Navigational Sensing for the EduBot

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Introduction

- Autonomous navigation
- Detecting obstacles is crucial
- LIDAR – Light Detection and Ranging
  - Spinning laser measures distances
- Goal: Create a map

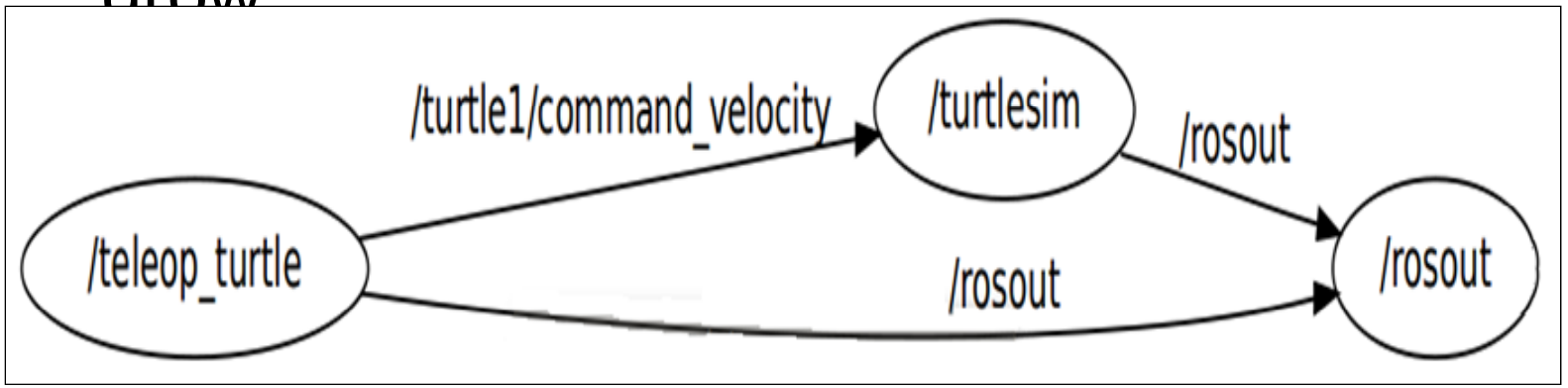
EduBot & RHex

- Family of 6-legged robots
- Designed to move on a variety of terrains

ROS

- Robot Operating System
- Open-Source
- Modular programming
- Easy to expand and grow

- Parts of Speech
  - Nodes
  - Topics
  - Messages



SLAM

- Simultaneous Localization & Mapping

- Determine position while mapping
- Compare successive laser measurements
- Compute the change in position

Requirements for ROS Mapping

- Computer running ROS
- Laser scanner

- Odometry Data
  - ROS uses SLAM and odometry for mapping
  - Cart: Script for manual position updates

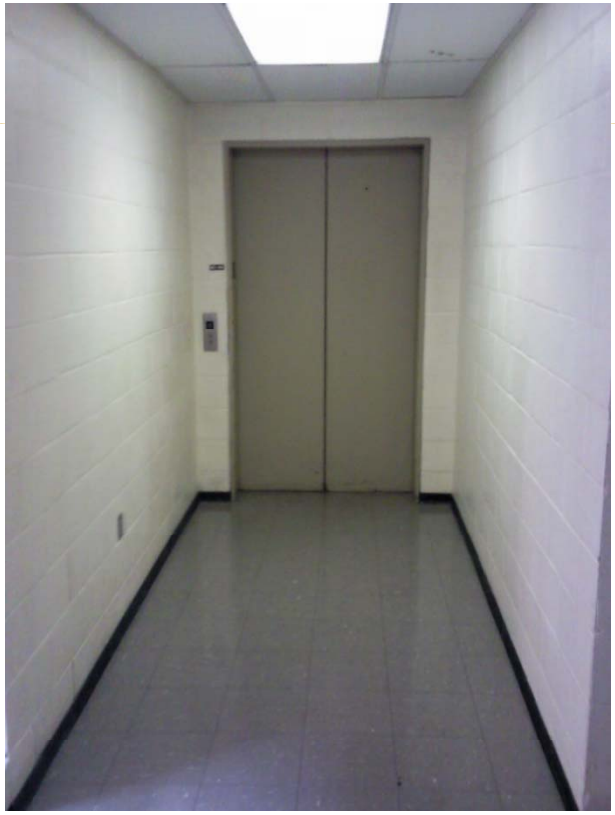
Source: Hokuyo Automatic Co., Ltd. (www.hokuyo-aut.jp)

The Mapping Process

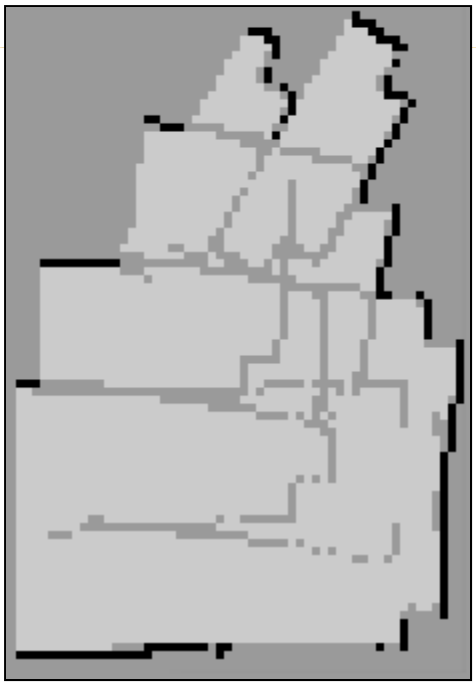
- Begin gathering laser and odometry data
- “Record” this data
- “Play back” this data while running the mapping utility
- Save the map

Maps from the Cart

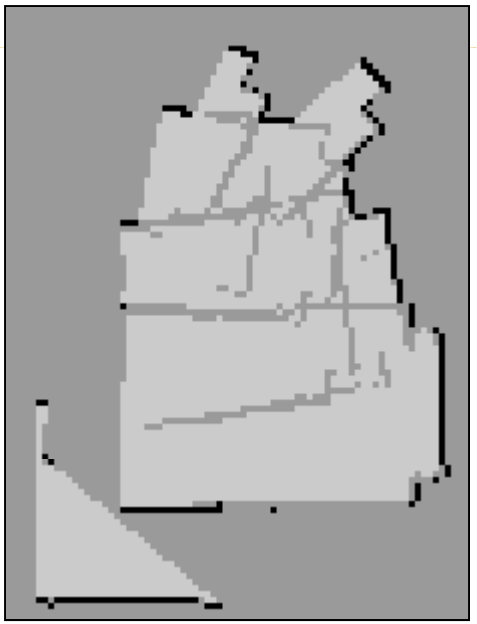
Actual GRW Elevator Lobby



Attempt 1

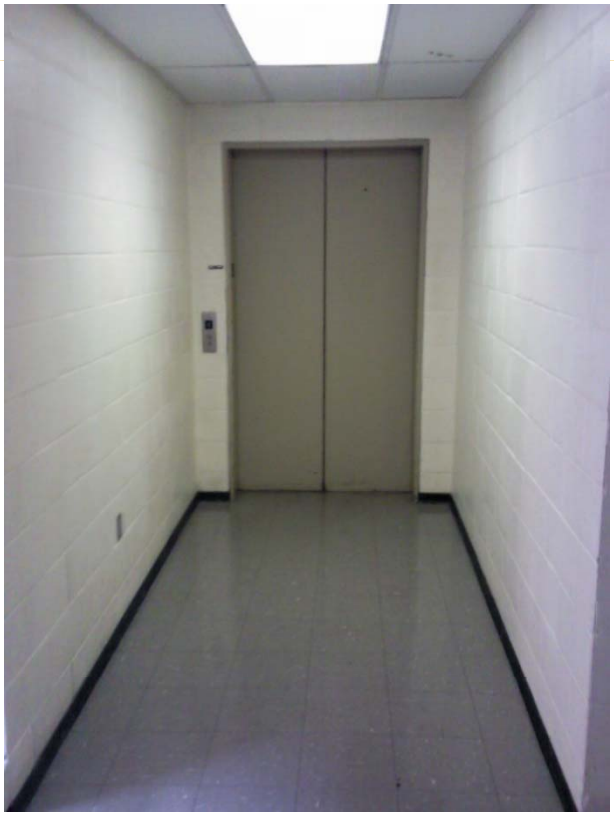


Attempt 2

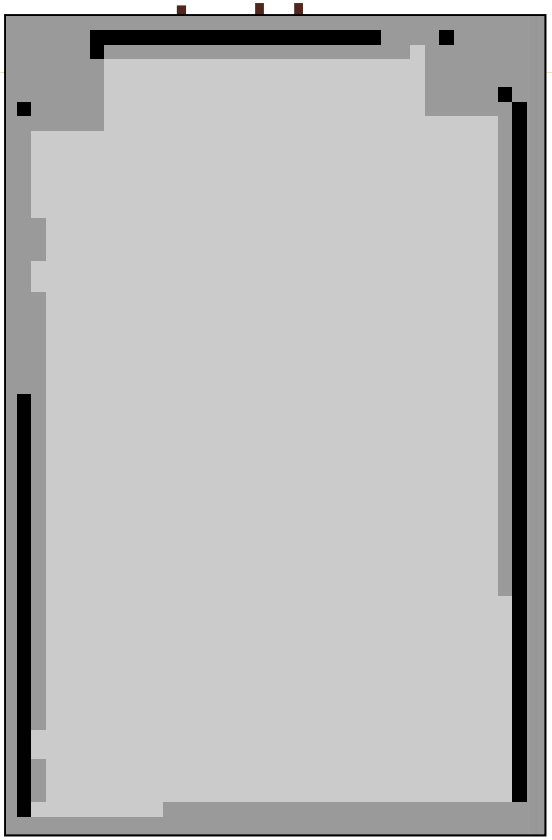


Maps from the Cart

Actual GRW Elevator Lobby



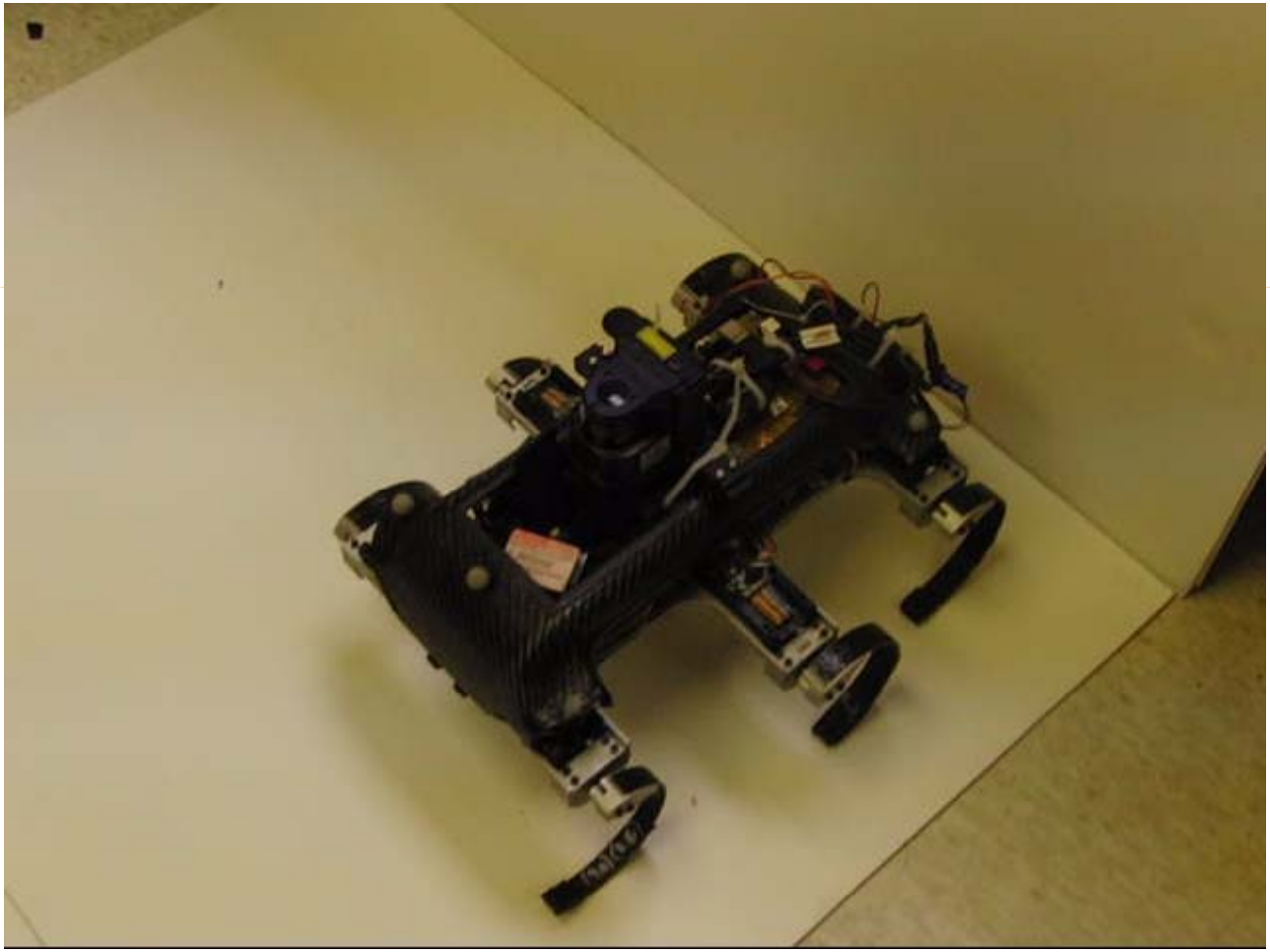
Mapped GRW Elevator



Implementation on the EduBot

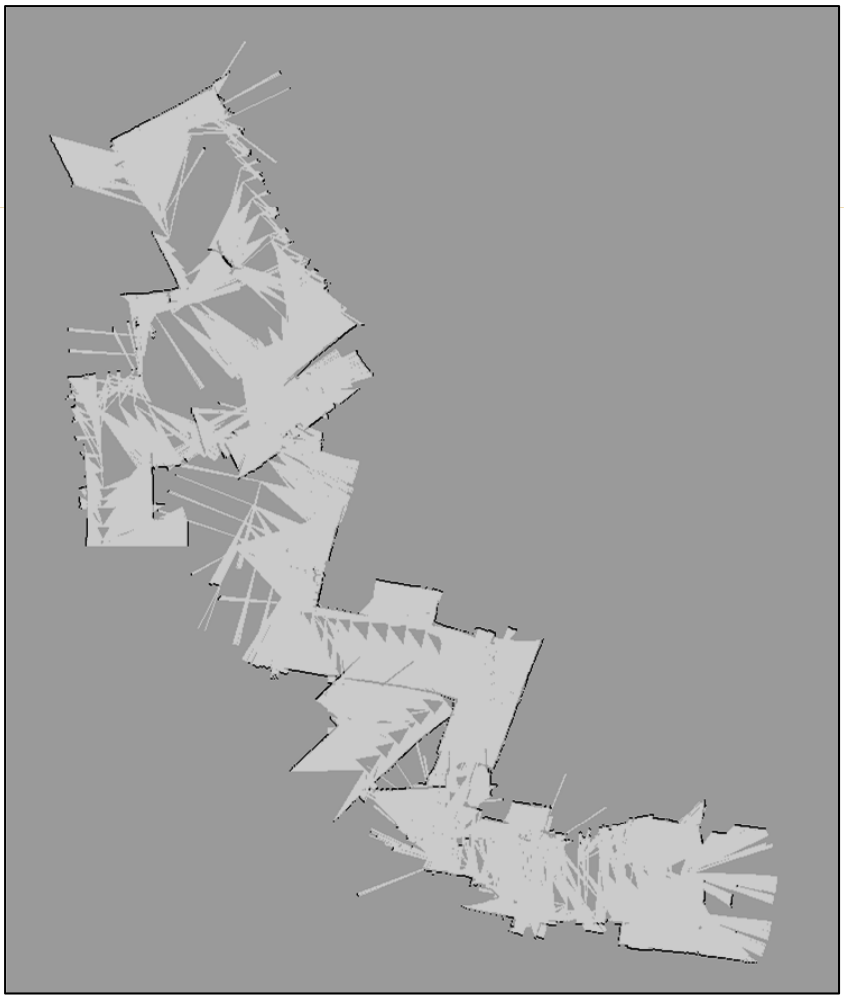
- Laser mounted on EduBot
- Laser powered from EduBot battery
- Odometry Program
- Speed = 15 cm/s
- Turn Speed = π/8 rad/s

EduBot Mapping



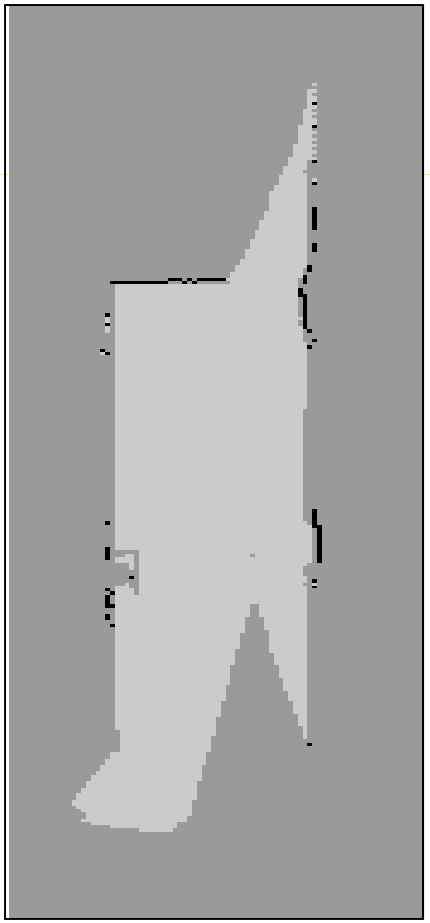
Maps from the Edubot

Levine Lobby



Maps from the EduBot

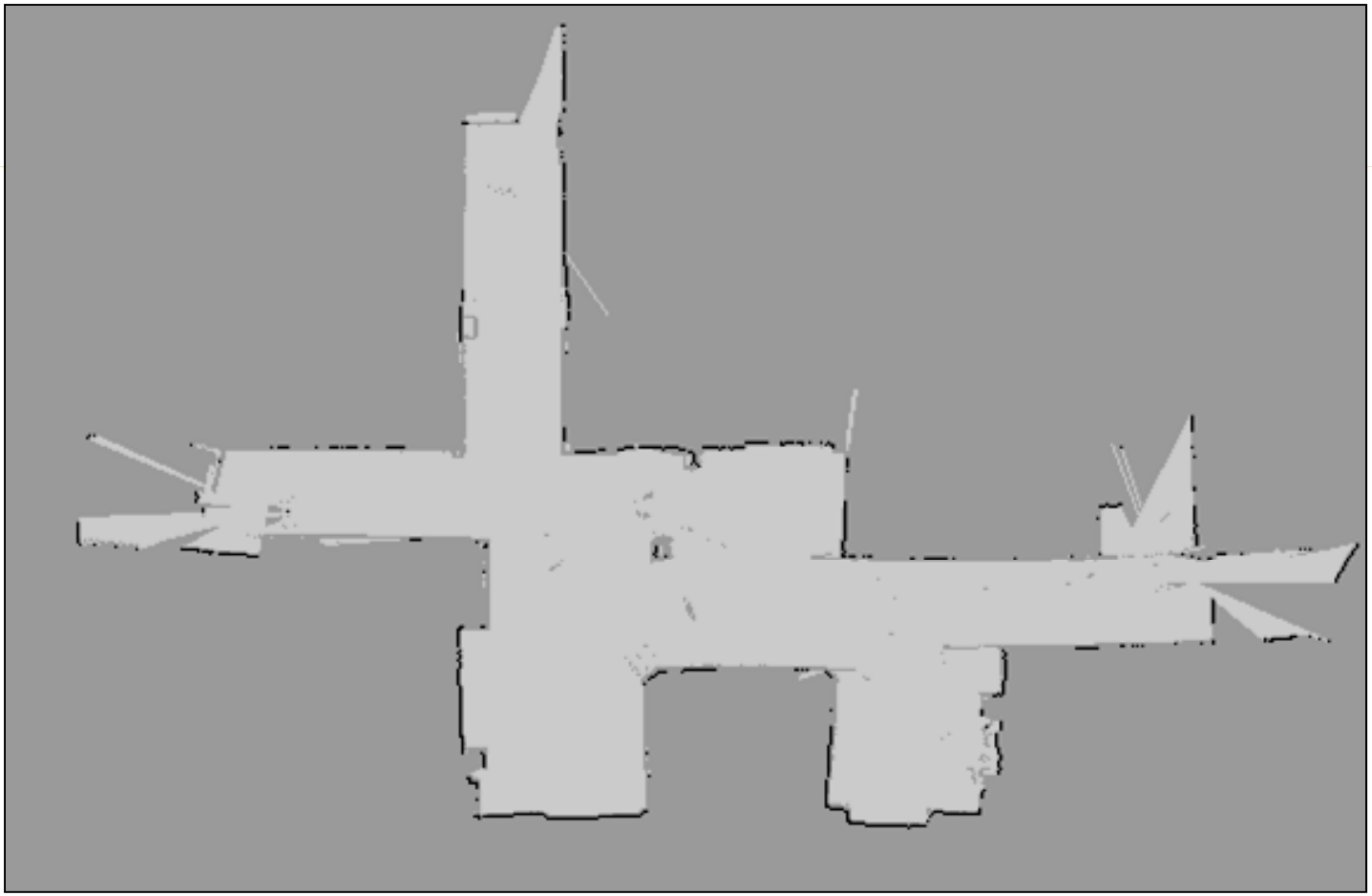
KodLab/Haptics
Lab Hallway



The KodLab Hallway

Maps from the EduBot

KodLab/Haptics Lab Hallway



Future Work

- Can be used with ROS Navigation Stack
  - Autonomous Navigation to desired pose
- Better physical stability to reduce G forces
  - E.g. in the desert
- ROS on EduBot
- GPS (only outdoors)

Source: KodLab Website (kodlab.seas.upenn.edu)

Acknowledgements

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Battery Power

- Two 14.8V, 1320mAh batteries
- Still: 10W (0.68A)
- Walking: 30W (2.03A)
- Laser: 4.4W (0.37A)
- Without Laser
  - Walking: ~40 minutes
  - Still: ~120 minutes
- With Laser
  - Walking: ~33 minutes
  - Still: ~75 minutes