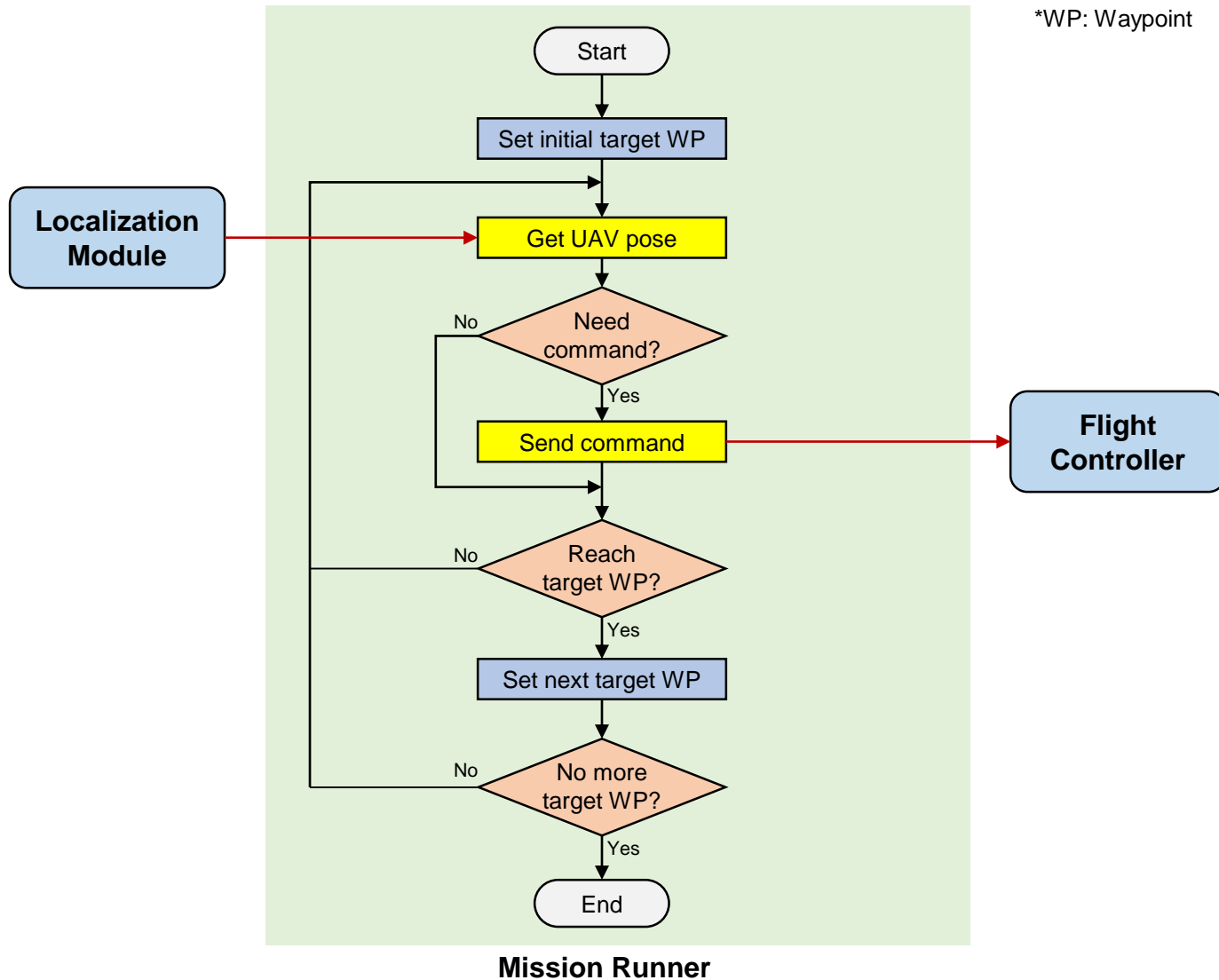
❑ Objectives

Implementation of waypoint following, where the waypoints are given by users in advance.



Implementation of Waypoint Following (2/4)

□ Procedure for Waypoint Following



Implementation of Waypoint Following (3/4)

□ Plan

| Category | Task | Week 1 | Week 2 | Week 3 | Week 4 |
|------------------------|---|--------|--------|--------|--------|
| UWB | Implementing outlier removal in C++/ROS | | | | |
| UWB-aided Localization | Non-linear optimization in C++/ROS | | | | |
| | Validation using Oshawa dataset | | | | |
| | Validation by real experiment | | | | |
| Mission Runner | Implementing mission runner in C++/ROS | | | | |
| | Validation by simulation | | | | |
| | Validation by real experiment | | | | |

Implementation of Waypoint Following (4/4)

□ References

- DJI official1 - void Control::positionAndYawCtrl(float32_t x, float32_t y, float32_t z, float32_t yaw)
<https://developer.dji.com/onboard-api-reference/index.html>
https://developer.dji.com/onboard-api-reference/classDJI_1_1OSDK_1_1Control.html#a6ed4bc74691c3e4fb0d5b30bcb67d6f5
- DJI official2
<https://developer.dji.com/onboard-sdk/documentation/guides/component-guide-missions.html>
<https://developer.dji.com/onboard-sdk/documentation/sample-doc/missions.html#output>
- DJI Matrice100 control and waypoints following
<https://youtu.be/kBwdWXCKFFI>
- Stand-alone waypoint navigator
https://github.com/ethz-asl/waypoint_navigator
- Interface of DJI autopilot based on its OSDK (3.2)
https://github.com/ethz-asl/dji_onboard_sdk_ros/wiki/Waypoint-Following
- Building your own DJI M100 drone
<https://discourse.ros.org/t/building-your-own-dji-m100-drone/1272>



Current Work Thread of QDrone Team

April 1 2019

Jungwon Kang

List of Work Thread

| |
|--|
| Building a mapping system |
| Building UWB-IMU dataset |
| Multilateration-based localization (by Zahra) |
| Graph-based UWB-IMU localization (by Jungwon) |
| EKF-based UWB-IMU localization (by Kunwoo) |
| Predefined path following using UWB-based localization |
| MTO project? |



Meeting Minutes

Oct 8 2019

Jungwon, Zahra, Kunwoo, Prof. Gunho Sohn

Minutes 1

□ Paper Writing

- Multilateration & EKF (led by Kunwoo)
 - Should finish by the end of Oct 2019
 - MDPI Journal of Drone

- Q-Drone benchmark data (led by Zahra)
 - Should finish by the end of Nov 2019
 - Would release a first draft on Oct 17 (Thurs)

- Pose graph for Q-Drone positioning
 - Should finish by the end of Dec 2019

Minutes 2

☐ Tasks

- Building a payload system
 - By cooperating with Patrick
 - Having a meeting with Patrick on Oct 10 (Thurs)?
- Demonstrating way-point following
- Purchasing items
 - Batteries for M600 (from ADERSIM account)
- Preparing Aug (Niagara / Oshawa) dataset
 - Writing MTO report