Open Source System Prototyping in Autonomous Logistics

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Autonomous Logistic Applications

Autonomous Yard Logistics

Automated First and Last Mile Delivery

Core Questions for Prototyping:
Which robotic technology can increase delivery efficiency and how?

Our Mission - Fail Early and Fast in Application or Don’t
We use mostly open source tools in the robotic development!
Why?

State-of-the-art technology
Lots of know-how online
Very fast purchase
Software is independent from hardware
Transparency
Fully customizable

Learning one tool for the rest of your life!?

Understanding software development as a process that took decades
Our (Software) Development Philosophy

KISS
Keep It Short and Simple.
Everything Should Be Made as Simple as Possible,
But Not Simpler. (Albert Einstein)

Unix philosophy
Write programs that do one thing and do it well.

Continuous Integration
Design your code by writing tests at first.
Create a automatic work, code, test and data flow.
Provide fast integration feedback for the developer.

Open Tools and standards create real fundamental Innovation
Open Source is the major way for software standardization.
Open source community is the major driver
for new software technology.
Linux is the mostly installed operation system worldwide.
[https://en.wikipedia.org/wiki/Usage_share_of_operating_systems]
Experimental and Demonstration
➢ Fenced non-public test track with free space
➢ Safety operator is always in the driving vehicle
➢ Integrate a independent “Anti Collision System”
➢ Real-Time monitoring
➢ Automated ring recorder for all vehicle/sensor data
➢ Low-level controller and actuators you can trust
➢ Safe emergency stop
➢ ...

Public Area Testing (End 2018)
➢ Release with deployment from continuous integration
➢ Safety driver reaction time measurement
➢ Online monitoring of all safety critical systems
➢ Hardware and Software-In-The-Loop statistics
➢ Data privacy test points
➢ Data anonymization and signing
➢ ...

Safety and Security by Design
Learn by the experience of others and finding your way

- Create an understanding of the problem.
  - Read papers and learn how to use search engines.
  - Create abstractions. Be creative!
  - Learn in the simulator and on the test track.
  - Learn from open source solutions
    - Autoware
    - Apollo
  - Try out algorithms from ROS, Python, Linux, ...
  - Get in contact with universities, other companies and the open source community.

Create a software toolbox and knowledge base. Keep it up to date!

Urban test track mapped with Lidar

Extensive Online Research
Design and Abstract
Create a shippable “Product” from the Beginning

Run and love your product with Robot-in-the-Loop

- Gather Information from real live experience as early as possible.
  - Only Software that is integrated into your product and runs can grow and develop over time.
  - Define High-Level Goals for your Team and Robot.
    - Go around the block.
    - Find the Rabbit.
    - Move a Container from A to B

Build a robot **without safety driver**, that runs fully autonomously gathering 24h outdoor operation experience on a limited and safe test track.

Husky from Clearpath Robotics
Define and Run your Code Pipeline
➢ Learn from your prototypes for your product(s).
  ➢ Create a (new) safe implementation of your design.
  ➢ Redundancy in software and hardware.
  ➢ Reduce system dependencies.
  ➢ Fulfill all tests with hard thresholds.
  ➢ Test and train your system in large scale with all computational power you can get.
  ➢ Reduce costs of sensors with better algorithms.
  ➢ Find a way to upgrade and maintain all your different kinds of systems.
  ➢...
Summary and Take-Away

Contribute to Open Source

- Donate to open source
- Buy licenses if you need to.
- Buy hardware with open source
- Bug fixing and feature adding
- Tell other about good open source projects
- Support open source companies
- Educate young people in open source software

Use Open Source

- Find the right algorithms by researching and prototyping with open source modules
- Create your development infrastructure with open source
- Create new standards with open source.
- Give your developer and engineers the freedom they need with open source.

Understand and respect the licenses.
Thanks For Your Attention!

StreetScooter is a company of Deutsche Post DHL Group