Bachelors of Engineering

Project presentation

Department of Electronics Engineering
Sardar Patel Institute of Technology
Munshi Nagar, Andheri(W), Mumbai-400058
UNIVERSITY OF MUMBAI
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A PRESENTATION ON

ROBOT DEVELOPMENT USING ROS

By

SRIJAL POOJARI
&
CHIRAG SHAH

Under the guidance of

Kumar Khandagle

Problem Statement

To explore the ROS framework and implementing a quadcoptor running ROS to create a 3D map of the real time environment that it sees using a depth sensor (Microsoft Kinect).

Abstract

This project deals with exploring the ROS framework for

- Development of a robotic system with various sensors and actuators
- To develop a quadcoptor capable of forming a 3D map of an indoor environment using a depth camera (Microsoft Kinect)

Introduction

What is ROS?
What is Microsoft Kinect?
What are the challenges?

Project Objectives

- Learn the ROS framework
- Understand and implement SLAM algorithms for 3D mapping
- Understand the interfacing of different hardware components with ROS packages
- Combine the software and hardware components to create a stand-alone quadcoptor for 3D mapping

Literature Survey

- Huang et al. (2011). *Visual Odometry For GPS-Denied Flight And Mapping Using A Kinect.* MIT, University of Washington. Website.
- Shen S., Michael N., Kumar V. (2010). *Autonomous aerial navigation in confined indoor environments*. University of Pennsylvania. YouTube.
- Alessio Tonioni (2015). *Autonomous quadcoptor flight in ROS*. GitHub Source.
- Will Selby (2016). *3D Mapping & Navigation with ROS*. Website.
- Belavadi S., Beri R. (2017). *Indoor Environments Mapping using UAV.* GitHub Source.

Software Requirements

- Ubuntu 16.04 (Xenial Xerus)
- ROS Kinetic Kame

Hardware Requirements

- RGB-D Camera (Microsoft Kinect)
- Quadcoptor capable of lifting payload upto 1kgs
- Single Board Computer capable of running Ubuntu and ROS

Project Plan

Week	Objective
1 to 3	Installing ROS, Understanding the underlying concepts.
4 to 5	Interfacing the Microsoft Kinect sensor on Gazebo simulator.
6 to 8	Understanding Pointclouds and RTAB Map for real time environment mapping.
9	Interface the Kinect sensor for mapping of real world environments.

Results

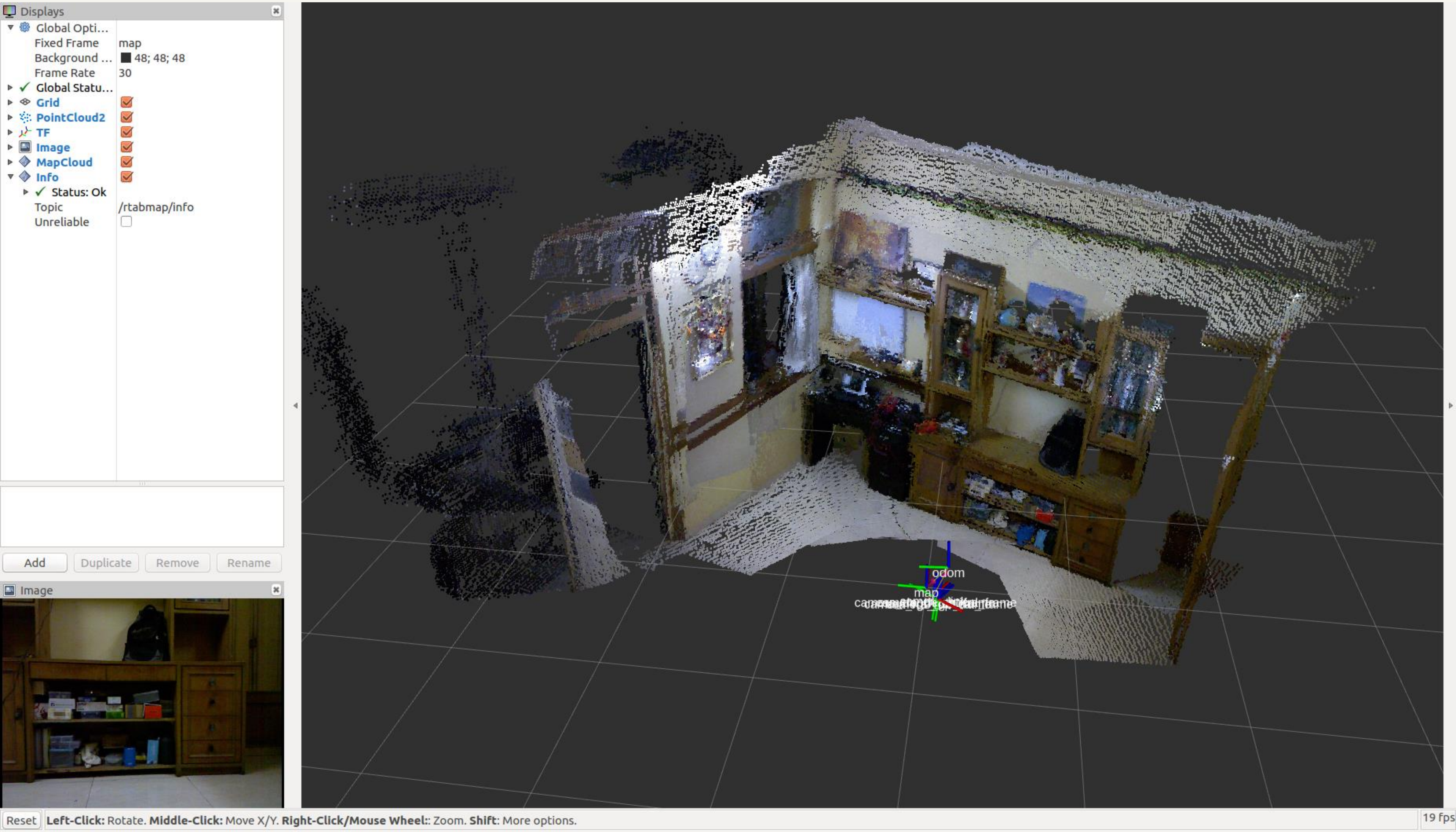
Work done up till now involves (August 4, 2017)

- Reading and understanding the framework of ROS
- Practicing ROS commands by following the official ROS wiki
- RTAB installation

- *“Give me six hours to chop down a tree and I will spend the first four sharpening the axe.“*
  - Abraham Lincoln

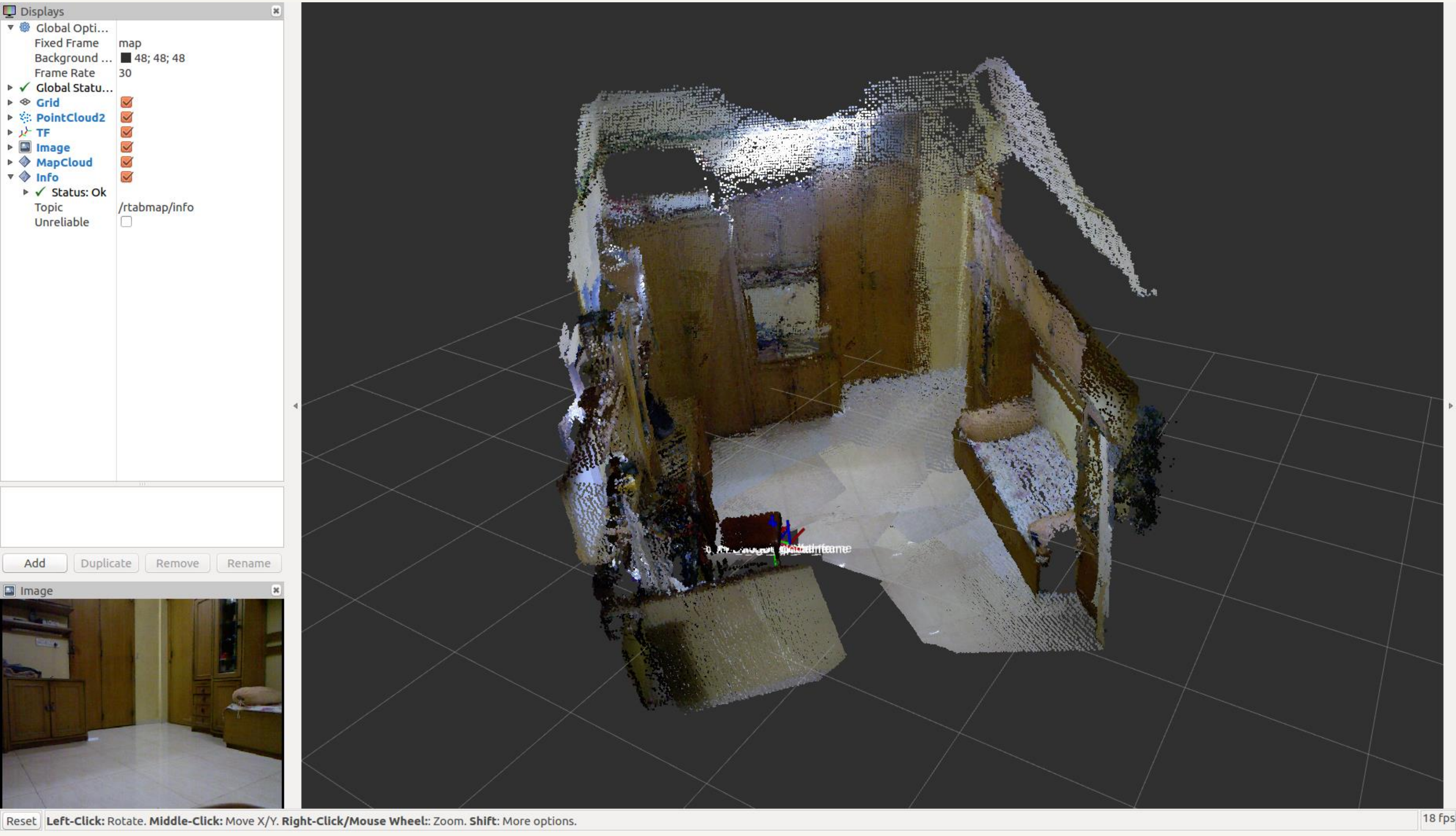
Results

Mapping using hand-held Kinect



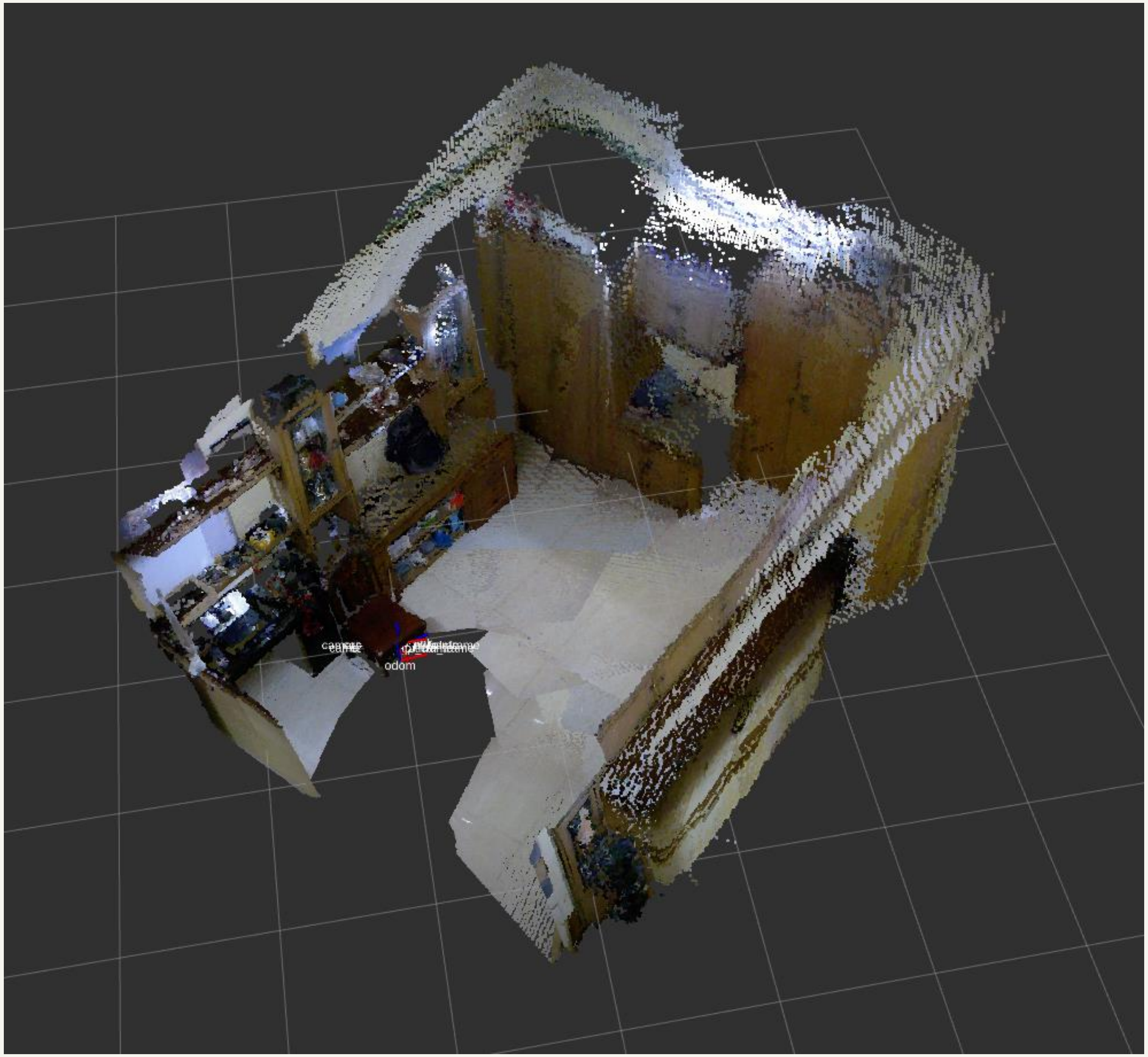
Results

Mapping using hand-held Kinect



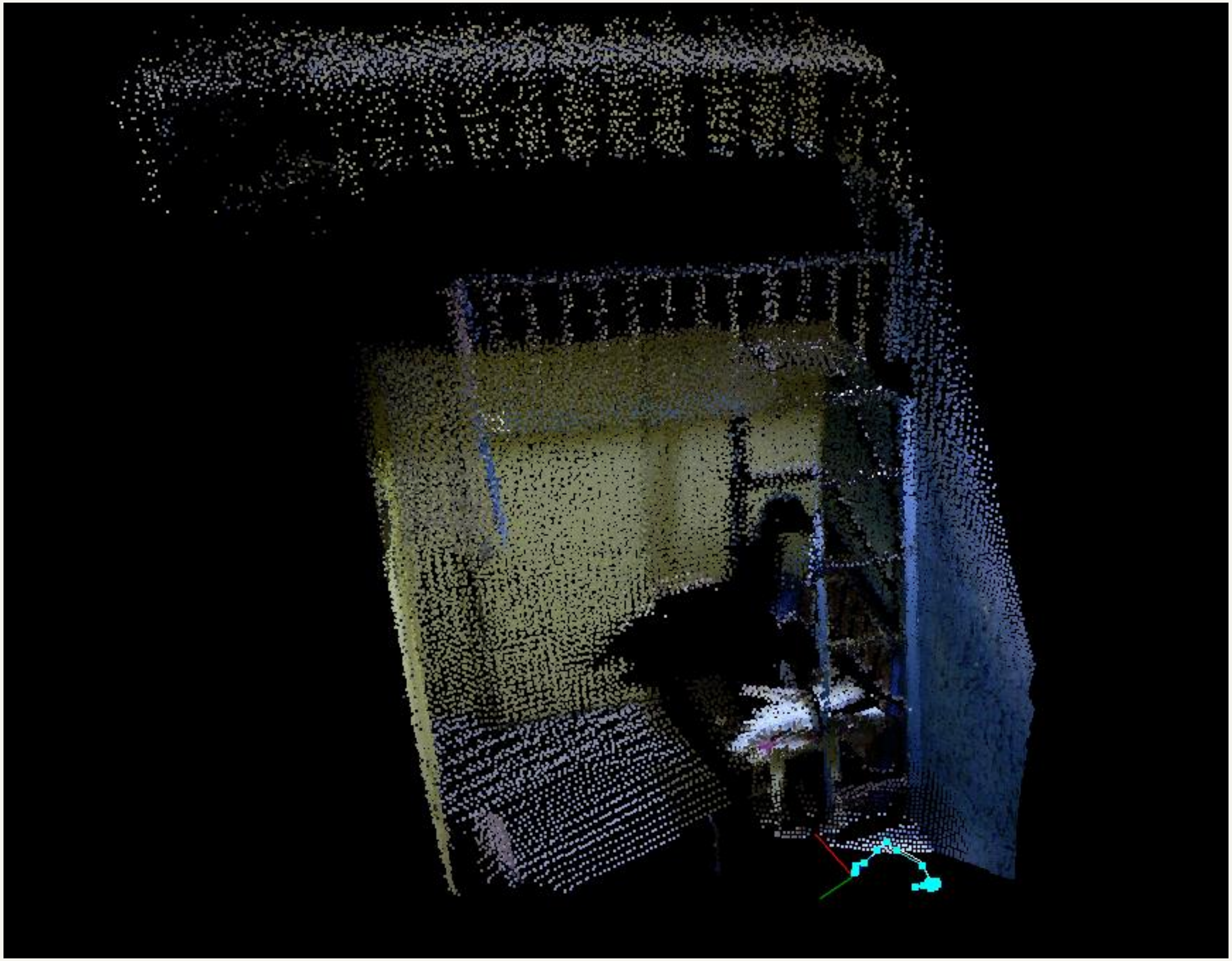
Results

Mapping using hand-held Kinect



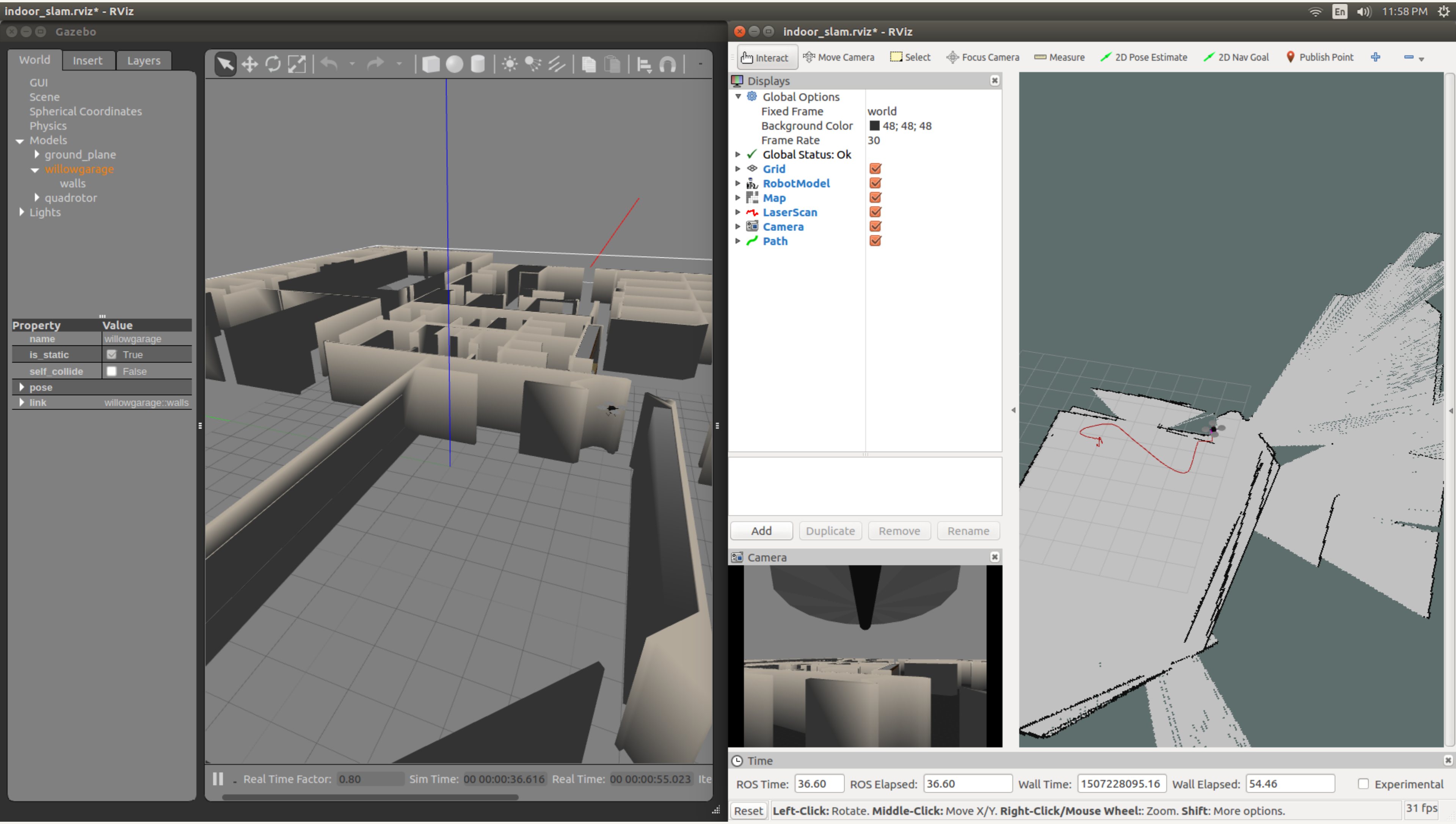
Results

Mapping using hand-held Kinect on RPi with mapping streamed to a PC



Results

Simulation using hector quadrotor package on ROS Gazebo and RViz

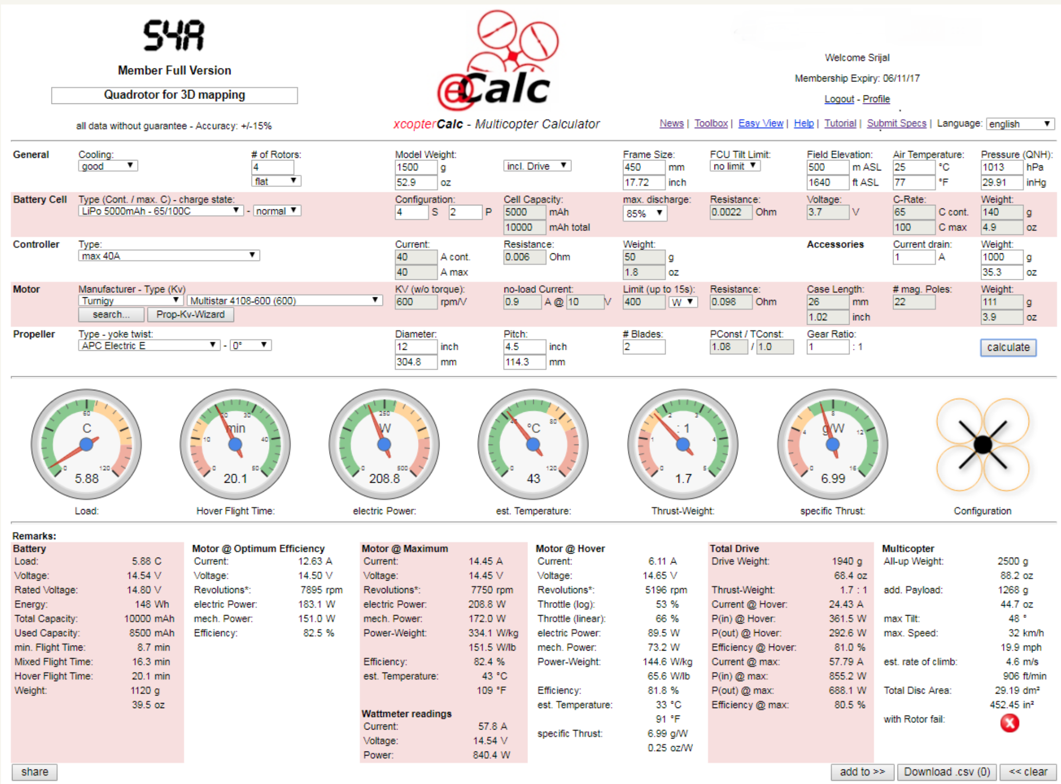


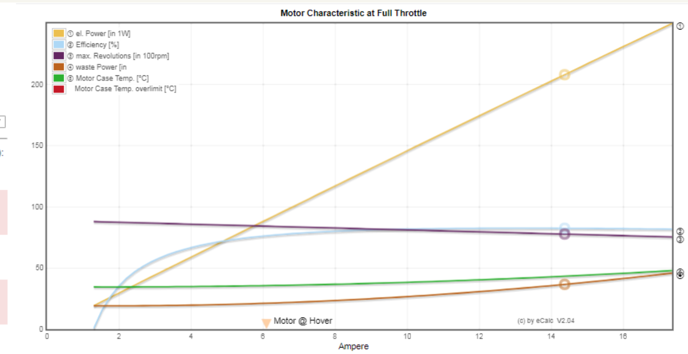
Results

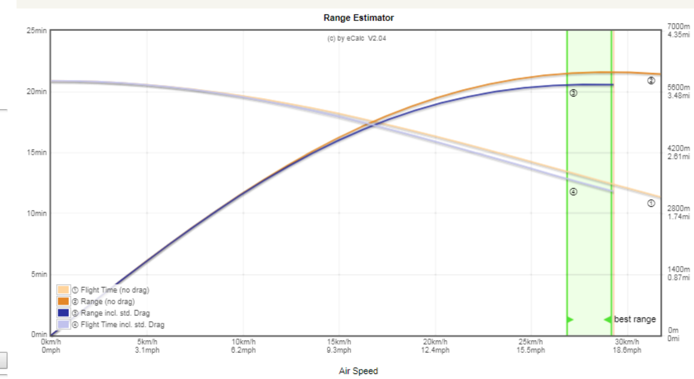
Interfacing RC Transmitter with ROS

Results

Quadrotor configuration planning







Challenges Faced

- Insufficient documentation of most packages.
- Difficulty in debugging when things go wrong.
- Lack of fundamentals and terminology in Robotics

Ongoing work

- Wireless streaming of map data over the ROS network.
- Selecting a light weight and small form-factor computer which can handle the required computations.
  (RPi, ODROID XU4)
- Designing the quadrotor.

References

- Official ROS Documentation : http://wiki.ros.org/
- ROS Forums : https://answers.ros.org
- Quigley, M., Gerkey, B. and Smart, W. (2015). *Programming robots with ROS*. Sebastopol, California: O'Reilly Media.

THANK YOU