HOF UNIVERSITY OF
APPLIED SCIENCES

Autonomous Mobile Robot with LiDAR Mapping

UGV02 Platform + Jetson Xavier Nano + RPLiDar A1

Team members

Orozbekov Emir

Asykpaeva Kyial

Munduzbaeva Altynai

Alieva Nargiza

Tynymbekova Zhanetta

Hryshyna Hanna

Project Motivation

- Growing importance of autonomous mobile robots
- Need for safe navigation and obstacle avoidance
- Integration of ROS, LiDAR, and embedded systems

Project Goal

Build an autonomous mobile robot

Real-time obstacle detection using LiDAR

ROS-based software architecture

High-level control on Jetson, motor control on ESP

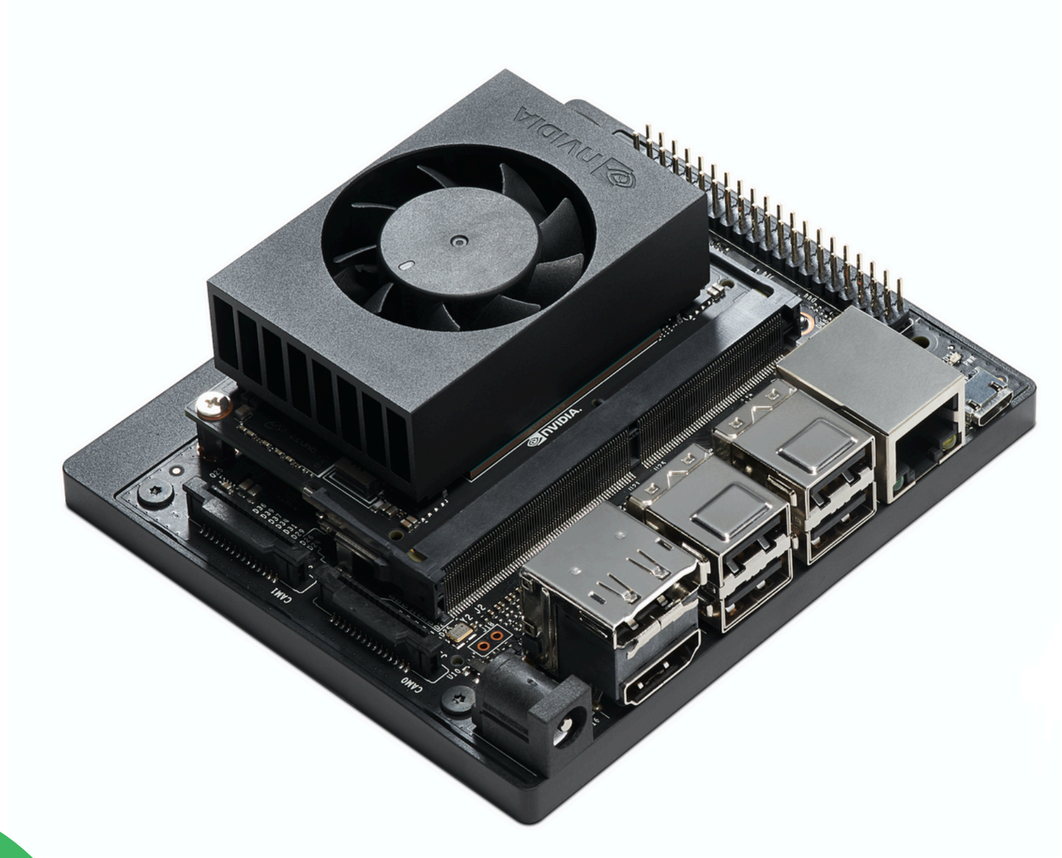
Robot Platform Overview

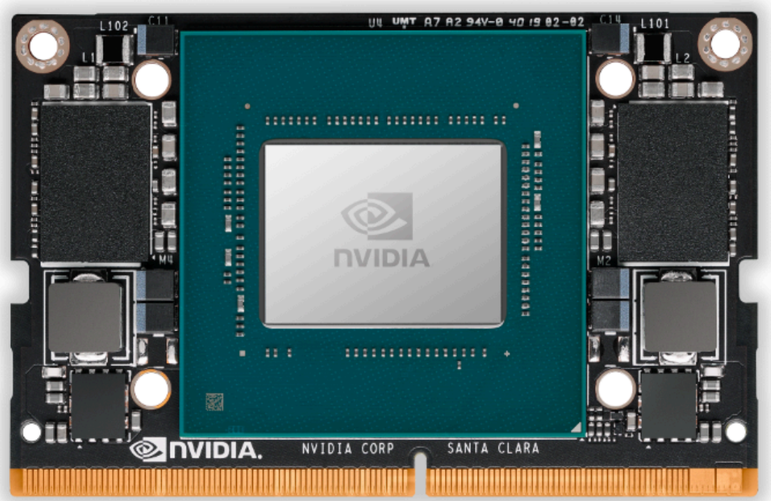
- UGV02 tracked robot platform
- Indoor navigation
- Stable movement

Main Hardware Components

- Jetson Xavier Nano (main computer)
- LiDAR sensor
- Motor controller + motors
- Battery system

Why Jetson Xavier Nano





- Ubuntu + ROS support
- Real-time processing
- Suitable for robotics applications
- No ML required

Why LiDAR

- Accurate distance measurement
- Lighting independent
- Reliable obstacle detection
- Suitable for indoor mapping

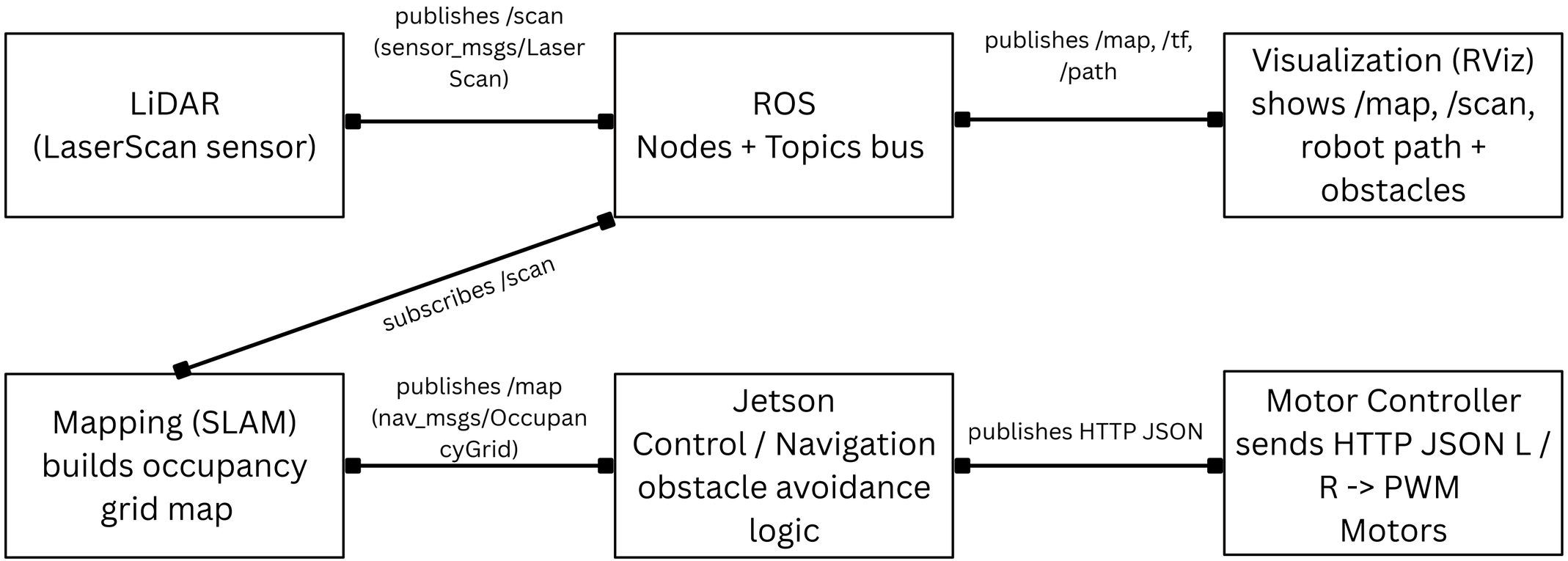
Software Environment

ROS (Robot Operating System)

Ubuntu Linux

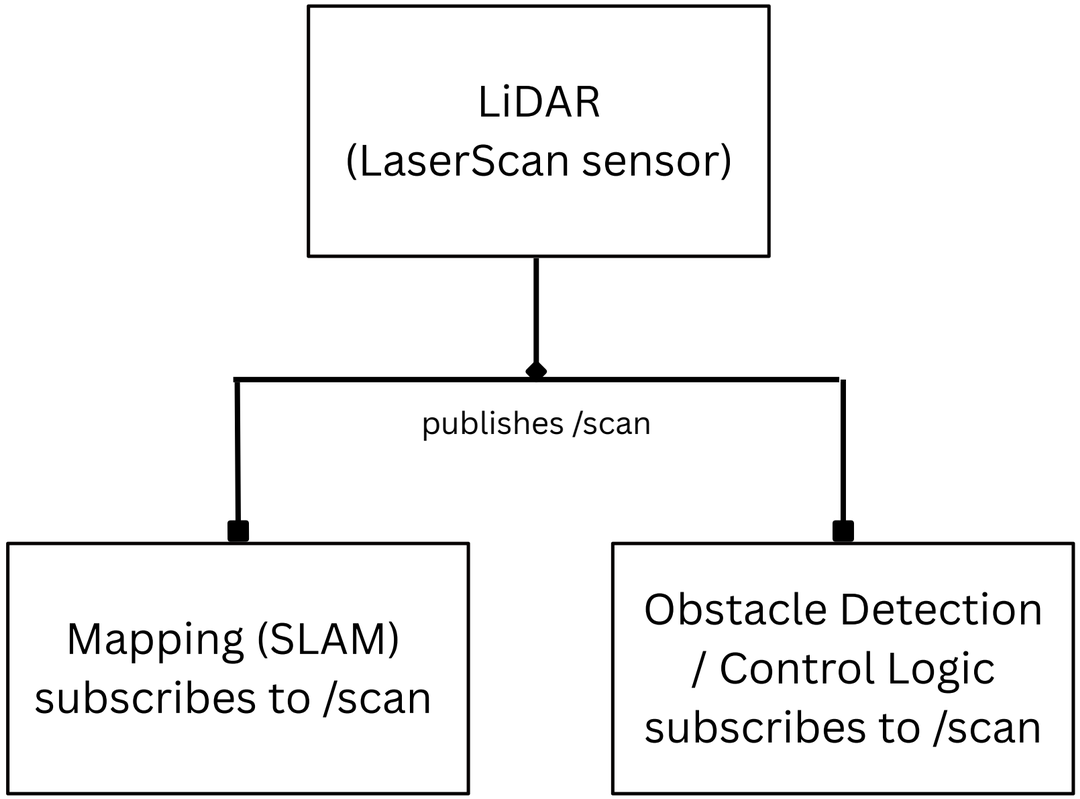
Python-based nodes

ROS Architecture



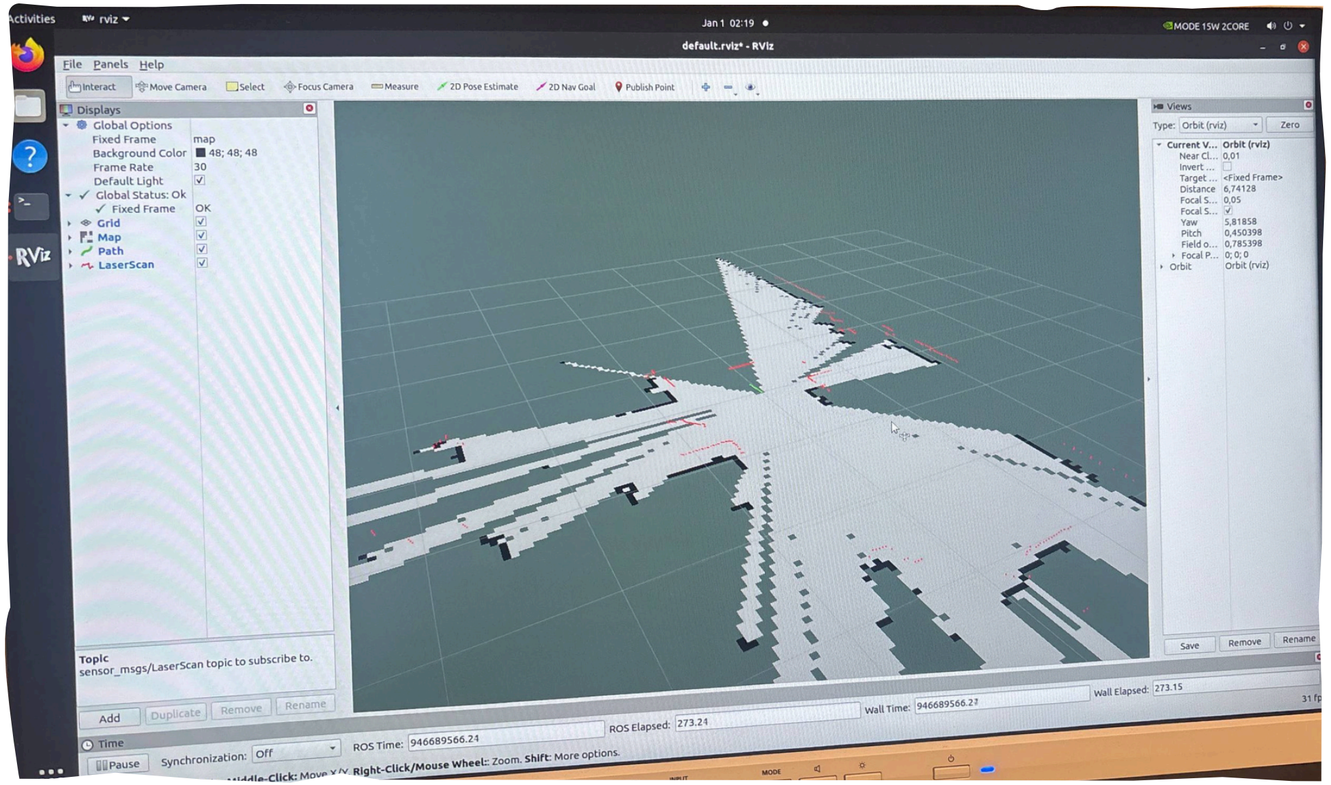
Sensor Data Flow

- /scan — LiDAR data
- Data published continuously
- Used by: mapping, obstacle detection

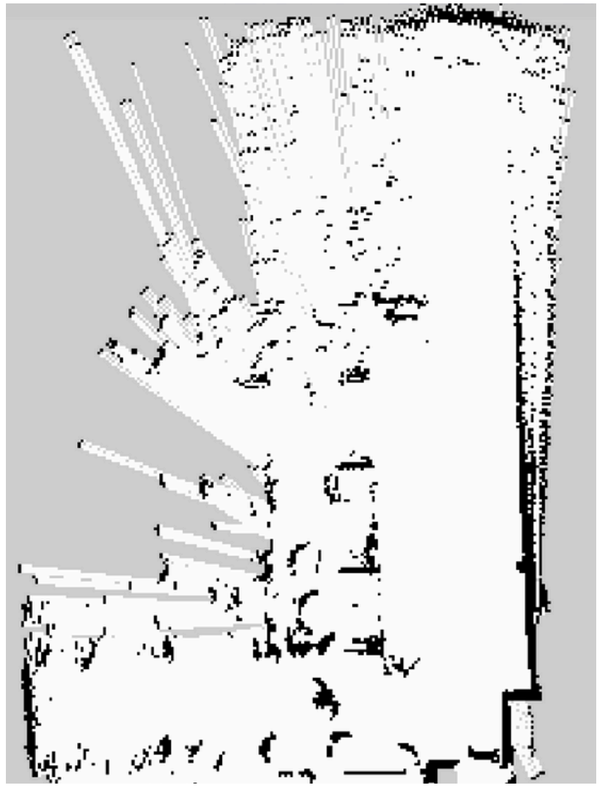


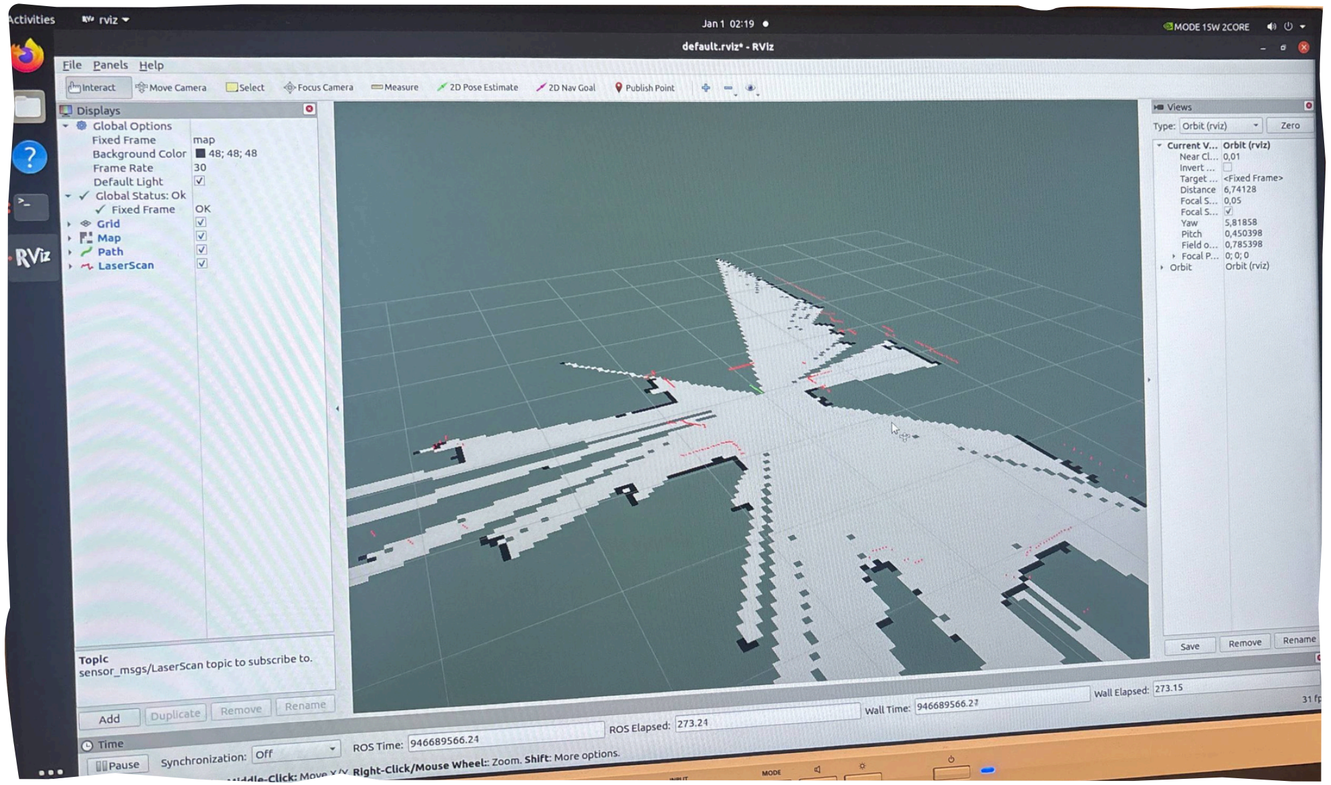
Mapping Process

- SLAM-based mapping
- Robot builds map while moving
- Map updated in real time



Map Visualization





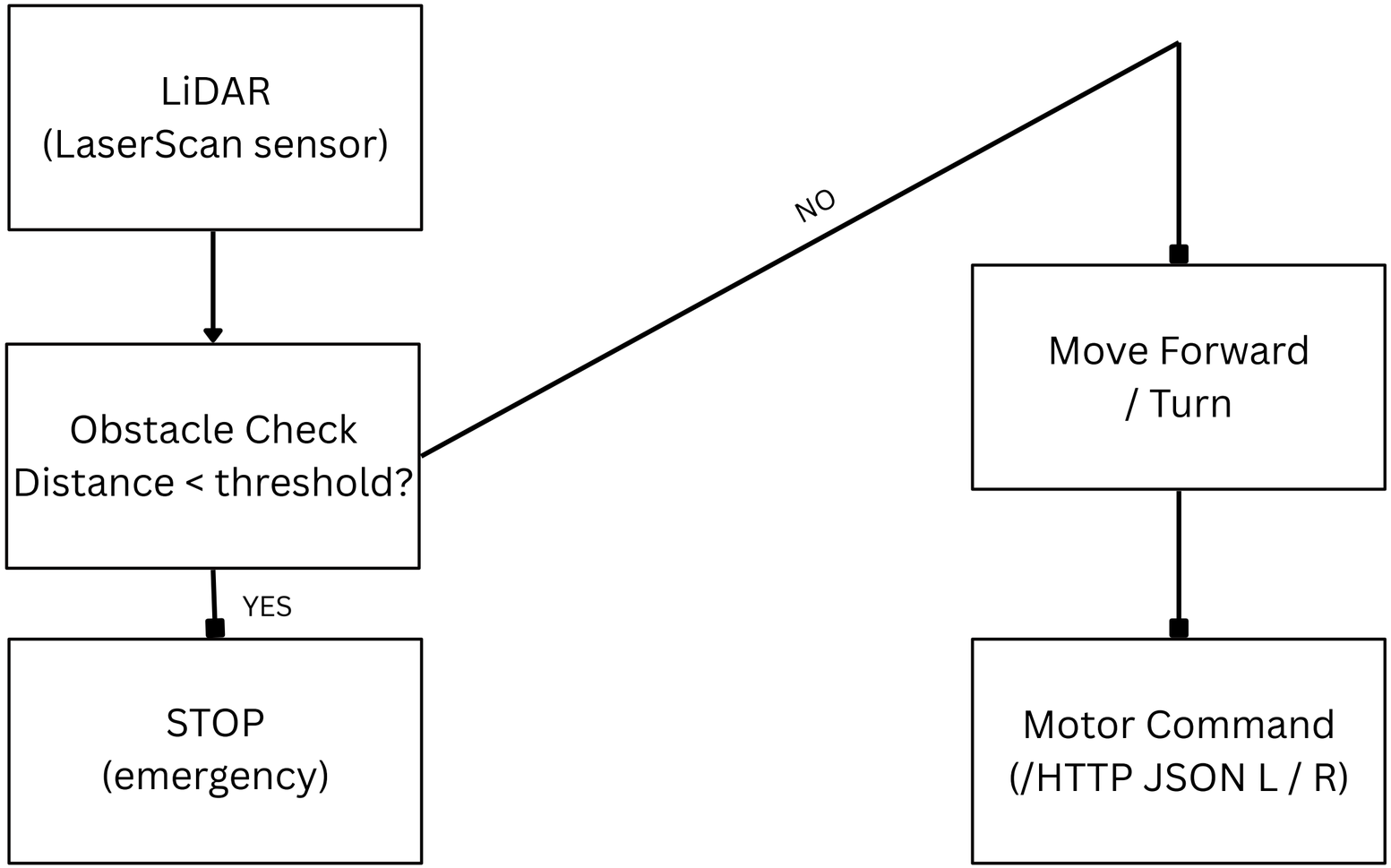
White — free space; Black — obstacles; Line — robot path

Obstacle Detection

- Based on LiDAR scan data
- Obstacles detected in real time
- Marked on visualization

https://drive.google.com/file/d/1JgAfv8gvsPmnohkQ3jNif7fIq2BTtJEe/view?usp=drive_link

Robot Control Logic



Robot Operating Modes

STOP

- Immediate motor stop
- Emergency & safety mode

MAP

- No motion commands sent
- LiDAR & sensor processing active

AUTO

- Autonomous navigation
- Real-time obstacle avoidance

Current Results

Stable LiDAR scanning

Successful map generation

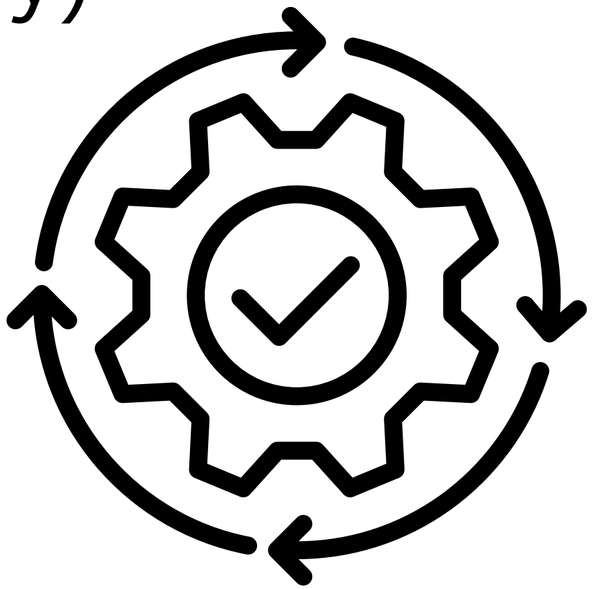
Real-time obstacle detection and avoidance

Autonomous navigation in AUTO mode

Clear distinction between free space, obstacles, and unknown areas

Demonstration Status

- Live demo unavailable (battery)
- System fully functional
- Full video by January 30



Challenges and Limitations

- Limited battery life
- Restricted test environment
- ROS configuration complexity

Future Improvements

- Improved power management
- Camera integration
- Advanced navigation
- Possible ML extension

Thank You