Map My World

Hytham Tag

Abstract—The purpose of this project is to apply SLAM principals to localize and make the robot map and generate a map of the world where 2D grid and 3D map is created from a simulated environment where the simulation takes place in Gazebo environment and a robot model from the previous project is used with an added RGB-D camera.

Index Terms—Robot, IEEEtran, Udacity, LaTeX, deep learning.

1 Introduction

THE SLAM was always a problem that faced us in every way and for the robot to be fully autonomous it must adapt and understand the dynamic environment around it as dynamic represents real world that changed every second so the robot must be able to recover the right data from noisy data that come from the sensors, the noise is filtered by means of probabilistic problems In this project it is required to test and simulate 2 3D world environments using SLAM where one environment is given and the other is meant to be designed and developed in Gazebo in world format.

2 Background / Formulation

Given that the map needed for the localization, but at the same time the robot location and orientation is need for mapping this is considered a problem that faced the humanity like did the chicken or the egg came first as SLAM problem is very hard problem ant to be able to localize and map at the same time many approaches are used as

- Exteneded Kalmen Filter EKF
- FastSlam
- GraphSLam

SLAM algorithms isn't easy to implement specially for 3d mapping where there are huge amount of noise that must be filtered to be able to read the right data.

2.1 FastSLAM

Fastslam is one of the robust incremental mapping algorithm that can deal with multimodal distribution. However it suffers from two important limitations which are the derivation of the Jacobian matrices and the linear approximations of nonlinear functions. but the FASTSLAM algorithm can solve the SLAM problem using custom particle filter approach, with the help of Extended Kalmen Filter, FastSLAM is able to estimate the trajectory of the robot which will allow it to mape the world more easily.

2.2 GraphSLAM

Also the Graph-based SLAM solver the full SLAM problem by recovering the entire path and map, and uses all information recorded. The idea of GraphSLAM is as follow:

- Use a graph to represent the problem
- Every node in the graph corresponds to a pose of the robot during mapping
- Every edge between two nodes corresponds to a spatial constraint between them
- A graph is built and find a node configuration that minimize the error introduced by the constraints
- Once we have the graph, we determine the most likely map by correcting the nodes

3 SIMULATIONS

The simulation consists of ROS (Kinetic), Gazebo and RViz. The main ROS package is the RTAB-Map package. where 2 different environment are tested in . where the same robot from the last project is used an upgraded to use RGB-D Camera.

3.1 The Kitchen Dining

The kitchen Dining scene was provided and will be used for simulation

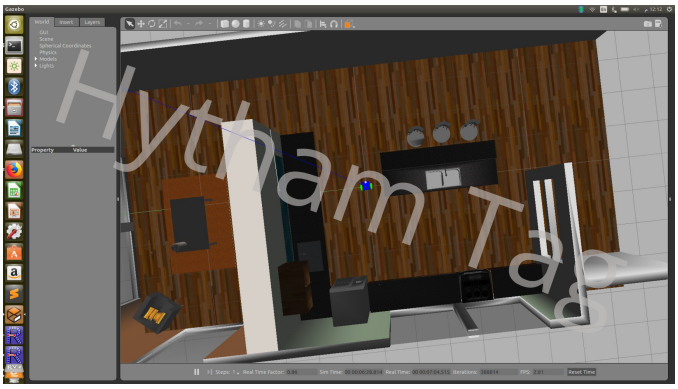

Fig. 1. Kitchen Dining

3.2 My World Scene

My World scene was designed in Gazebo to be used as the experimental environment to deploy a robot to perform SLAM where different type of objects are placed.

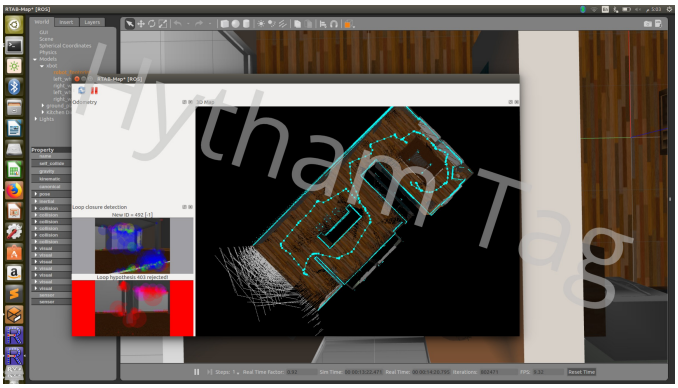

Fig. 2. Kitchen Dining RTMAB

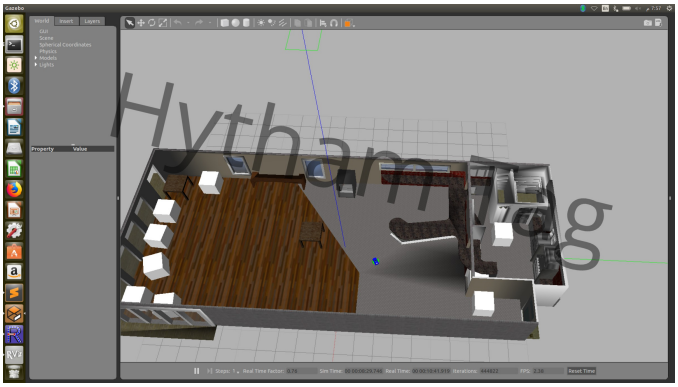

Fig. 3. My World

4 Results

4.1 The Kitchen Dining

The generated map of the kitchen is successfully generated with high accuracy as i slowed down the speed to avoid any slipping.

4.2 Cafe world

Cafe worls isnt sucessful as i tohught even i slowed down the speed of the robot but there was a shift.

5 Discussion

More tuning is needed and better design of the robot is need as i edited the robot to have to wheels in the back and one

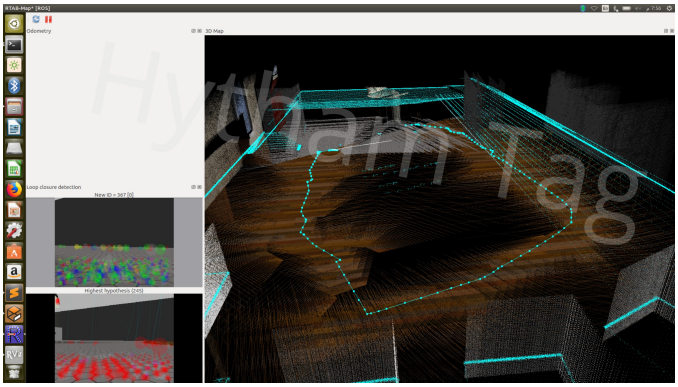

Fig. 4. My World RTABMab

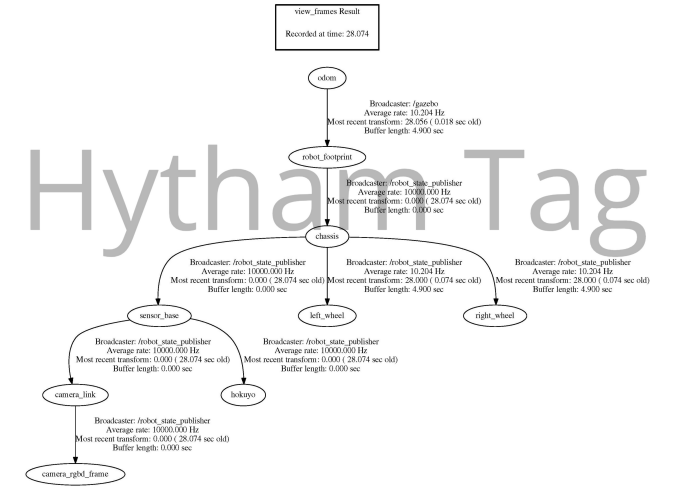

Fig. 5. Transform frame between different robot links

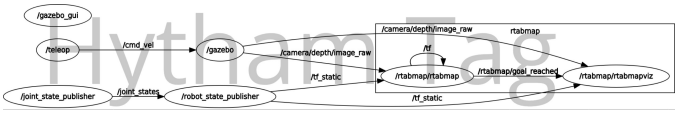

Fig. 6. Ros Graph

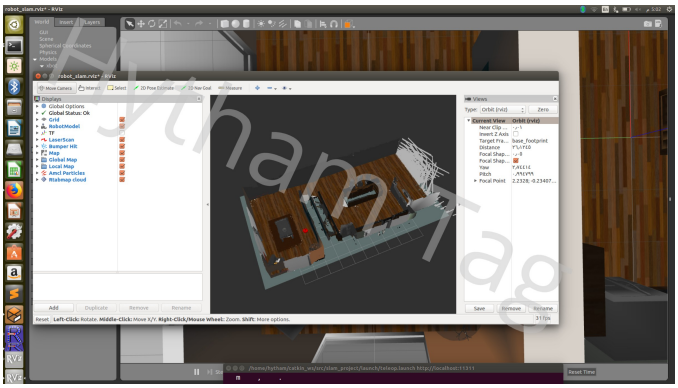

Fig. 7. Kitchen Dining Map

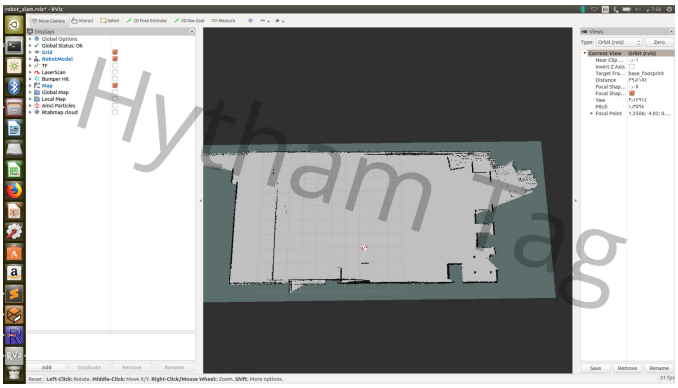

Fig. 8. Kitchen Dining Map

free wheel in the front but the robot was rising like a horse every time i move forward so i changed the design back to two free wheel one in front and one in back to achieve better result but in future work i will do it again.

6 Conclusion / Future work

It's required to tune the parameters again to achieve better results but also i intend to do it with a robot in a real world as I'am in deep love with SLAM.