RISE:2019
Graduate
Category: Engineering and Technology
Degree Seeking: Computer Engineering
Abstract ID#: 2484

Northeastern University

Path planning for socially-aware humanoid robots

Denisa-Andreea Constantinescu, Aakash Rohra, Taskin Padir, David Kaeli

Opportunity

Motivation

Foster the development of service robotics applications:

- Remote medical attention & care
- Self-service: museums, hotels,...
- Logistics: organize & deliver

All these applications require efficient path planning for socially-aware navigation

Background

Designing efficient autonomous navigation architecture for mobile robots involves trading off multiple constraints:

- Mobile robots have **limited resources**
- Some sensors are costlier than others (e.g., cameras and 3D laser scanners stream data at high rates)
- **Intensive computation** required to provide useful insight for **real-time navigation**

Approach

System requirements

- Autonomous robot navigation in indoor environments
- Account for people
  - estimate the path of all individuals in the environment
  - respect each individual's private space
- Low-power & real-time

Robot behavior

- Don't collide
- Don't bother people
- Follow the path to goal

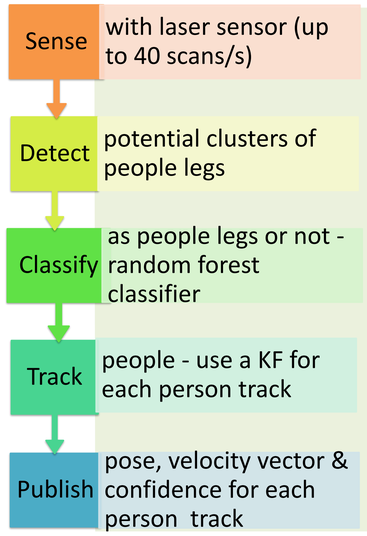
Implementation

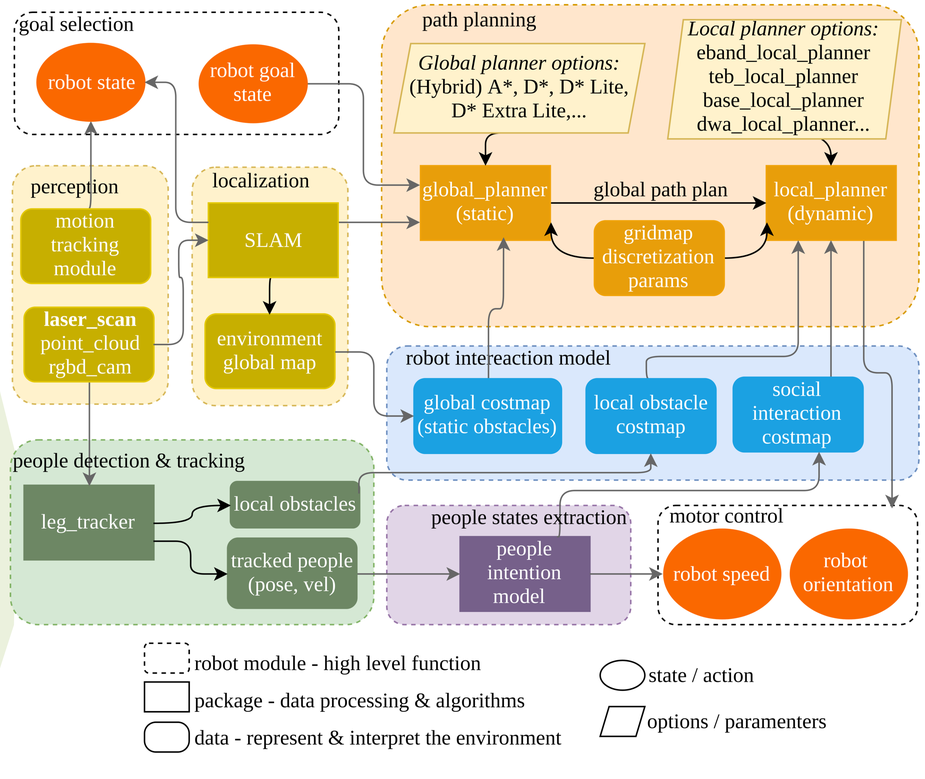
Sensor system:

- Hokuyo UST-20LX Laser
- IMU 6DOF

Computing onboard:

- 4th Gen i7, NVIDIA Jetson TK1
- HSR with Robot Operating System (ROS)



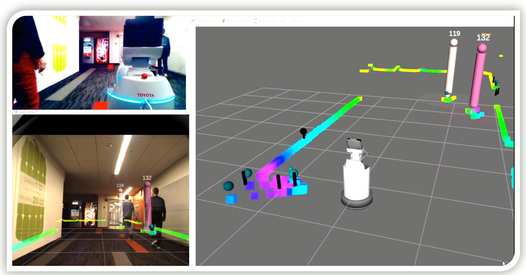


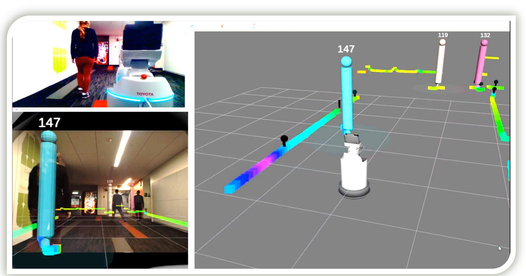
Results

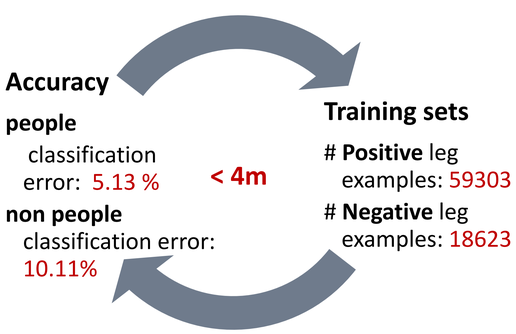
Indoors navigation framework prototype for a Human Support Robot (HSR):

- Uses only **onboard computing** devices
- Requires less than 60W to run
- **Low-power sensor system** (< 5W)

=> improved battery life in robotic applications while providing sufficient accuracy







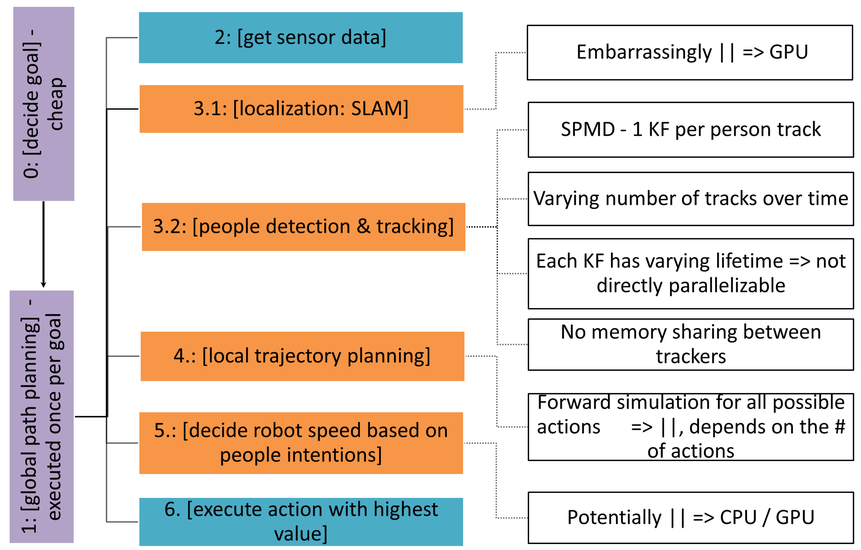
Impact

The unique feature about my research is: *allowing autonomous socially-aware navigation using low-power computing.*

This addresses the problem of: *not having a standard autonomous navigation framework for service robots.*

Future work:

- Real-time execution
- Reduce power by ~60%



Next steps - meet low-power & real-time requirements using *parallelized implementation on low-power high-performance accelerator hardware*

References

1. Leigh, Angus, et al. "Person tracking and following with 2d laser scanners." 2015 IEEE International Conference on Robotics and Automation (ICRA). IEEE, 2015.
2. Luo, Yuanfu, et al. "Porca: Modeling and planning for autonomous driving among many pedestrians." IEEE Robotics and Automation Letters 3.4 (2018): 3418-3425.