

The background of the slide is a wide-angle aerial photograph of a large university campus. The campus features numerous modern buildings with white or light-colored facades, some with green roofs. A large, well-maintained green lawn with a circular pattern is visible in the center. In the background, there are several hills covered in dense green trees under a clear blue sky.

[2022-2 PROJECT]

Self-Driving Robot for Fire Detection

Team AIM Lab

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Contents

■ Introduction

■ System Overview

■ Core Technologies

- ▶ SLAM
- ▶ Localization
- ▶ Fire Detection
- ▶ Stanley controller & Path follower

■ Experimental results

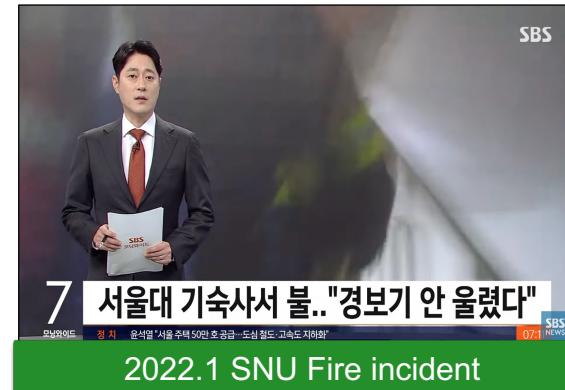
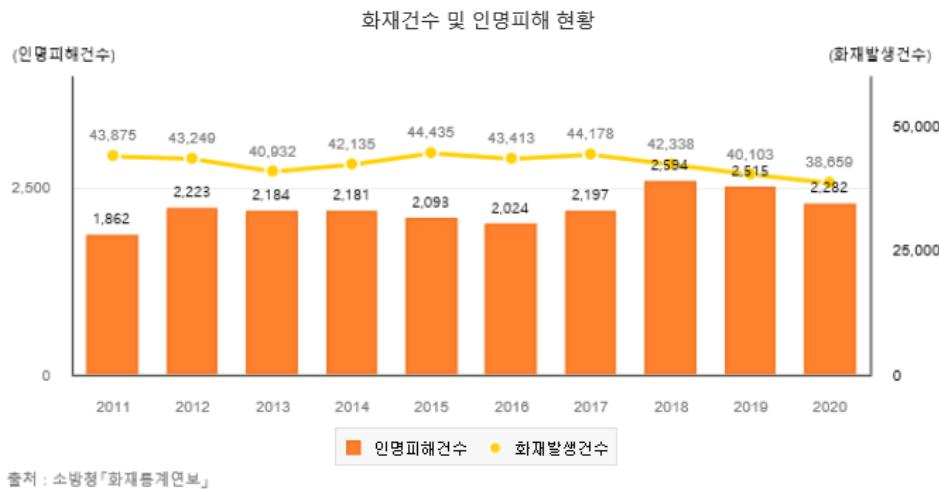
■ Conclusion

Introduction

Introduction

Recent Issues at Universities

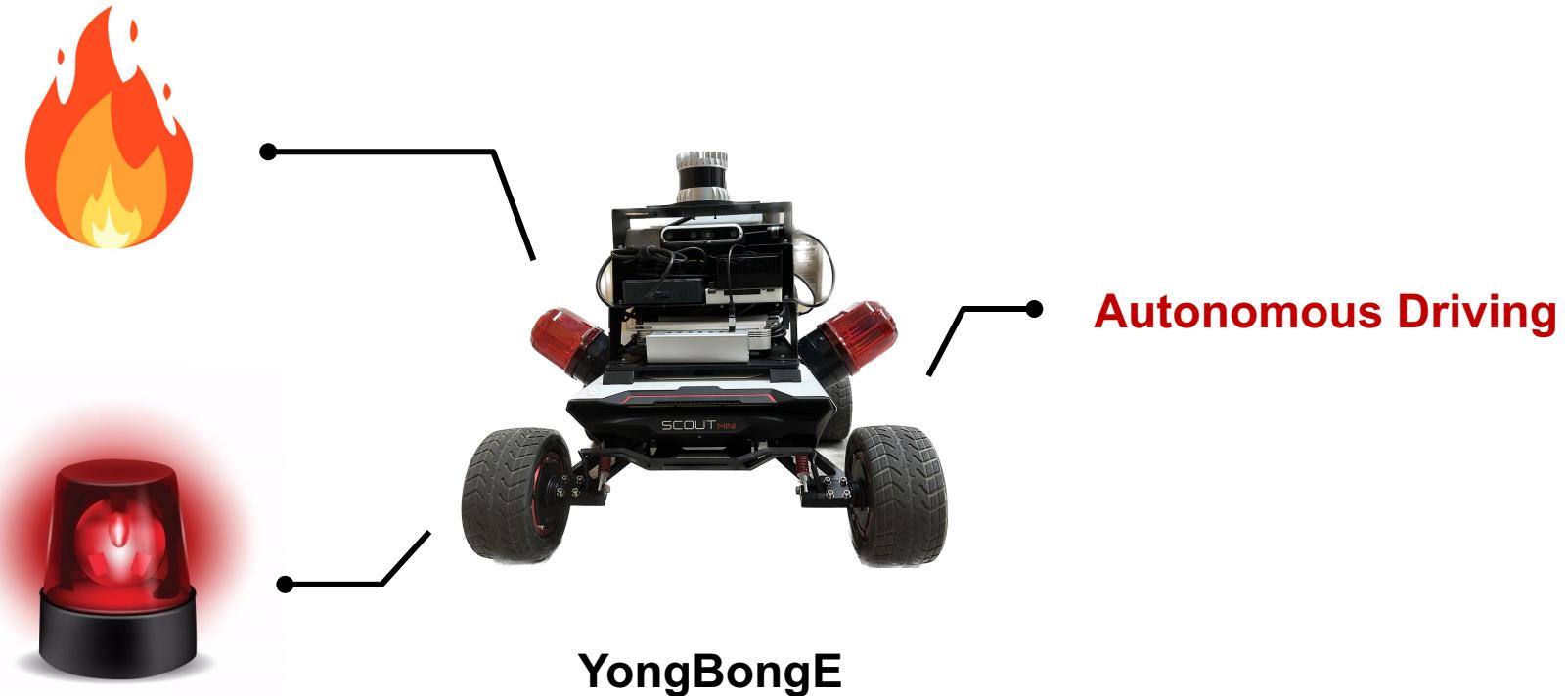
- ▶ About 40,000 fires in Korea in 2021 caused 2,000 casualties and 600 billion won worth of property damage
- ▶ Recently, the issue of dormitory fire in the university



Proposed Model : YongBongE

■ YongBongE : Self-driving Robot for Fire Detection

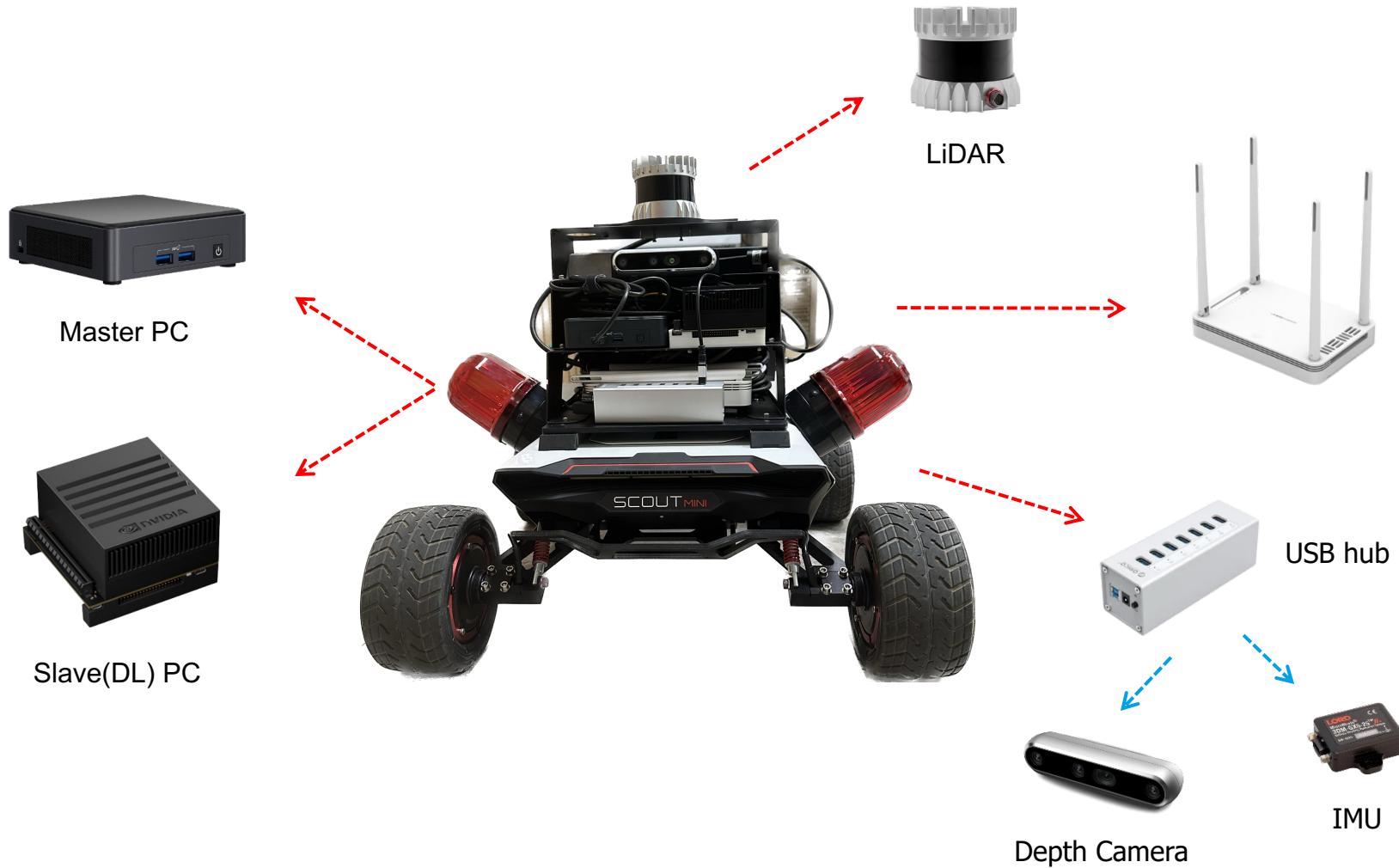
- ▶ Fire Detection and evacuation notification



System Overview

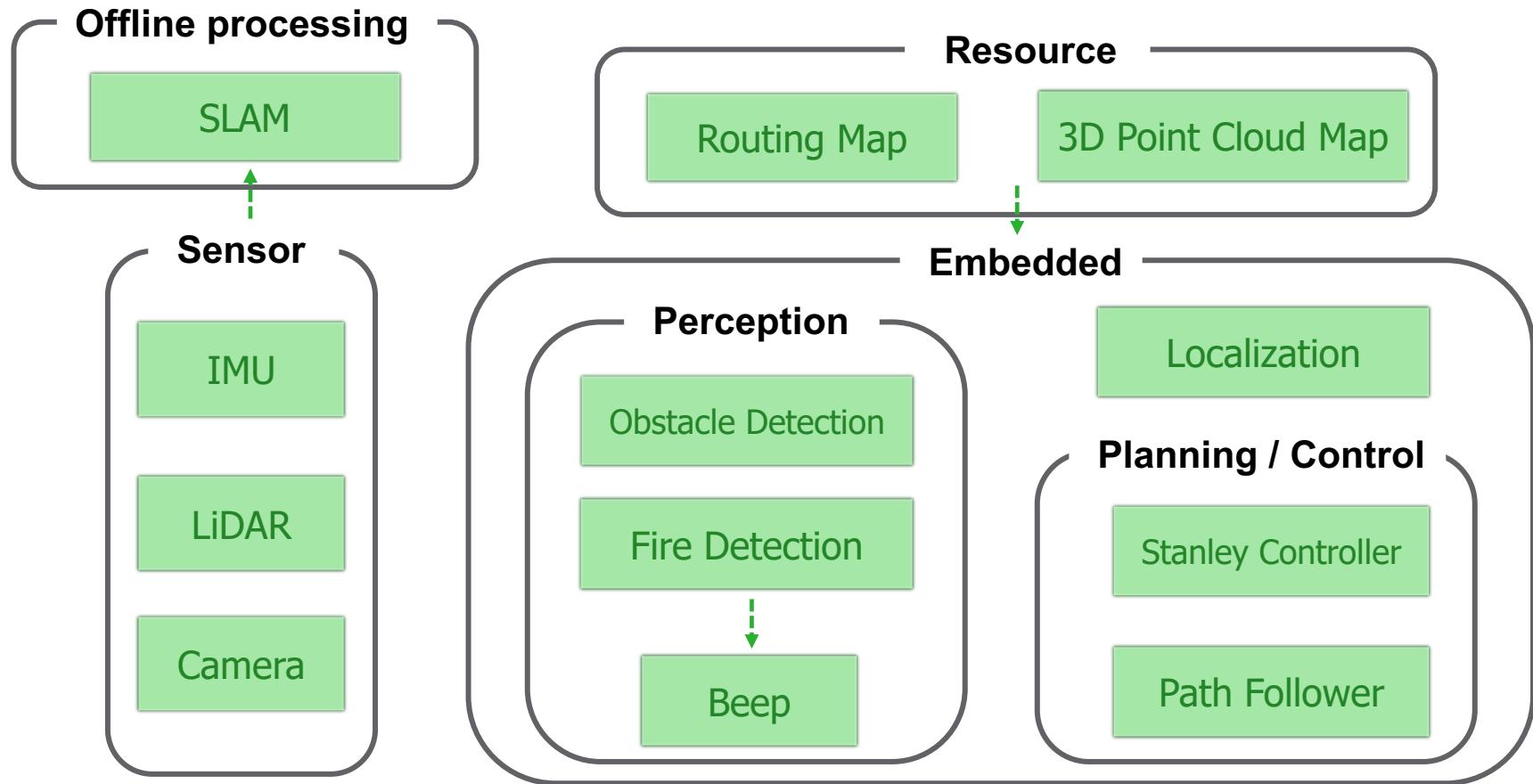
System Overview (I)

Components of YongBongE (HW)



System Overview (II)

■ Components of YongBongE (SW)



Core Technologies

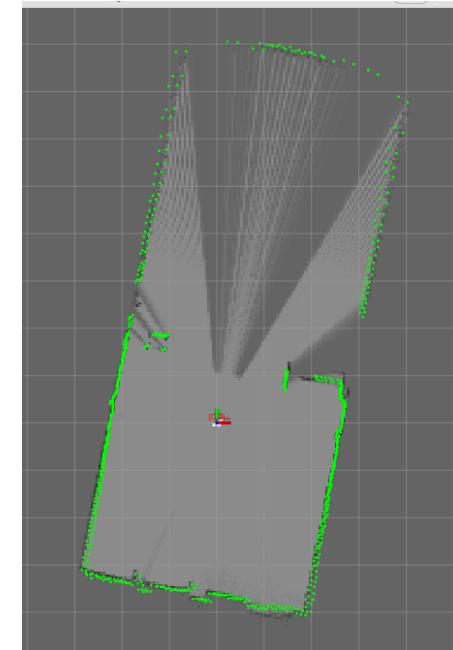
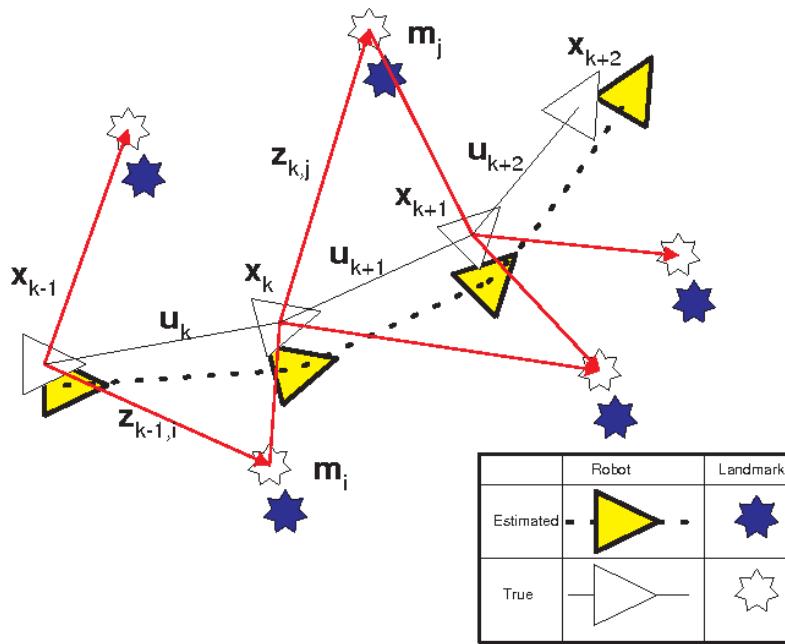
Core Technology 1 : SLAM

SLAM

▶ Simultaneous Localization and Mapping

Estimating the location of the robot

Making a map of what's around the robot



Core Technology 1 : SLAM

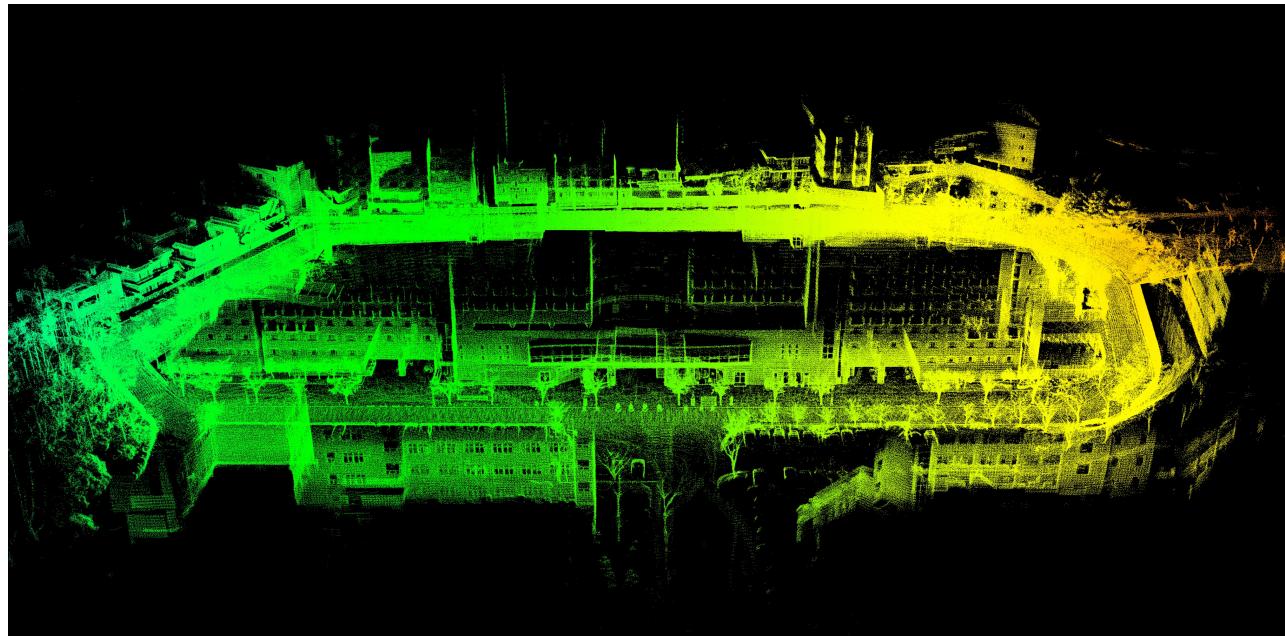
■ SLAM

► Simultaneous Localization and Mapping

Estimating the location of the robot

Making a map of what's around the robot

► Algorithm : LIO-SAM



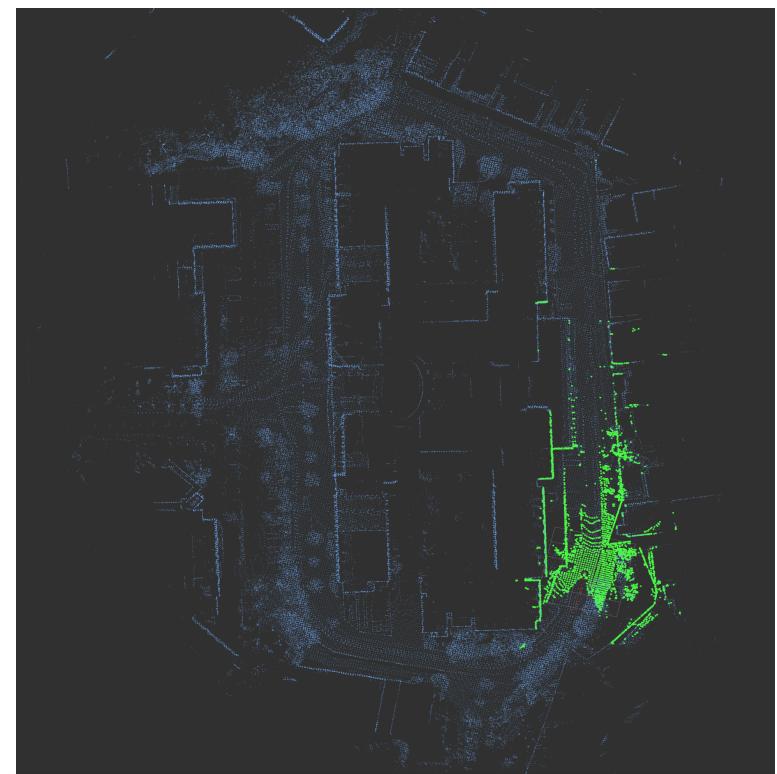
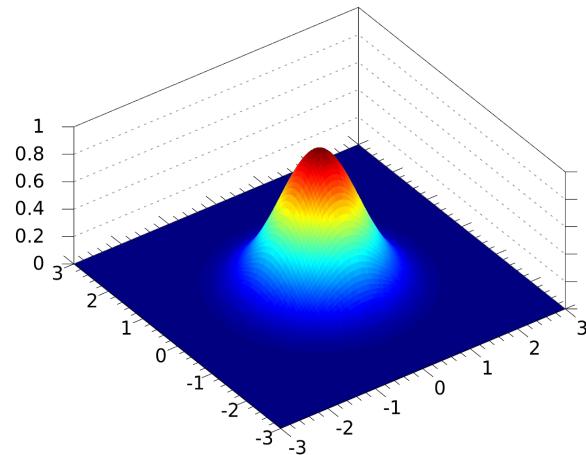
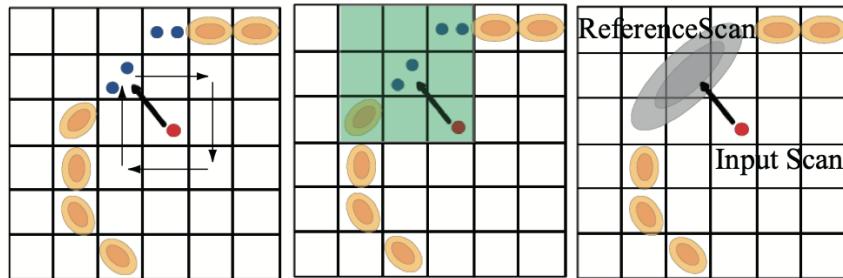
Results of mapping around dormitory using LIO-SAM

Core Technology 2 : Localization

■ Localization

► Algorithm : NDT(Normal Distributions Transform) Matching

- Statistical models of 3D points to determine the most probable registration between two point clouds.

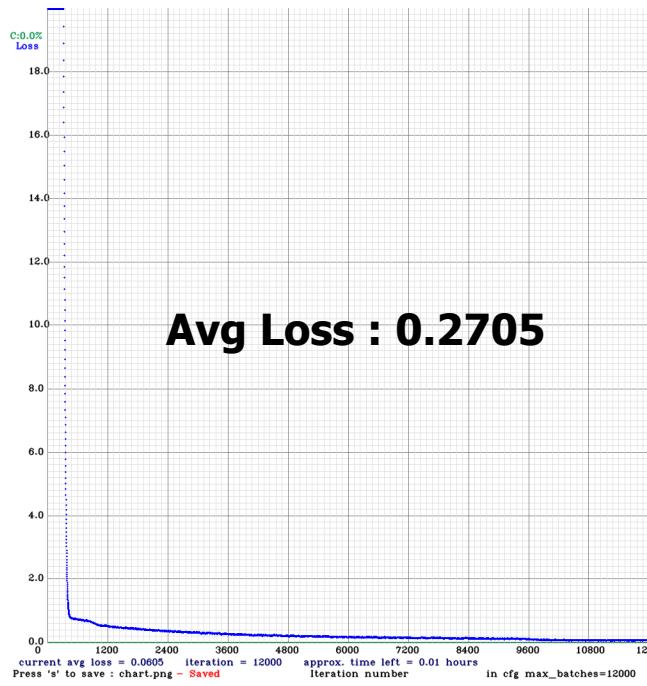


Results of Localization around dormitory using NDT

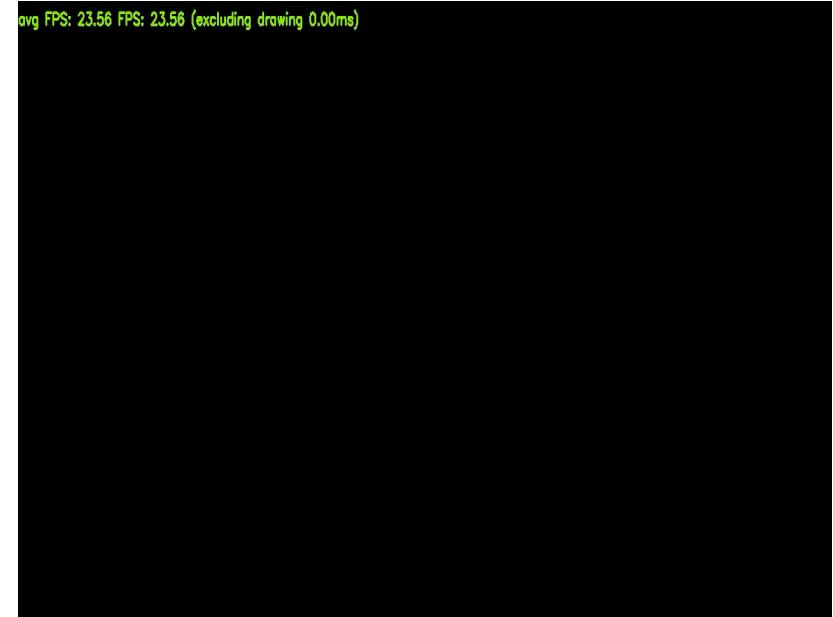
Core Technology 3 : Fire Detection

■ ML based Object Detection

- ▶ Model : YOLOv4 tiny
- ▶ Custom Training for Fire Objects
- ▶ Evacuation notification sounds activated when a fire is detected



Inference
→

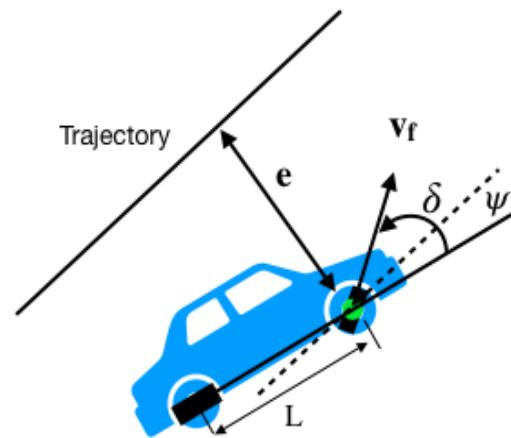


Core Technology 4 : Stanley controller & Path follower

Stanley Controller

- ▶ Hold the front wheel as a reference point
- ▶ Control by considering Cross track error and heading error

$$\delta(t) = \psi(t) + \arctan\left(\frac{kx(t)}{u(t)}\right)$$



Path follower

Stanley Controller

Lateral Control

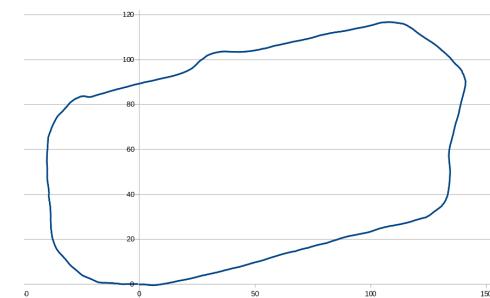
Constant Speed

0.8m/s

+

→

Path



Experimental results

Experimental results

■ YongBongE around CNU Dormitory



Autonomous Driving around CNU dormitory



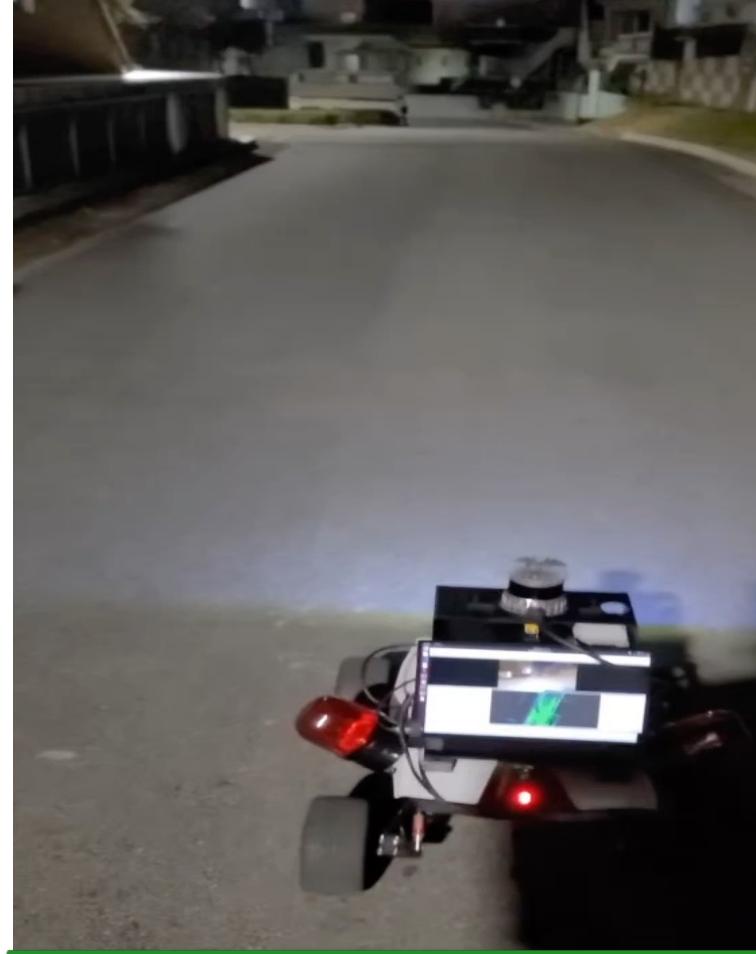
Fire Detection

Experimental results

■ YongBongE around CNU Dormitory



Walking Obstacle



Running Obstacle

Conclusion

Conclusion

■ YongBongE

- ▶ 1) Construction of a HDmap of the around dormitory based on 3D LiDAR SLAM.
- ▶ 2) Estimating the current position of YongBongE by matching the map and sensing data.
- ▶ 3) Implementation of fire detection system using YOLOv4 tiny and alarm operation.
- ▶ 4) Autonomous driving in navigation path using Stanley controller & Constant Speed.

■ Expected effects

- ▶ Minimum damage in the accident of Fire
- ▶ Patrol around the dormitory is possible through Autonomous Driving

■ Future work

- ▶ It will provide a service to detect and track suspicious pedestrians or thieves
- ▶ Service across the entire school beyond the dormitory

Thank you