Self-Driving Car

PiCar X

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1. Introduction and Goals
2. Current State
3. Steps to reach our goal
4. Problems and approaches

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Introduction and Goals

PiCar X

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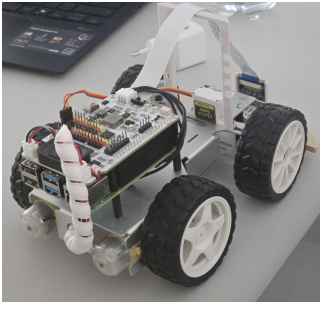
- AI-driven self-driving robot car equipped with a Raspberry Pi 4 and a video camera.



Minimal Goal

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Different ideas → Shared baseline

- Follow checkpoints
  - tape on the floor
  - cartons with a letter

Further Goals

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- **Self-driving taxi**: make the car go from point A to point B, knowing the layout of the city and the checkpoints.
- **Self-driving rover**: make the car drive until it finds a defined object/landmark.

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Current State

Current State

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What can the car do already?

- Hardware
  - Raspberry Pi 4 with 4 GB of RAM
  - Video Camera
  - Wireless Connection
- Software
  - Detect objects (like stop signs, based on YOLO library)
  - Follow a line on the floor
  - Stop when seeing an object

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Steps to reach our goal

Setup and testing

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- OS Installation
- Car testing and calibration
  - steering angle
  - camera view angle
  - spinning rotation
- Library testing
- Documenting the existing library[1]

[1] https://github.com/psnjk/roboeye.git

Model selection and data collection

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- Define what the checkpoints and the driving environment will look like
- Research the existing approaches to self-driving cars[2]
- Choose an approach (model) based on limitations (computing power onboard, connection speed)
- Define the metrics for model performance

[2]Example: End to End Learning for Self-Driving Cars by Nvidia

Training and testing

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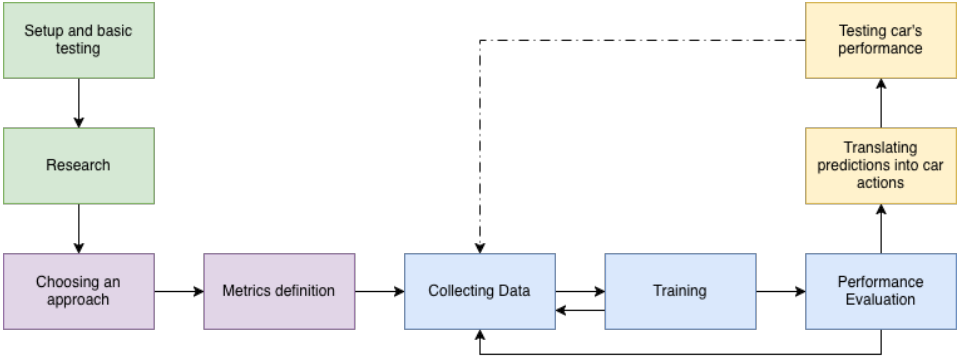
- Collect data
  - manually - automatically
  - driving examples
  - car images
- Train/Finetune/Optimize model chosen
- Translate model's predictions into car's commands
- Test car's performance

Workflow


Setup and basic testing
Research
Choosing an approach
Metrics definition
Collecting Data
Training
Performance Evaluation
Translating predictions into car actions
Testing car's performance

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Problems and approaches

Limitations for any chosen approach

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- Library not working/containing bugs
- Changing environment/conditions
- Incorrect metrics selected
- Poor image quality

Approach-specific cons and pros

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- Model running onboard
  - Low processing power
  - Model selection limitations
  - Advantages: low latency and autonomy
- Model running on PC and connected to the car
  - Car is not fully autonomous
  - Connection speed
  - Advantage: processing power