One-Pager: Autonomous Mobile Robot with LiDAR Mapping

Group: 07

Team Members: Emir Orozbekov, Kyial Asykpaeva, Altynai Munduzbaeva, Nargiza Alieva, Zhanetta Tynymbekova, Hanna Hryshyna

1. Project Summary

This project focuses on the design and implementation of an autonomous mobile robot capable of navigating an indoor environment using LiDAR-based perception and ROS.
The robot builds a map of its surroundings in real time, detects obstacles, and makes movement decisions without human intervention.
The project emphasizes classical robotics techniques, system integration, and reliable real-time operation rather than machine learning.

2. Scope of Work

- Primary Goal: Develop an autonomous mobile robot that can safely navigate and build a map of an unknown indoor environment using LiDAR and ROS.
- Core Functionality:
  - Real-time LiDAR data acquisition.
  - SLAM-based map generation.
  - Obstacle detection and avoidance.
  - Autonomous navigation with multiple operating modes (STOP, MAP, AUTO).
  - Visualization of robot state, map, and sensor data using RViz.
- Out of Scope:
  - Outdoor navigation.
  - GPS-based localization.
  - Fully ML-based perception.
  - Manipulation tasks (robot arms, grippers).

3. Hardware Requirements

The following components are essential for the construction of the robot:

- Robot Platform: UGV02 tracked mobile robot.
- Main Computer: NVIDIA Jetson Xavier Nano Developer Kit.
- Sensor: RPLidar A1 (2D LiDAR).
- Motor Control: Integrated motor controller (PWM-based).
- Power: Onboard battery system.
- Miscellaneous: Mounting hardware, wiring, network connectivity.

4. Technology Stack

- **Robotics Framework**:
  - ROS (Robot Operating System).
  - RViz for visualization.
- **Programming & OS**:
  - Ubuntu Linux.
  - Python-based ROS nodes.
- **Navigation & Mapping**:
  - LiDAR-based SLAM.
  - Occupancy grid mapping.
  - Rule-based obstacle avoidance.
- **Communication**:
  - ROS topics (`/scan`, `/map`, `/laser`).
  - HTTP JSON commands for motor control.