캡스톤 디자인

- Path Planning

9th Week Progress

A6 Blue

2022/10/25

Path Planning

Search-based
- Dijkstra
- A* - Dijkstra + heuristic cost
- D* - Dynamic A*

Sampling-based
- RRT - Random Tree
- RRT* - RRT + rewire

Artificial Intelligence
- ANN - Artificial Neural Network
- GA - Genetic Algorithm

Our Algorithm

- Design own algorithm
  - A*(D*) 기반 : 장애물 회피

- Using python & ROS
  - Simulation

- Using drone
  - 3D path planning
  - Safety distance
  - Cost function optimization
    : Distance(Euclidean) ~~+ Power(battery) + Stability(?)~~

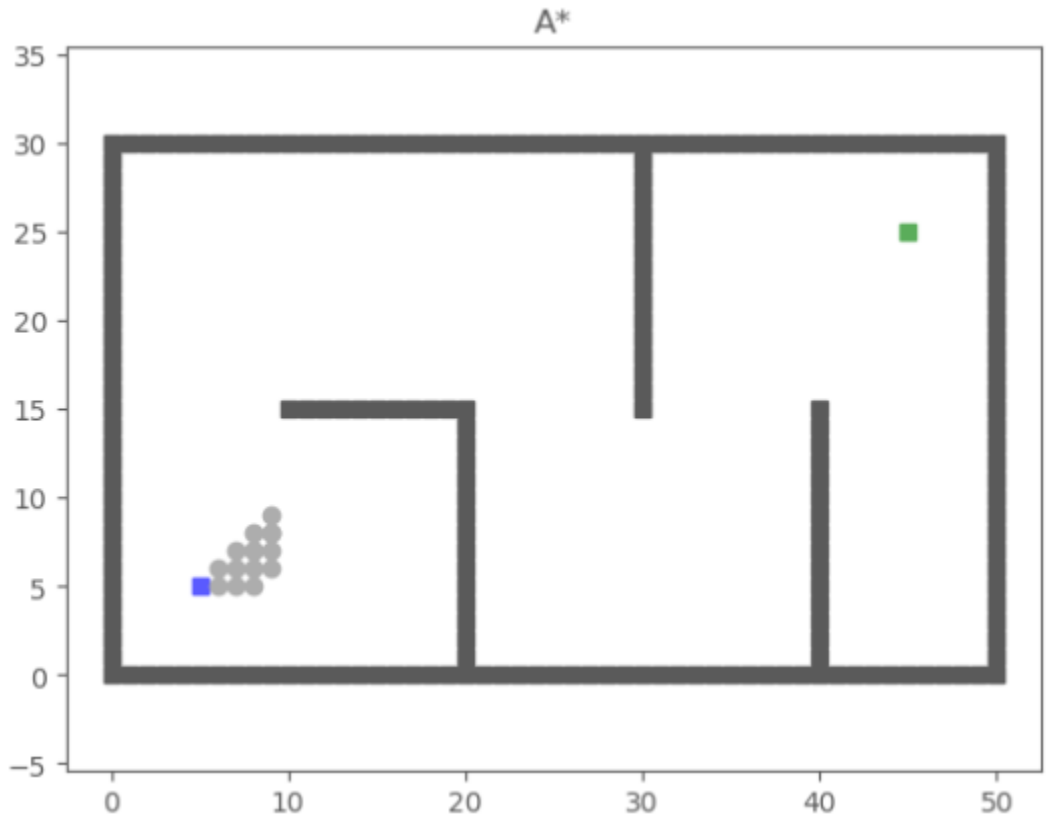
A* Algorithm

- Search-based algorithm
- Dijkstra + heuristic cost

- Cost function : f(n) = g(n) + h(n)

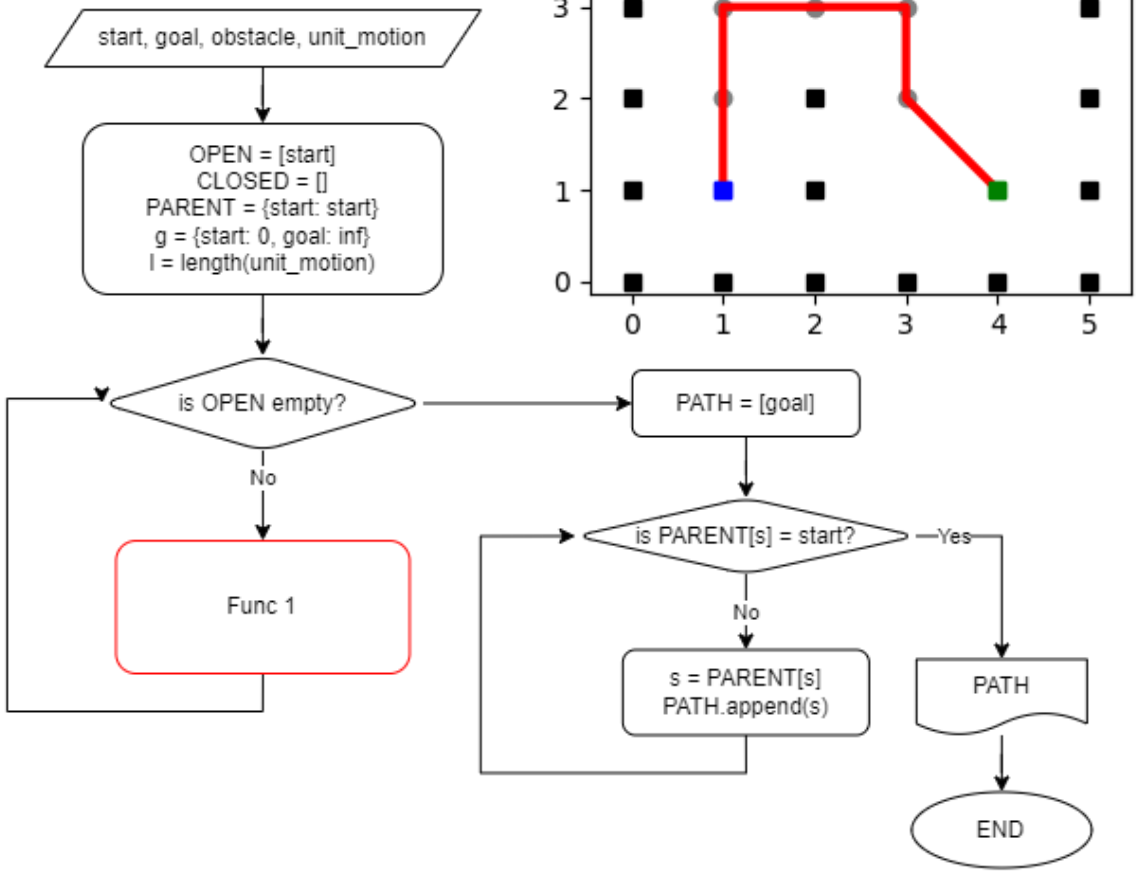
  g(n) : 현재 node까지의 cost

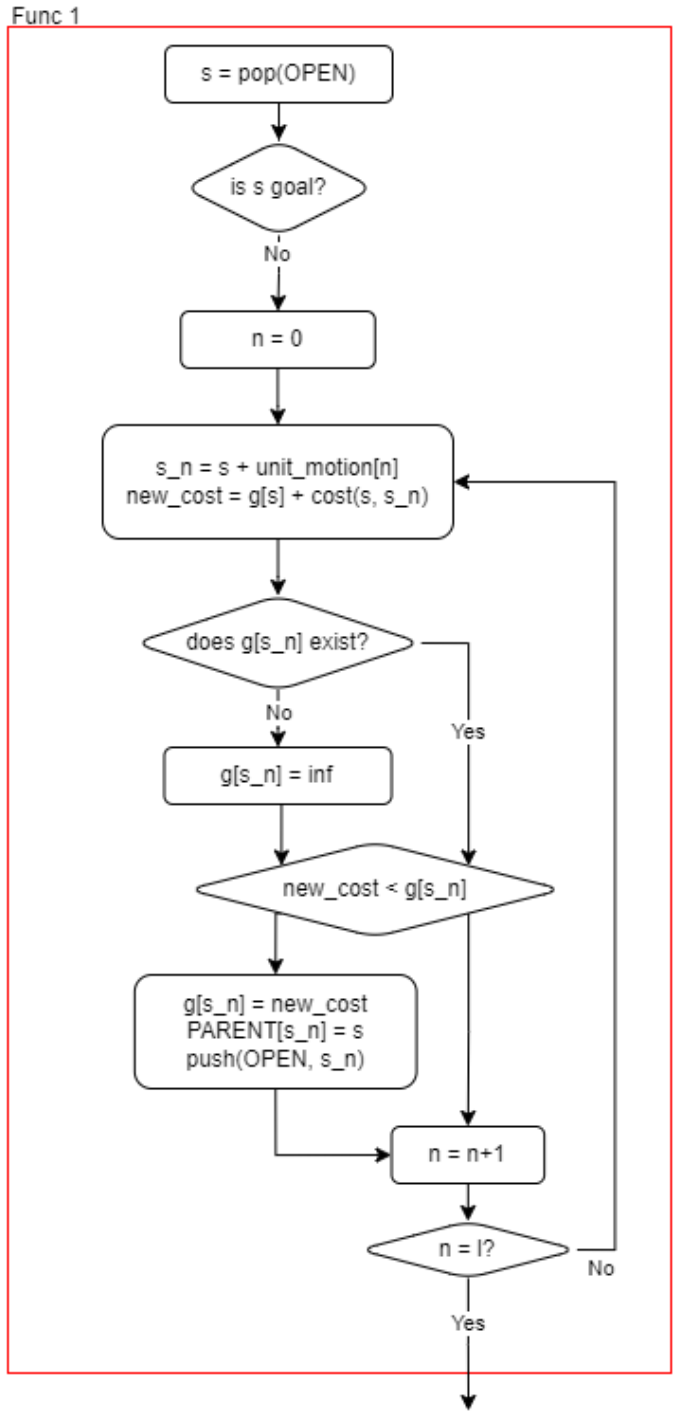
  h(n) : 현재 node부터 목표 node까지의 heuristic cost



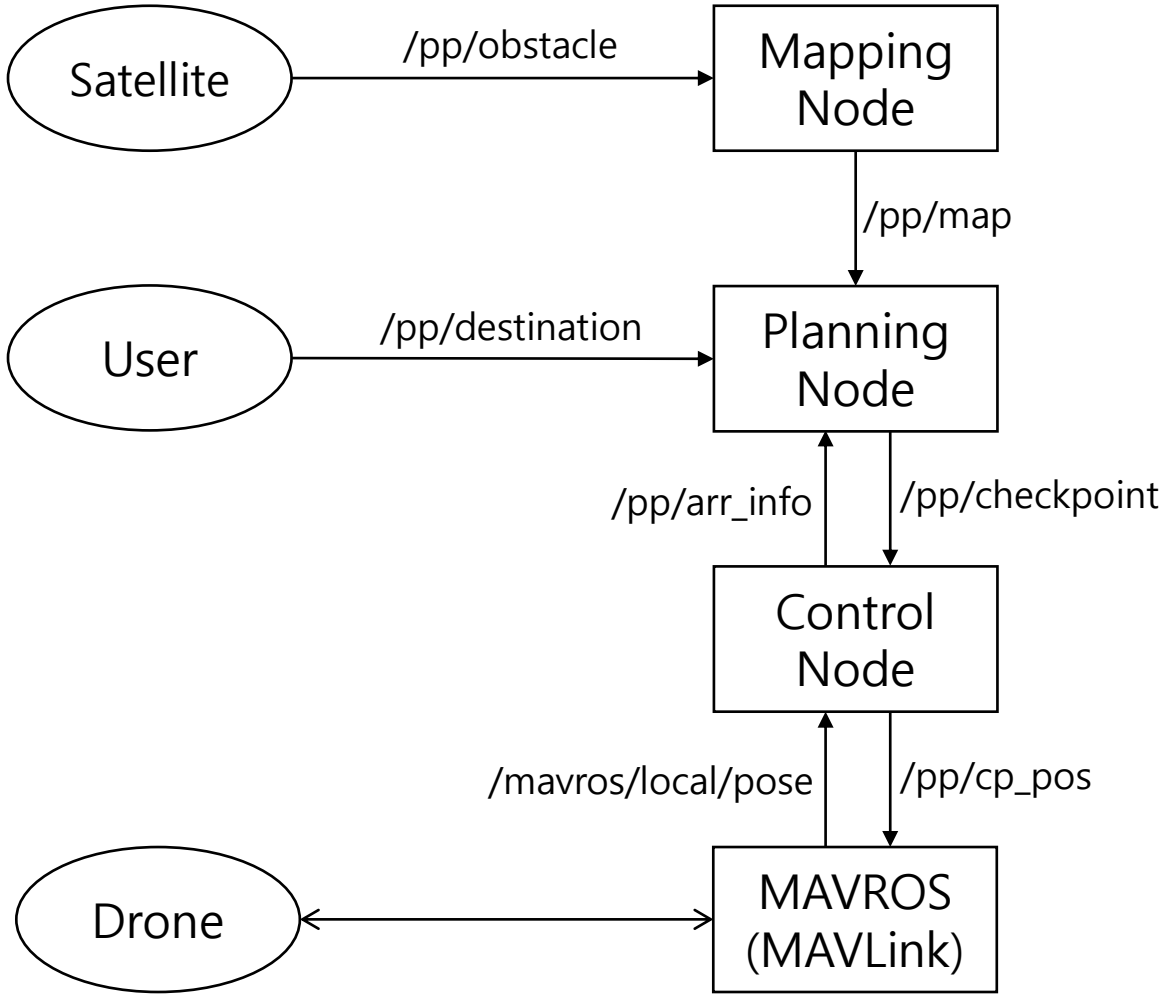
A* Algorithm

- Flowchart





Schematic



3 IOs / 4 Nodes / 7 Topics

IOs:

Satellite: Detect and manage obstacles

User: Set destination point

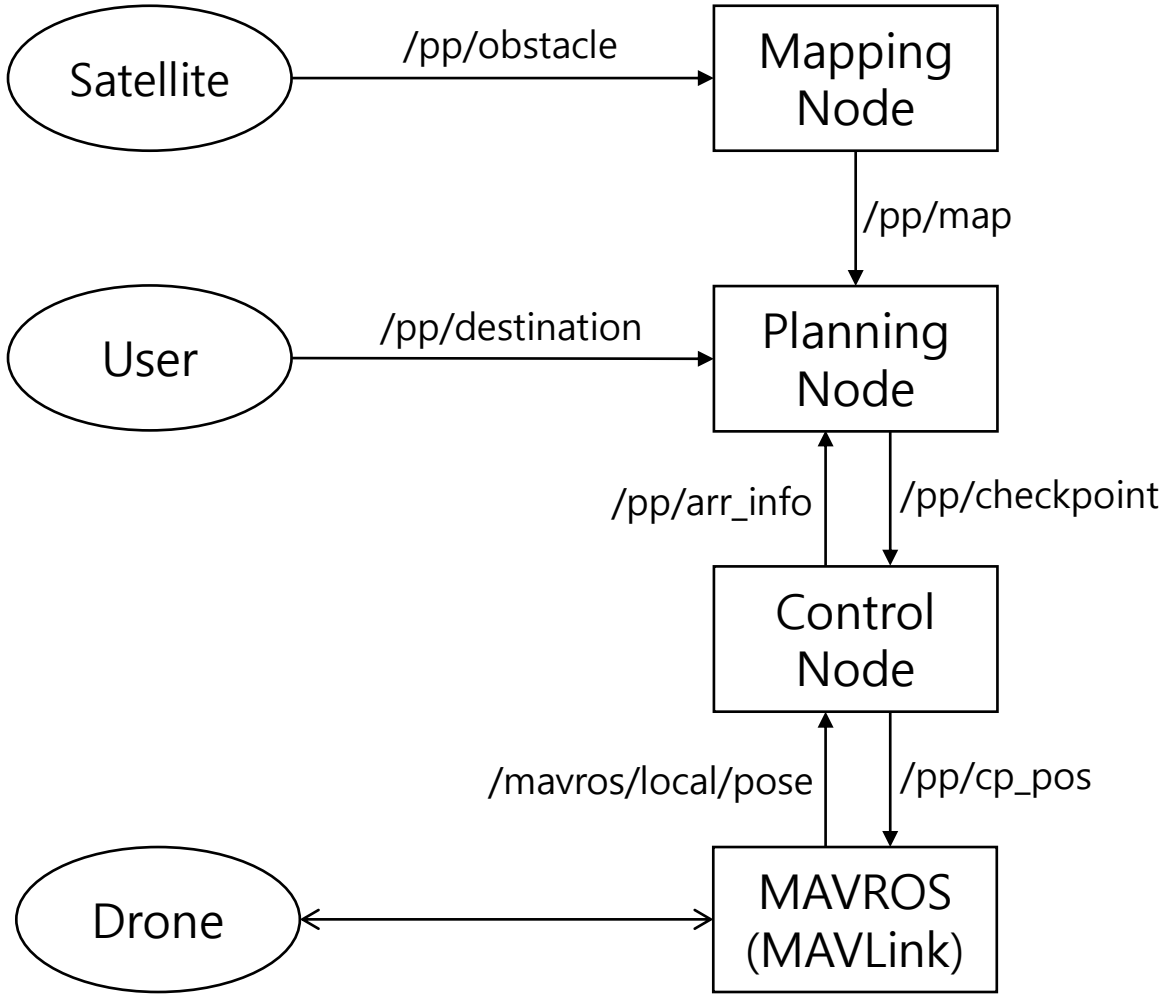
Nodes:

Mapping Node: Make map with obstacle

Planning Node: Path planning with current position, destination and map

Control Node: Transfer control signals and arrived trigger

Schematic



Topics:

/pp/obstacle: contains array of xyz coordinates of obstacle

/pp/map: contains array of xyz coordinates of map

/pp/destination: contains xyz coordinates of destination

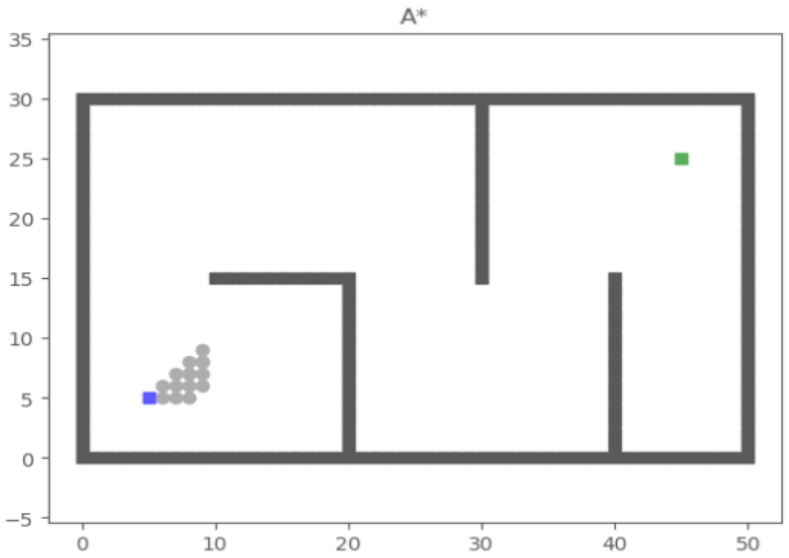
/pp/checkpoint: contains xyz coordinates of checkpoint, way to destination

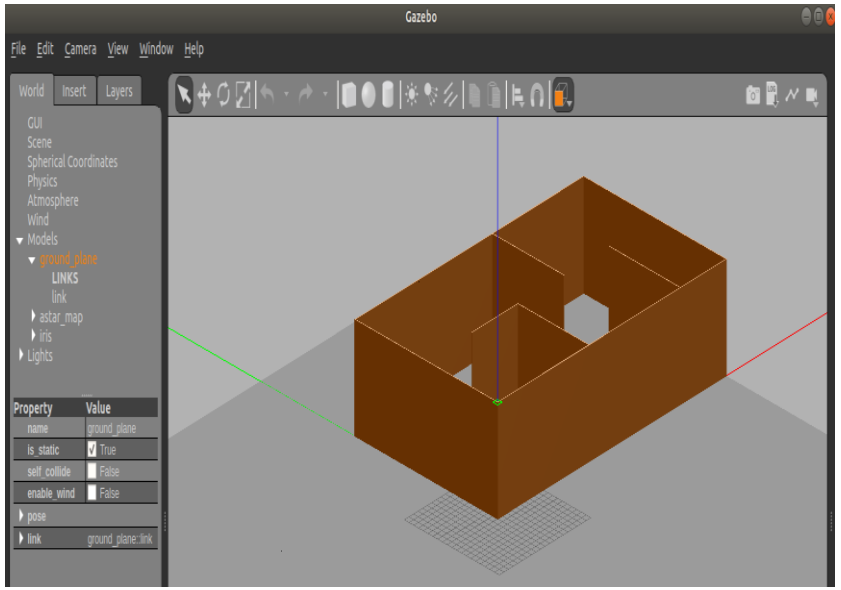
/pp/cp_pos: contains xyz coordinates of c heckpoint, way to destination

/pp/arr_info: contains bool if drone arrived checkpoint

/mavros/local/pose: contains xyz coordinates of drone's local position

Mapping





Box size :

50m x 30m x 10m

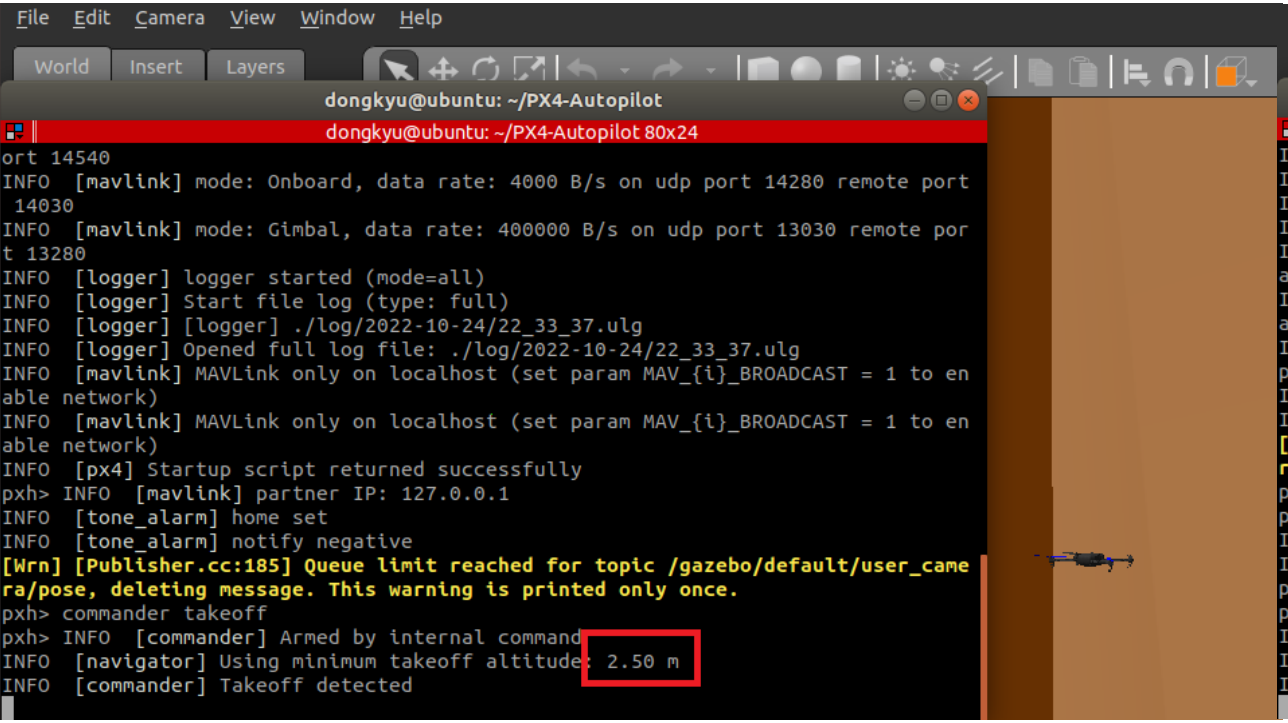
condition :

Gravity acc : -9.8 m/s^2

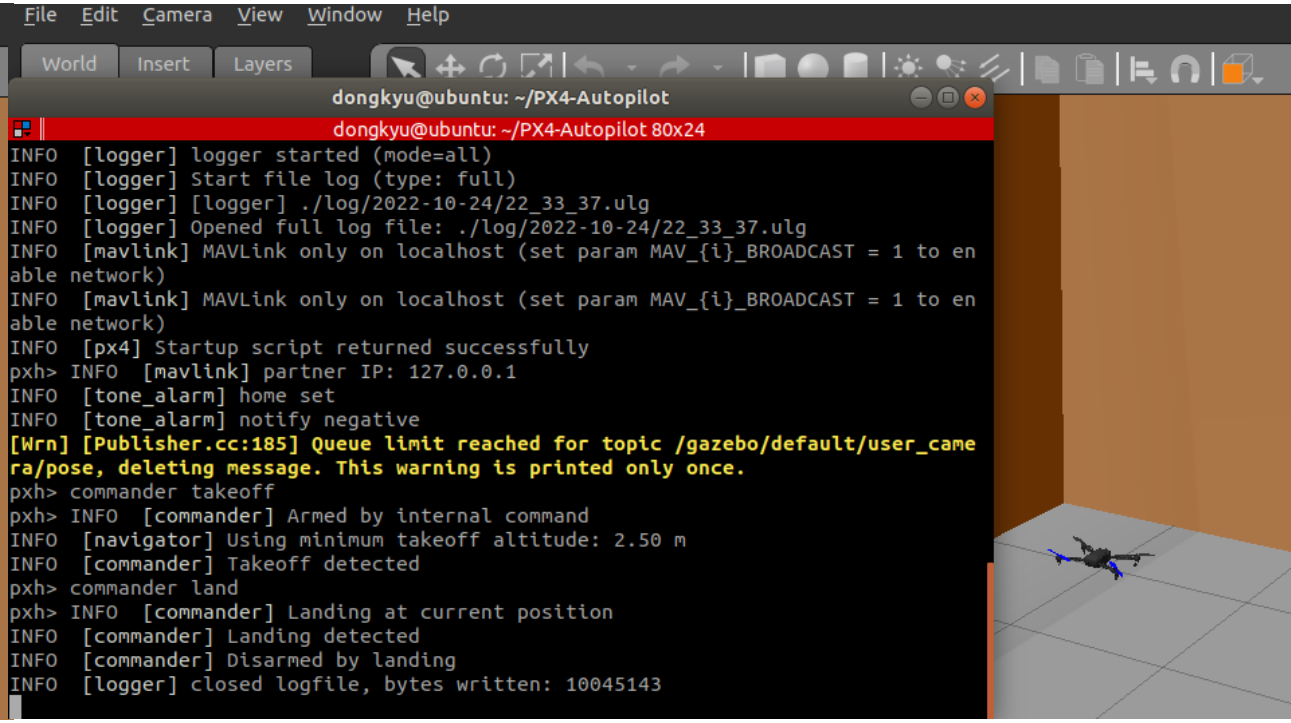
atmosphere type : adiabatic

Wind velocity : 0 m/s

Mapping



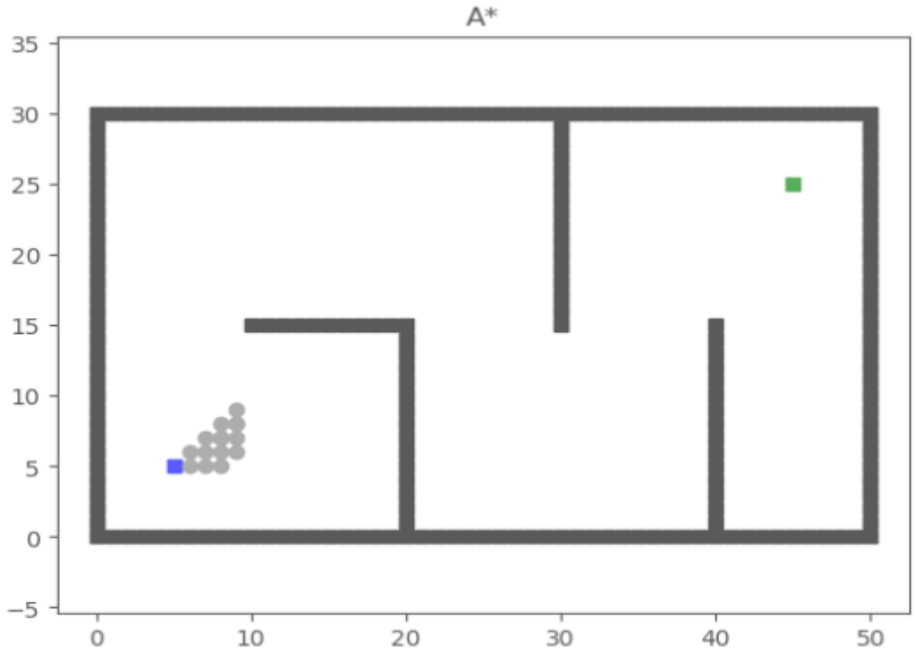
Successfully takeoff



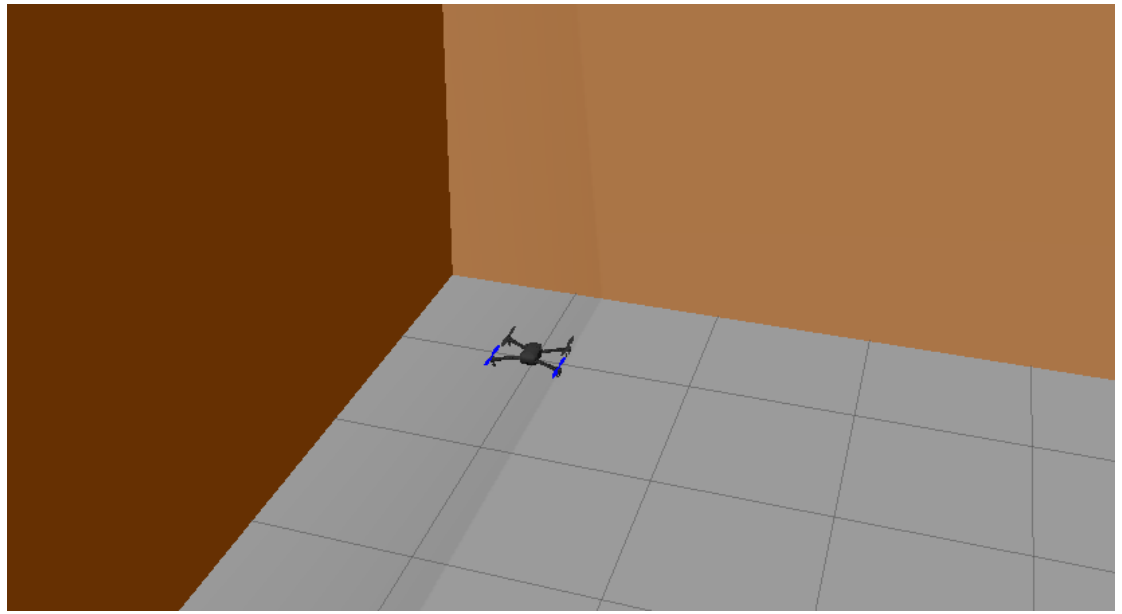
Successfully land

Flight altitude : 2.5m

Mapping(problem)



Start-point : [5,5]



Start-point : [1,1]

Mapping(summary)

Achievements:

Completed making example map in gazebo

Static map on Planning node implemented

- Mapping node not implemented

Dynamic mapping impossible

Challenges:

Real-time dynamic mapping with topic required in practice

Coordinate system is different in Gazebo

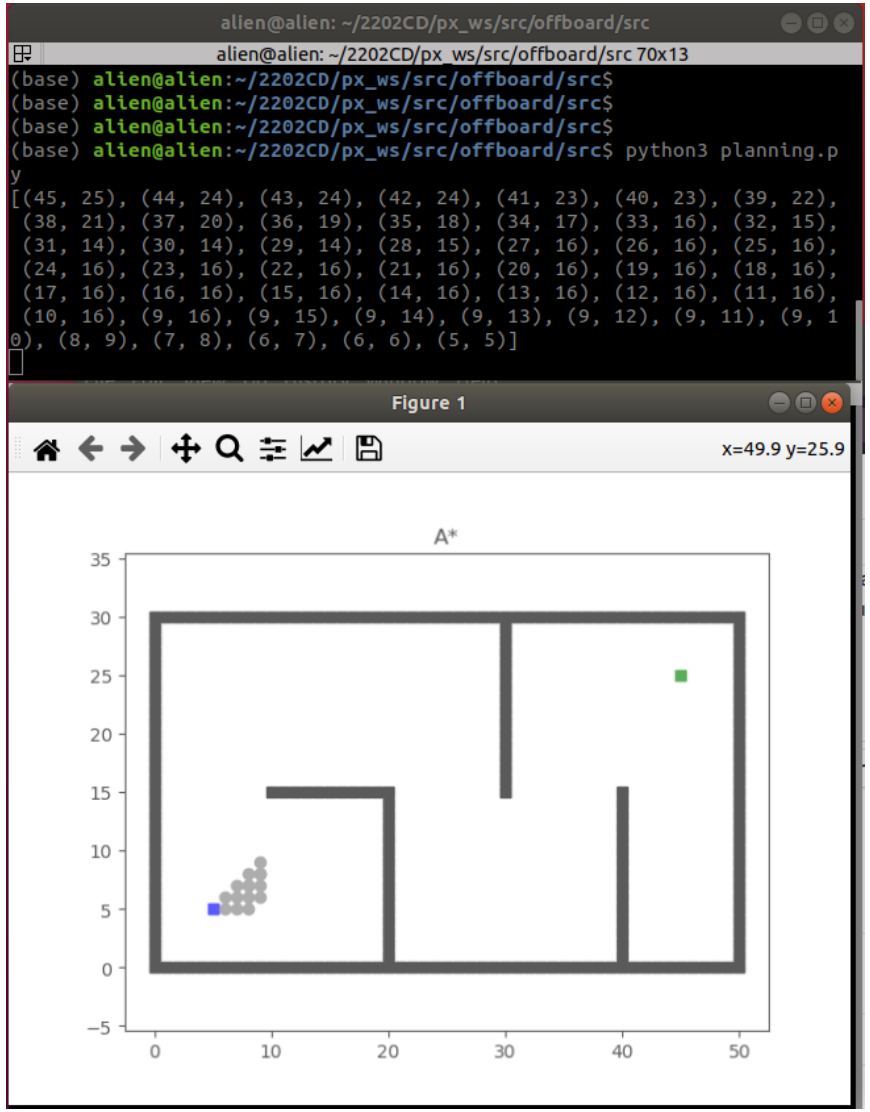
Plan for next week:

Solve problem about starting-point

Apply created code to map that we make

Make view-point in gazebo more comfortable

Planning



Achievements:

A* algorithm implemented

- input : map, start, destination
- output : route to destination

Challenges:

How to improve performance?

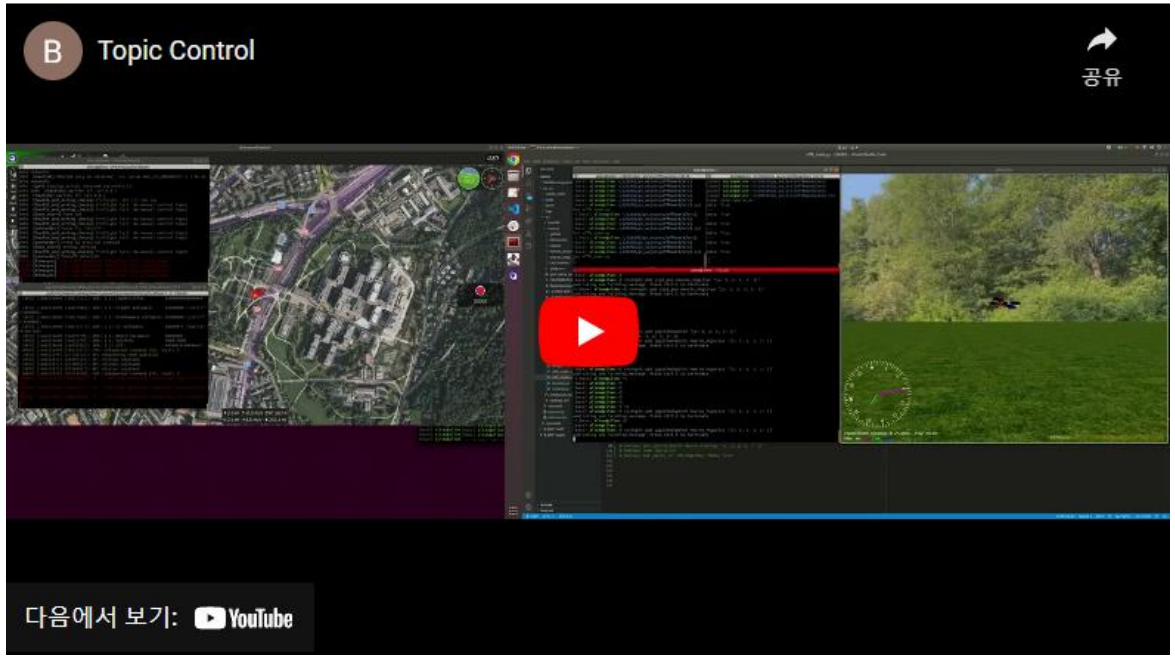
Planning node need to be changed for dynamic mapping

Plan for next week:

ROS embedding

- input : /pp/map, /pp/destination, /pp/arr_info
- output : /pp/checkpoint

Control



Achievements:

80% implemented

- drone controllable via topic
- sends /pp/arr_info True if distance between checkpoint and current position is under particular distance

Challenges:

Gazebo error occured in control PC

Overshooting

- Acceleration control required

Plan for next week:

Check if drone works well with ROS embedded Planning node

Solve Gazebo error

Plan

1. Static path planning

2. Acceleration control

3. Dynamic mapping & path planning