NAVIGATION IN INDOOR ENVIRONMENT USING AR DRONE 2

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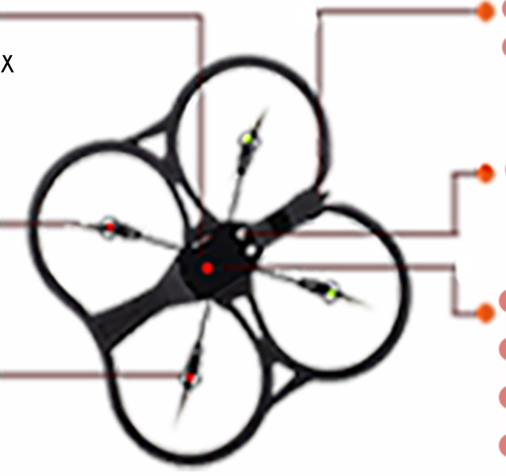
OBJECTIVE

Given the map of the environment, make the drone navigate from one point to another. In simulation and in real world.

Parrot AR Drone 2.0



- 1GHz 32 bit ARM Cortex A8 processor with 800 MHz video DSP TMS320DMC64x
- 1GB DDR2 RAM at 200MHz
- Specific high propelled drag for great maneuverability
- 4 brushless inruner motors.
- Low noise Nylatron gears for 1/8.75 propeller reductor
- HD camera 720P 30FPS
- Wide angle lens: 92° diagonal
- Ultrasound sensors
- 3 axis Gyroscope, 2000°/second precision
- 3 axis Accelerometer, +-50MG precision
- 3 axis Magnetometer 6° precision
- Pressure sensor +/- 10 Pa precision

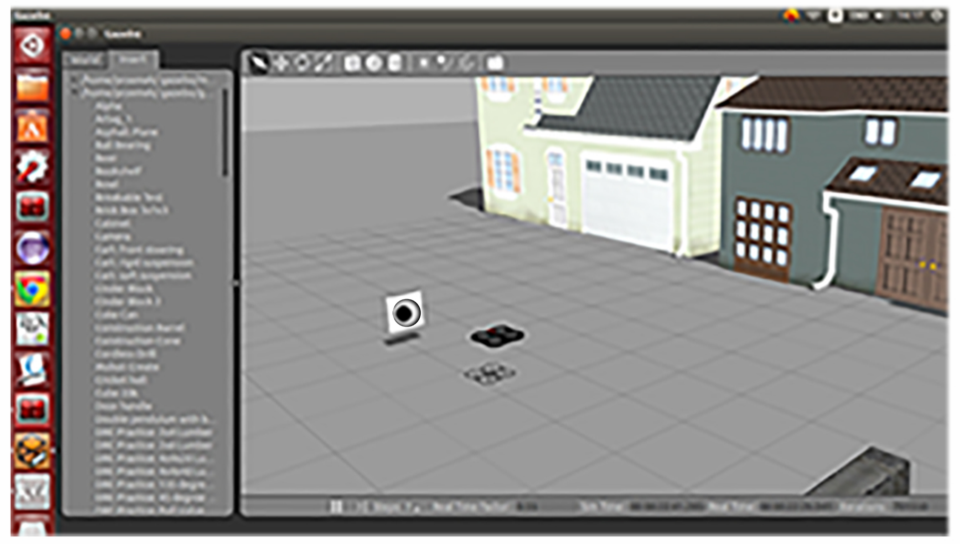
MOTIVATION

Drone applicability is not only limited to the outdoor applications (Package delivery, Surveillance, target tracking).
Drones can also be useful in indoor environments for manufacturing/services (e.g. Hospitals, Green houses,Production companies and Nuclear power plant)

TASKS ACCOMPLISHED

01. Alignment

Aligning AR drone to a marker and getting the robot pose from the ArUco marker.
Drone will get to know its position in the world and aligns with the marker using the PID controller.



02. Stabilisation

PID tuning to keep the drone at a fixed location

$$out(t) = P \cdot e(t) + I \cdot \int_0^t e(t)dt + D \cdot \frac{de(t)}{dt}$$

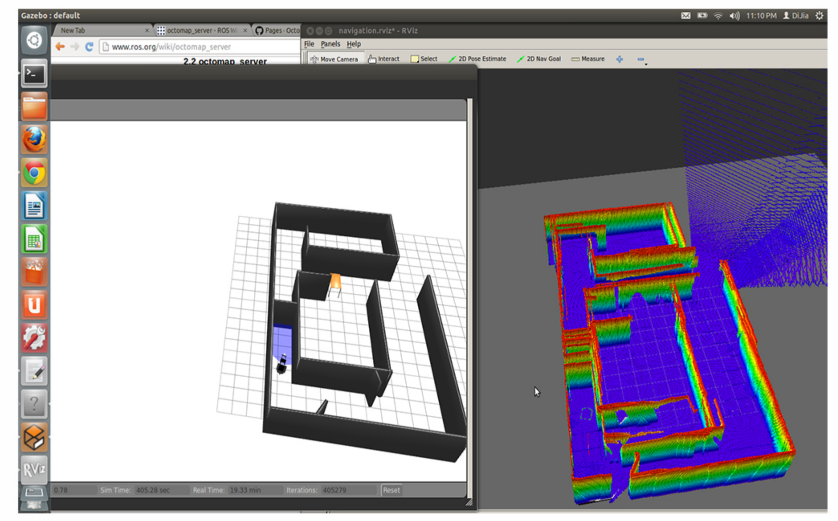
| e(t) = set_point - input | dt = current_time - last_time |

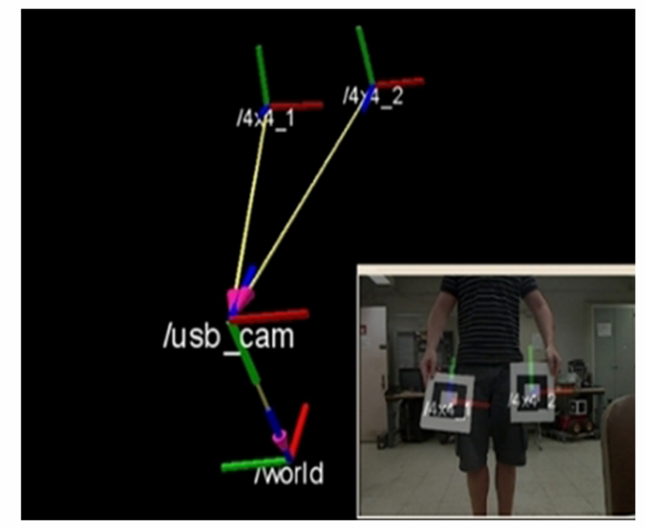
| P-proportional gain | I-integral gain | D-derivative gain |

- Input is the distance between the drone position and marker which was given by the marker
- Set-point is the target pose that is the distance that drone has to make with the marker.

03. ROS Visualisation

Visualizing the 3D map in Rviz.
Spawn the quadrotor and fix transforms to make it emulate the real drone.
Setup transforms between the map and the drone.



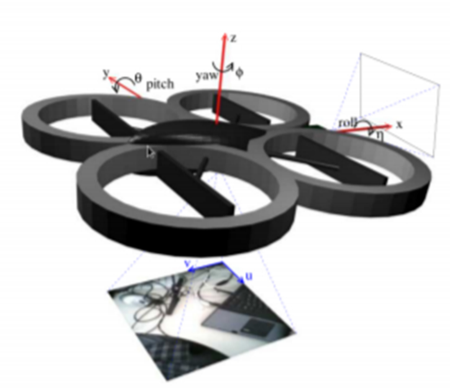


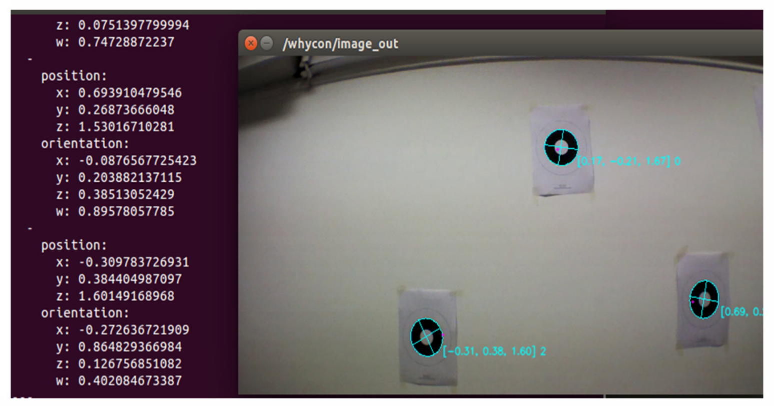
04. Indoor Navigation

Indoor navigation deals with navigation within buildings. Because GPS reception is normally non-existent inside buildings, other positioning technologies are used here when automatic positioning is desired.
For any navigation basically we need these aspects -

Localisation

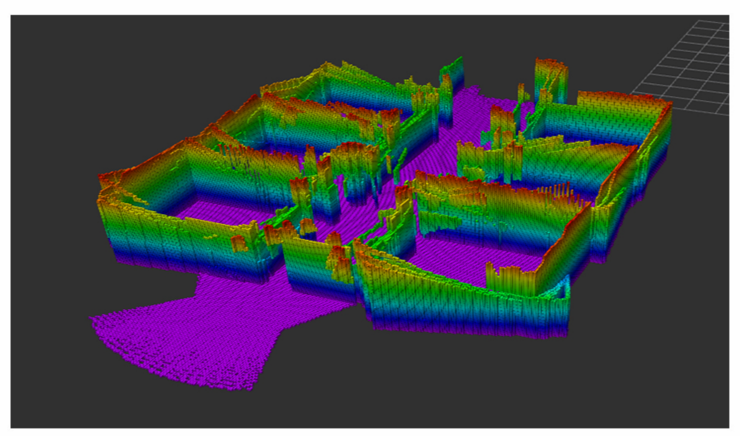
In-order to move the drone from one waypoint to another, the drone needs to know its position in its world frame.
We can get the pose from the odometry of the drone, but the values won't be accurate. We can use markers to get the pose of the drone.

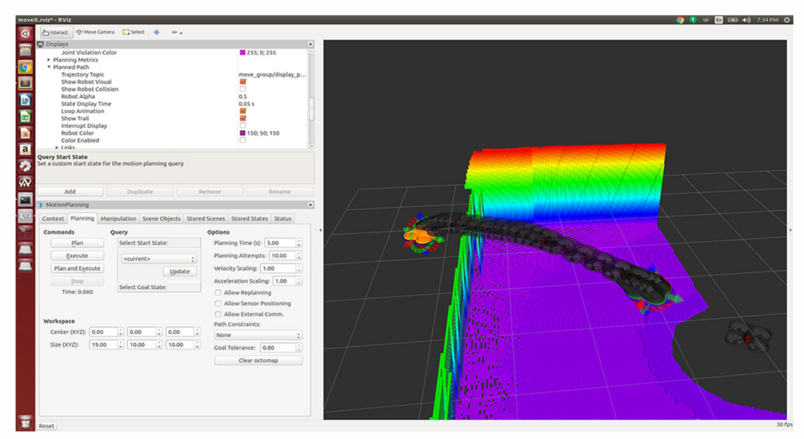




Motion Planning

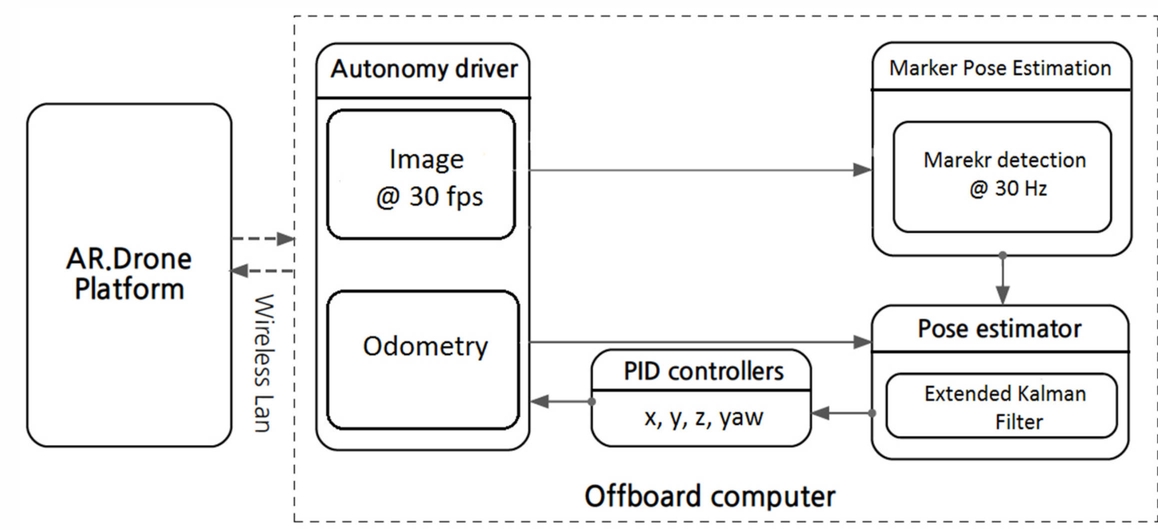
Path planning is an important issue as it allows a robotto get from point A to point B. Path planning algorithms are measured by their computational complexity. The feasibility of real-time motion planning is dependent on the accuracy of the map (or floor-plan), on robot localization and on the number of obstacles.
We use MoveIt! package for path planning. MoveIt! is state of the art software for mobile manipulation, incorporating the latest advances in motion planning, manipulation, 3D perception, kinematics, control and navigation.





Controller

When the system knows the drone's and the desired poses, it uses PID controllers to reach and maintain the pose. One controller is utilized for each coordinate of the 3D position and for the azimuth.



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