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Team D: CuBi

Teammates:
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ILR07

September 26, 2019

Individual Progress

The main focus for this review was the creation of base map for the room so that CuBi can localize and make more intelligent and aware decisions while exploring the room.

Following things were done:

1. Literature survey for various mapping and SLAM algorithms.
2. Implementation of RTAB Map for obtaining 3D map.
3. Integrating current sensor stack with the mapping / SLAM algorithm.
4. Obtain a map using stereo camera.
5. Get map both in 3D and 2D
6. Get the obstacles as detected by the SLAM algorithm.

Fig 1. shows the result of the 3D and 2D map with stereo camera (RtabMap).

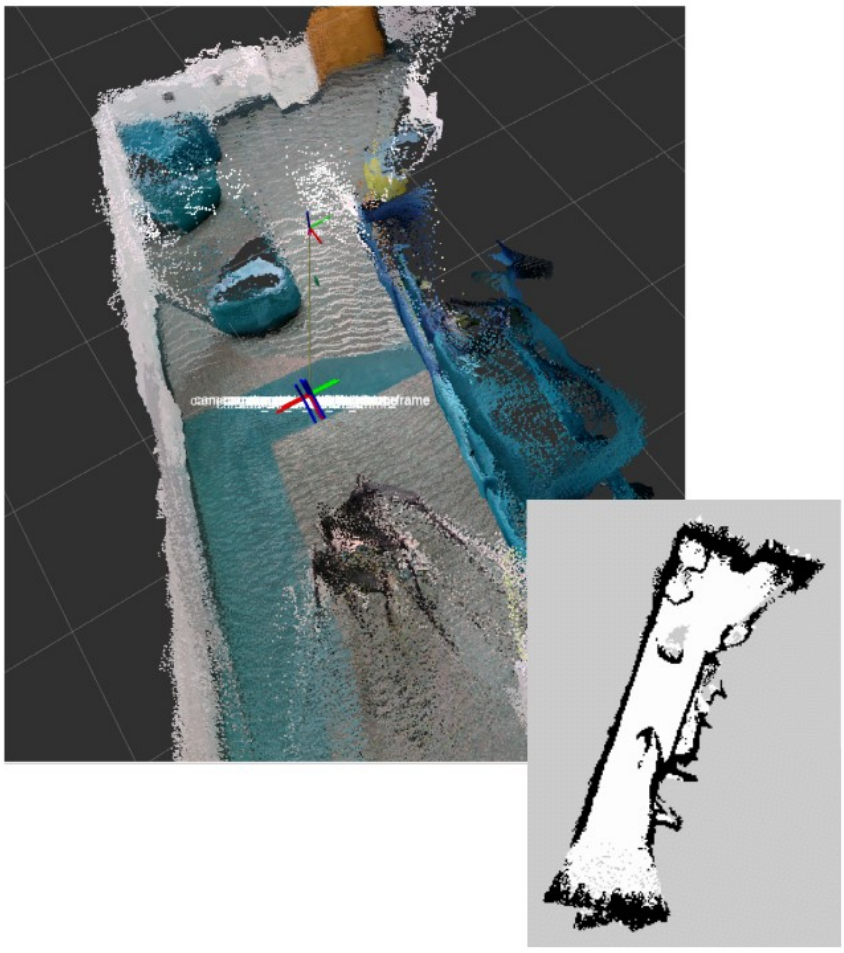

Fig 1. 3D map of the room with real-sense stereo camera and corresponding 2D map

Fig 2. shows the result of 2D map obtained with planar Hokoyu LiDAR in similar environment.

Fig 2. 2D map of the room with Hokoyu planar LiDAR

Results:

1. The LiDAR maping was faster because of 270 deg FoV.
2. The stereo camera map could detect obstacles lower than sensor height better.
3. The stereo camera gives both 3D and 2D map.
4. 2D LiDAR map is more accurate.

Challenges

Individual challenges:

1. The challenges of the LiDAR slam that we used (Hector SLAM) were that it was unable to detect obstacles lower than the sensor height.
2. Also LiDAR adds to extra cost.
3. 3D map might provide more information
4. Check if 3D mapping is done in real-time.
5. How to analyze the results. What metric to use.

Team challenges:

Following were the team challenges:

1. Further improving the integrated code and following good coding practices.
2. Individual task division.
3. Decision on many things - exploration strategy, sensor used for mapping, etc.

Teamwork

For this PR, we had meetings for task division. So, all of us interacted about breaking down tasks, forming collaborations and sub-teams.

I further cleaned the git code to make collaboration easy for team members.

Following describes the work done by the team members and how I interacted with them:

Paulo:

3D printed the mount for the caster wheel and attached it on the robot. Did some testing with Jorge after the new installment. I interacted with him about the problems with vibrations of the sensor stick, which potentially would affect mapping and object detection.

Fig 3. Shows the new design of the robot after attaching the caster wheel.

Bobby:

Helped Jorge in bringing up (boot algorithm) and control for CuBi. I interacted with him about obtaining the 2D LiDAR SLAM map and collection of more bag files.

Jorge:

Further improved the state machine. He worked on resetting of odometry with AR tag. He also improved the controls. Nithin helped him a bit. I interacted with him for project management and some ROS work.

Nithin:

Nithin helped me with the collection of Bag files and base map creation and we will further divide some tasks for the mapping and SLAM module. He also helped Jorge on some tasks.

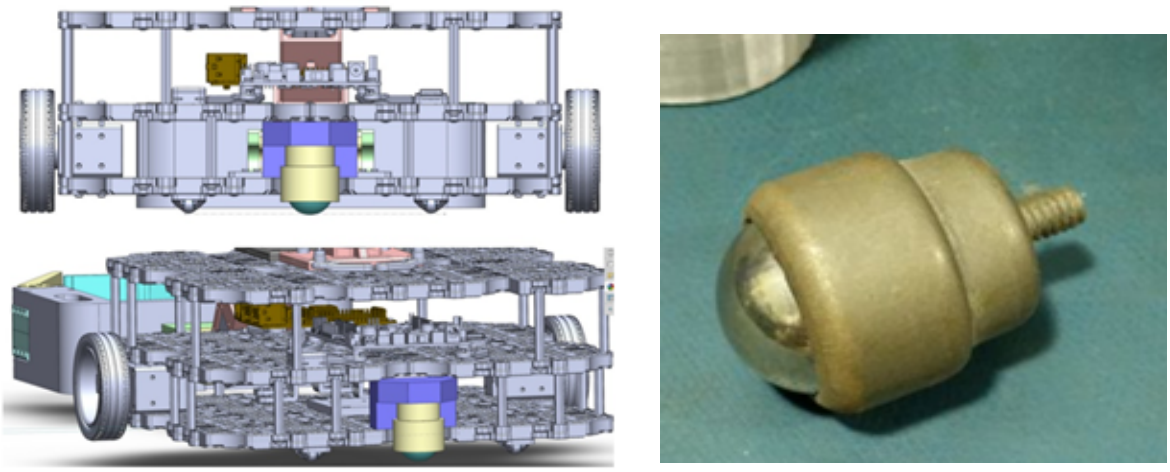

Fig 3. Design for new caster wheel
(Figure belongs to Paulo)

Future Work

Individual plans:

1. Analyze and compare 3D map/2D map with stereo camera vs 2D map of LiDAR.

2. Limit the range of stereo camera while mapping (becomes inaccurate for range >4 m).
3. Continue working on map creation and SLAM.
4. More research on SOTA SLAM - E.g. Semantic SLAM
5. Start, implement and deploy validation of picked toys using vision.

Team plans:

1. Initial room exploration strategies.
2. Completion of odometry reset.
3. Improve odometry by adding camera, LIDAR, and/or IMU information.
4. Failsafe operation in common states - i.e. avoid getting stuck in loops.