RWTH Aachen University - LELY Solution Documentation

RWTH Team

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1 Abstract

Our solution to the LELY Challenge consists of a team of asymmetrical robots implemented in ROS. Robot A navigates and maps its environment with use of a 2D LIDAR system. Robot B recieves a map of the environment and location data from Robot A and then uses its 3 ultrasonic sensors to navigate.

This document provides an outline of the design of the systems and the thought process behind their development.

2 Robot A

2.1 Overview

Robot A is a LIDAR-capable platform. Due to the walls of the challenge being only 37cm tall, the mounting point of the LIDAR is on the bottom front of the chasis, providing a 200 degree field of view. The restricted point of view is overcome through the natural turning of the robot during navigation.

2.2 Sensors

A RPLIDAR A1M8-R6 LIDAR is mounted on the front of the robot. The LIDAR interfaces with the laptop directly over USB.

The A1M8-R6 was chosen due to its excellent support in the ROS ecosystem, allowing for the implementation of a straightfoward mapping stack.

2.3 Hardware

A 3D-printed mount was created for easy placement and adjustment of the LIDAR.

2.4 Software

The A1M8-R6 LIDAR comes with ROS packages which allow for SLAM mapping without odometry information up to 12 meters. An ideal navigation stack for Robot A would be to use the gmapping ROS package to generate a cost map, allowing for the robot to be steered via the ROS move_base package.

Figure 1: The LIDAR sensor and 3D-printed mounting point attached to Robot A

However, due to technical difficulties with move_base, Robot A implements a wall following and corner detection algorithem. Five equally-spaced lines in front of the robot are sampled via LIDAR allowing it to maintain a constant distance to walls and to count and detect corners. Diffrerentiating between corners with right turns and left turns allow the robot to locate itself in a predefined map with uncertain wall lengths.

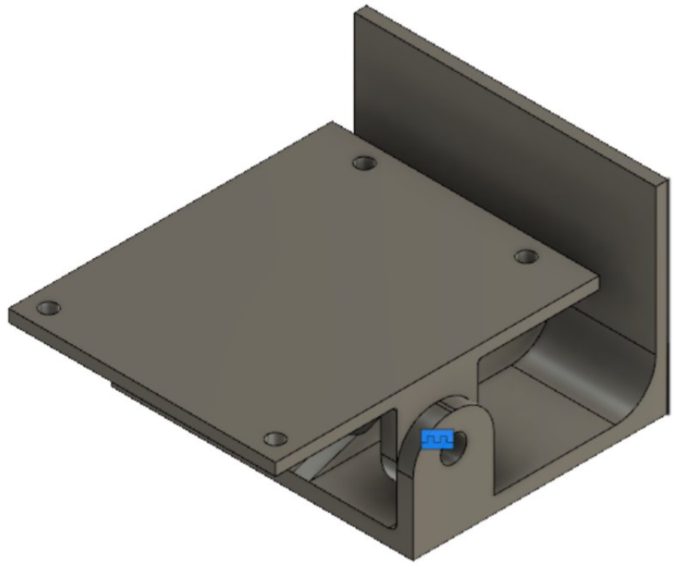

Figure 2: CAD rendering of LIDAR mount

3 Robot B

3.1 Overview

Robot B uses ultrasonic sensors mounted via aluminium frame to navigate its environment.

3.2 Sensors

Three HC-SR04 ultrasonic sensors are placed in an array around the robot. The sensors interface with the laptop via an Arduino Uno.

3.3 Hardware

An aluminium frame with 3D-printed connection points extends from the top mounting point to the bottom of the robot, allowing the sensors to attach to a low-enough point to read the walls of the maze.

Figure 3: Robot B with mounting frame, 3D-printed connectors, and ultrasonic sensors

3.4 Software

DESCRIPTION OF SOFTWARE

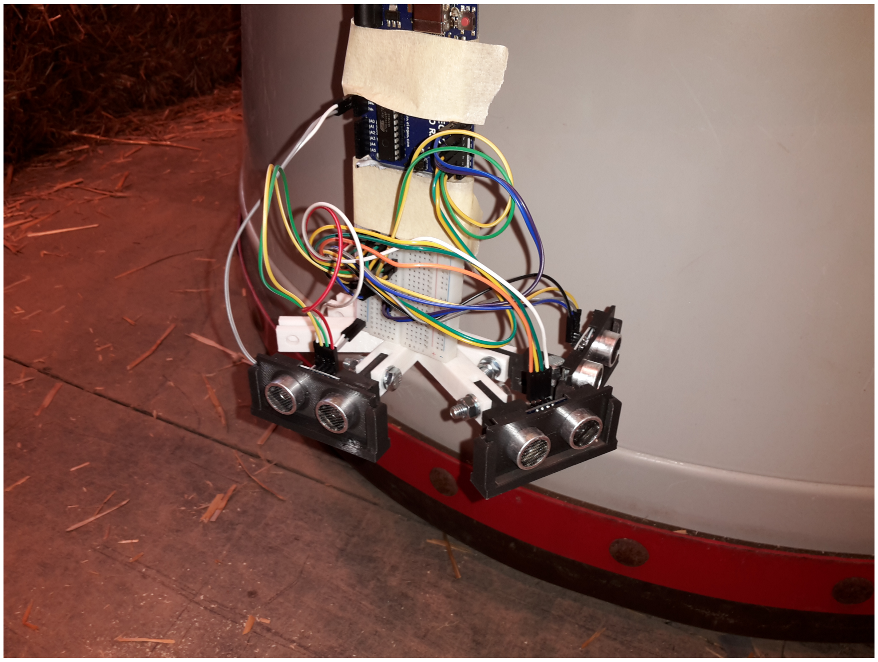

Figure 4: Robot B with mounting frame, 3D-printed connectors, and ultrasonic sensors

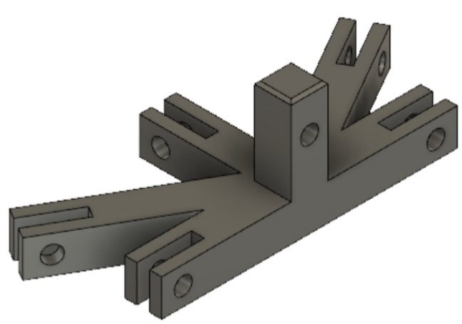

Figure 5: Central mount for connection points

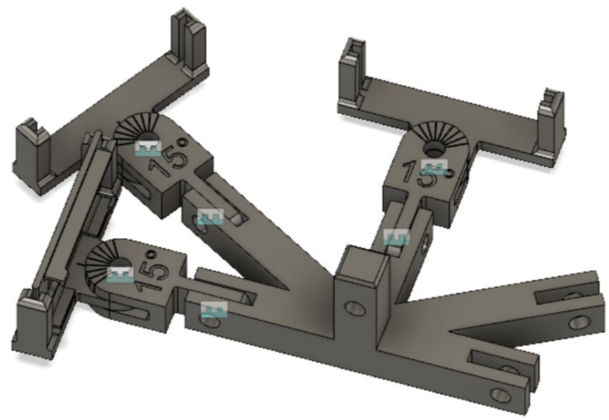

Figure 6: Central mount with connections for ultrasonic sensors