MONASH University

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MONASH ENGINEERING

SOFTWARE ENGINEERING

FINAL YEAR PROJECT

Soo Guan Yin, Andrew Prince, Lim Fluoryynx, Avinash Rvan, Jobin Dan, Mikhail Haris
Supervised by Dr Adamu Muhammad Buhari

ROS-based Autonomous Navigation System for Indoor Environment

INTRODUCTION

Our project mainly focuses on the automation of navigation systems for indoor environments using ROS-based systems. The main goals are as follows:

- ➢ Improve mapping accuracy
- ➢ Improve obstacle detection
- ➢ Allow a user to interact with robot during operation using voice commands

METHOD AND METHODOLOGY

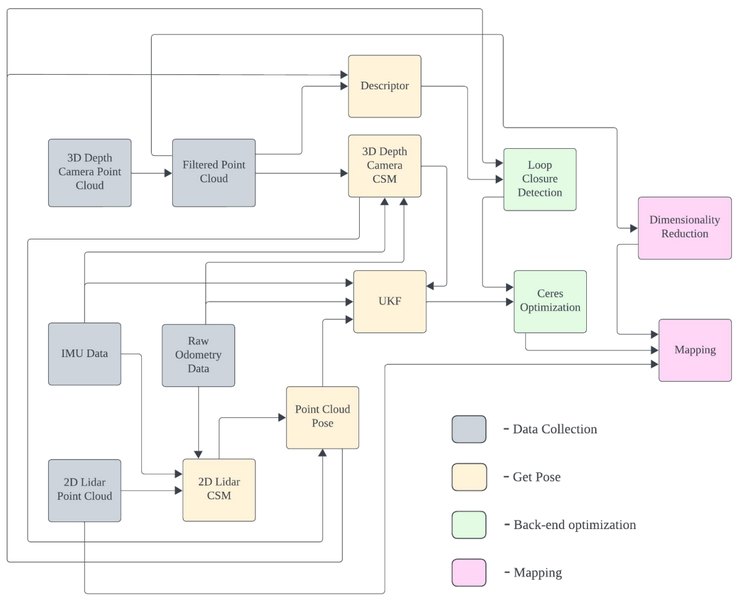


Figure 1: Flow chart of proposed method.

RESULTS AND DISCUSSION

Benchmarking results

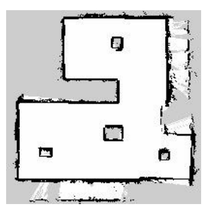


Figure 2: Mapping of kitchen

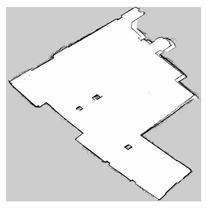
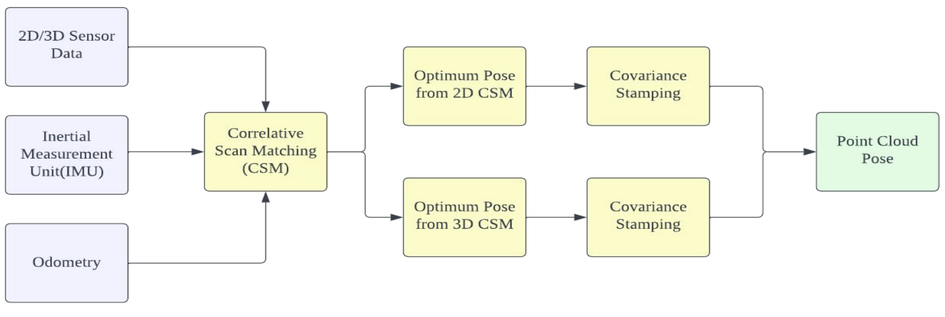


Figure 3: Mapping of basement

Location	SLAM methods	RSME (mm)	Proportion of occupied cells
Kitchen	Cartographer	104.791	0.2922
	Gmapping	37.789	0.3142
	Karto	69.280	0.2735
Basement	Cartographer	1257.6	0.2979
	Gmapping	116.2	0.4792
	Karto	95.4	0.3035

Fusing 2D and 3D Data for Enhanced Pose Estimation

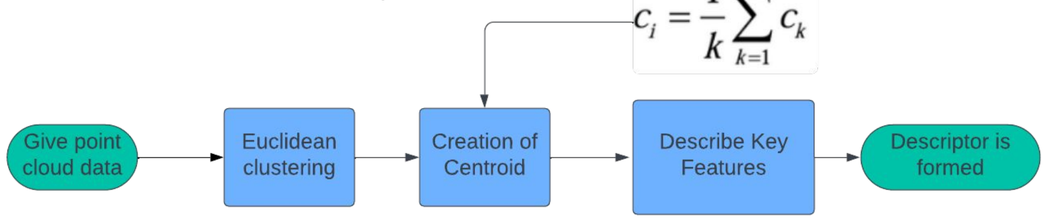
CSM refines 2D LiDAR and 3D Depth Camera data to improve pose estimation, fusing and optimising it for accurate real-time robot positioning [1].

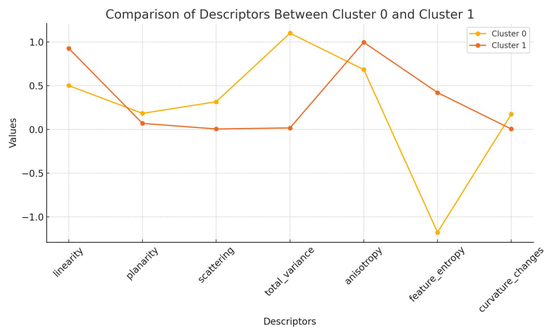


Descriptors

Descriptors summarize point cloud data by capturing important features. To create descriptors:

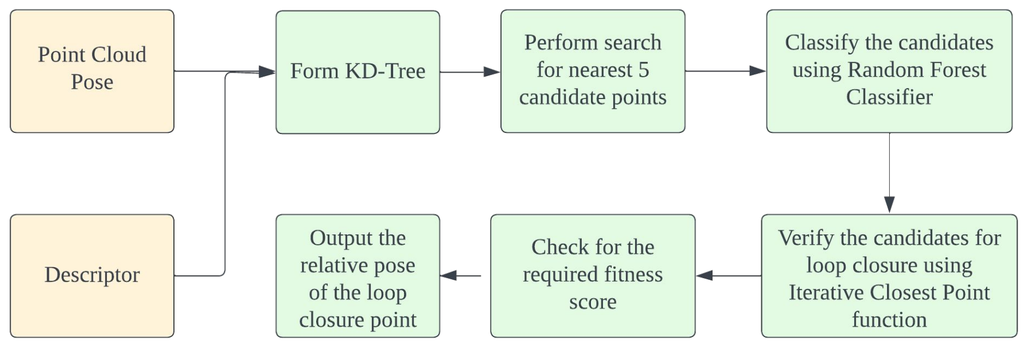
$$c_i = \frac{1}{k}\sum_{k=1}^{n} c_k$$



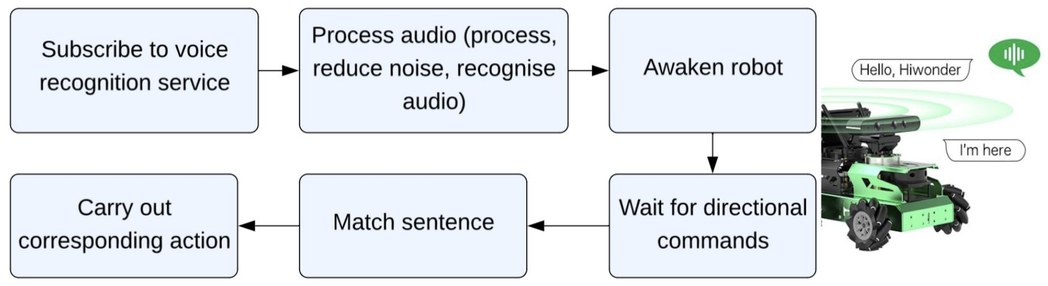


- Cluster 1: Compact with high anisotropy, showing strong directional variation.
- Cluster 0: More spread out, making it less stable for accurate matching.

Loop Closure



Voice Control



CONCLUSION

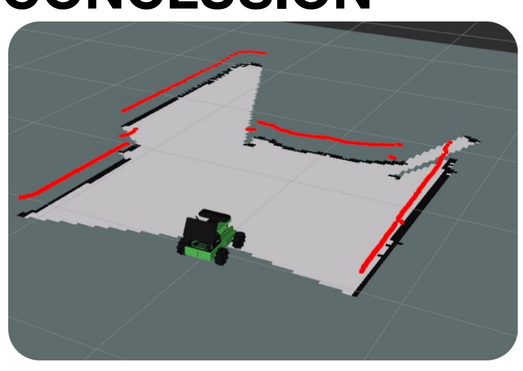


Figure 4: Robot default mapping algorithm that only use LiDAR

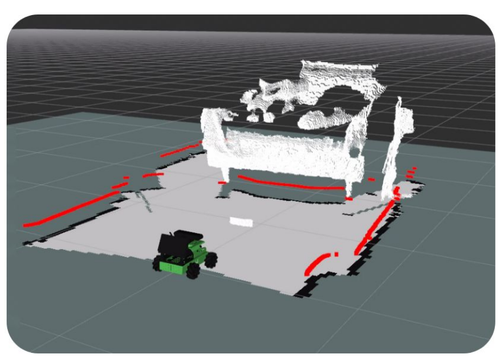


Figure 4: Robot default mapping algorithm that use LiDAR and Depth Camera

- ➢ The depth camera identifies obstacles that are below the 2D LiDAR's field of vision and displays them on the map.
- ➢ Robot gets awaken upon detecting "hello hi wonder" and responses with "I'm here"

REFERENCES

[1] L. Mu, P. Yao, Y. Zheng, K. Chen, F. Wang, and N. Qi, "Research on SLAM Algorithm of Mobile Robot Based on the Fusion of 2D LiDAR and Depth Camera," IEEE Access, vol. 8, pp. 157628-157642, 2020.