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SINCE 2014

Enhancing Safety in Autonomous Driving

Ni Dang

nidang2024@gmail.com

Data Science Retreat
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Safety in Autonomous Driving

Safety is a big concern when it comes to embracing self-driving cars or not!

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Motivation and Goal of the Project

- Motivation:
  - **Real-time** object detection is critical in **ensuring safety** in autonomous driving
  - Quick, accurate decisions can sometimes **save lives in a dangerous situation**

- Goal:
  - General: Enhance safety in autonomous driving
  - Specifically: Implement a real-time object detection system for self-driving cars

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YOLO Object Detection

- **YOLO - You Only Look Once**
- YOLO can **detect objects in real time** due to its speed.
- Detect **multiple objects** in an image or video frame

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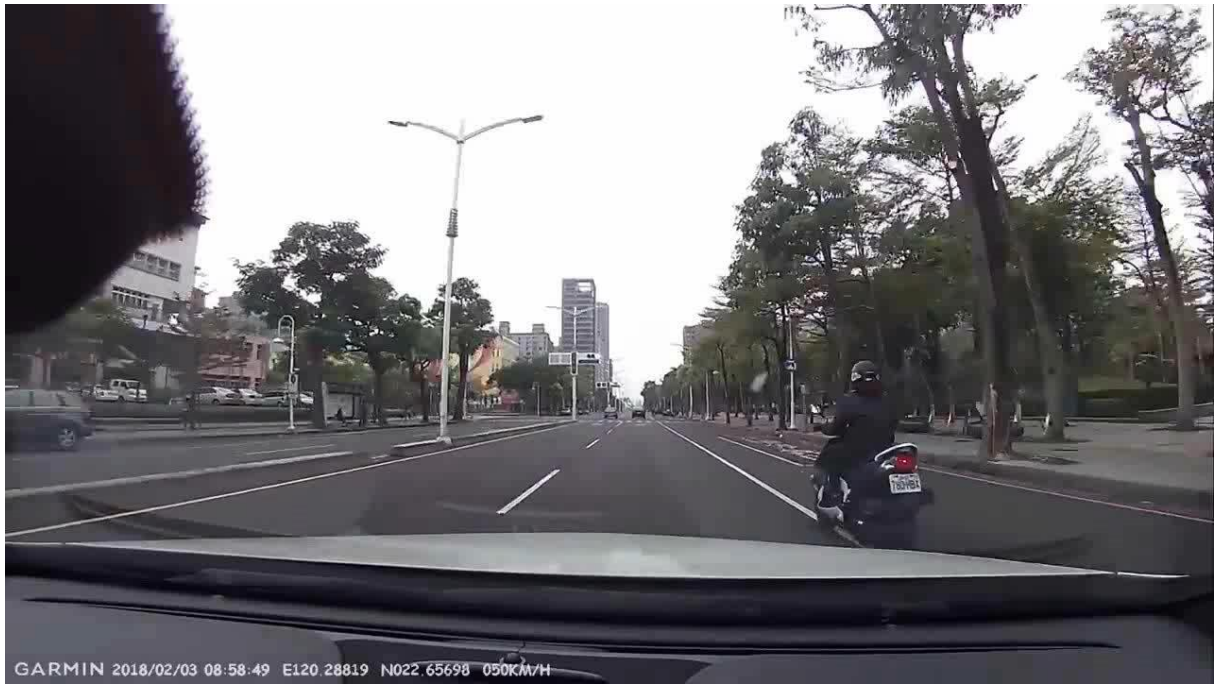
Object Detection using YOLOv8

Note: All videos are taken from the perspective of a self-driving car!



Original Video

YOLO – Object Detection

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What is a dangerous situation?

- Not all the people detected by the self-driving cars are in danger
- People who are in other lanes are kind of safe
- **People who are in the same lane of the self-driving car are in danger!**

Definition of Danger:
There is an **overlap** between the **current lane of the self-driving car** and the **detected people**!

To define danger: Lane detection is necessary!

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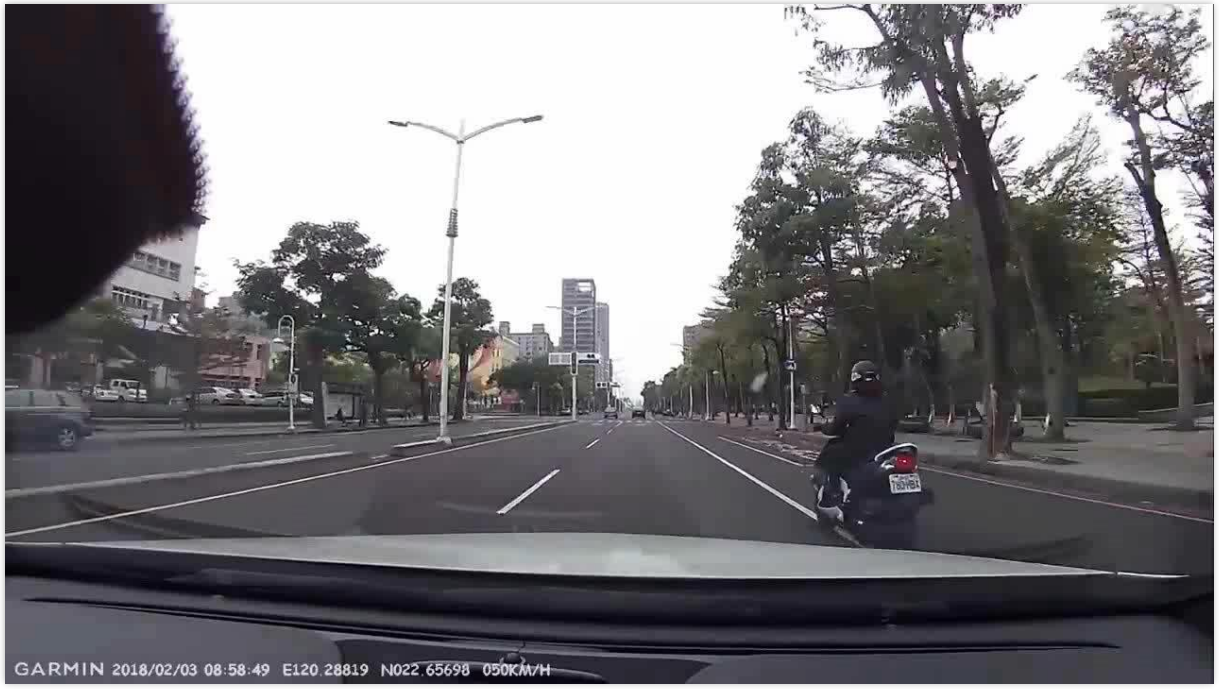
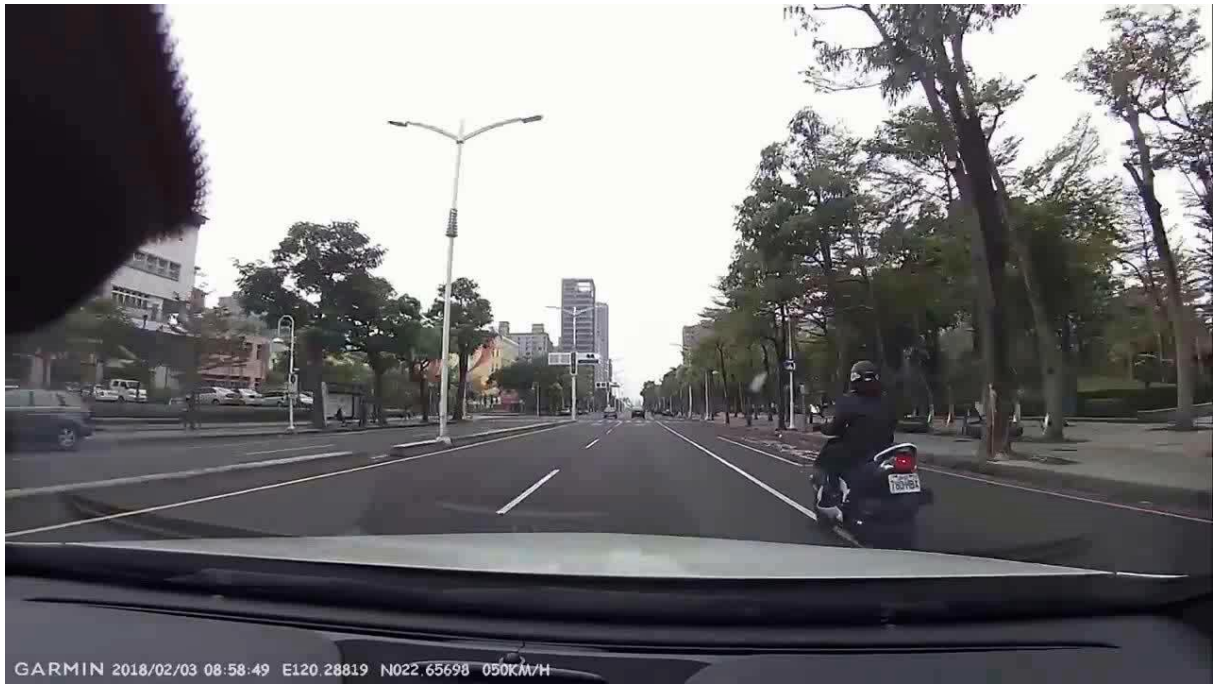
Lane Detection

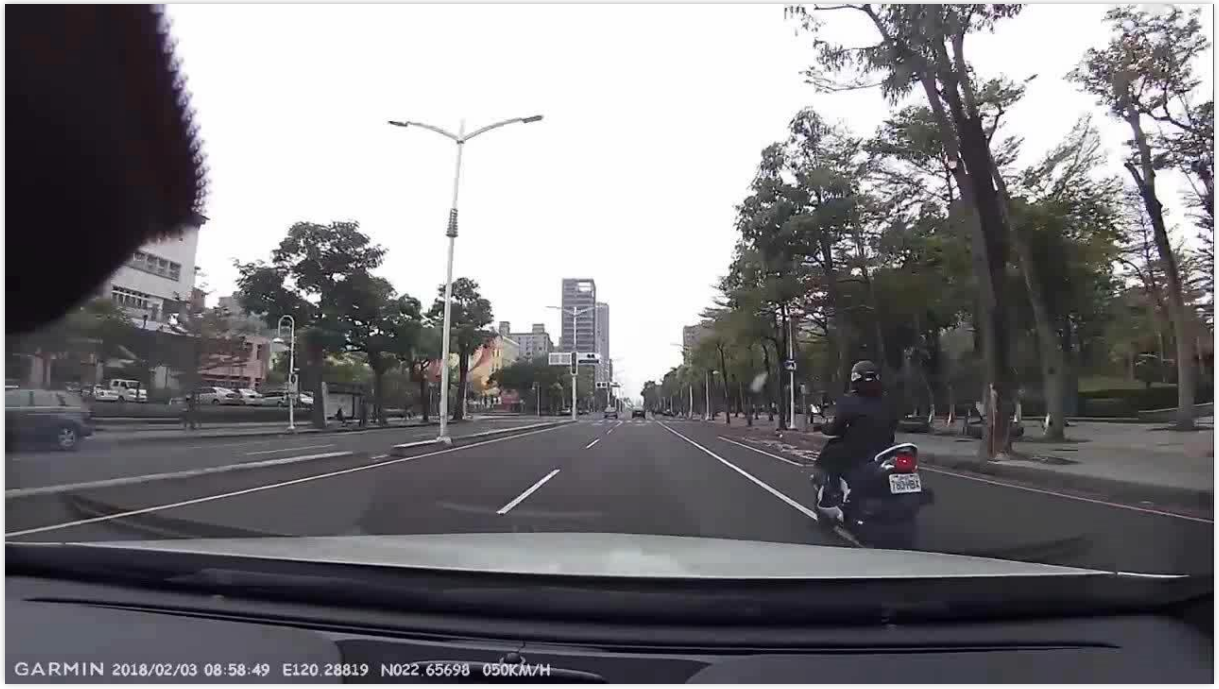


Original Video



Lane Detection

Is the motorcycle driver in danger?



Original Video

Object & Lane Detection with Warning

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Deployed Apps in Streamlit

- Object Detection for an Uploaded Video:
  App1: Object tracking with YOLOv8

- Object Detection for Video Streaming:
  App2: Real-Time Object Detection with YOLOv8

- Object & Lane Detection for Video Streaming:
  App3: Real-Time Object with YOLOv8 and Lane Detection
  (This one is super slow because there is too much computational burden for the Streamlit cloud.)

(The links to the apps will be public. Everyone with the links can play with them.)

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Limitation of Streamlit

☹ Streamlit is not practical!

- The calculation is done in the Streamlit cloud! Can be super slow!
- We cannot install Streamlit in a self-driving car!

☺ Raspberry Pi can solve this problem!

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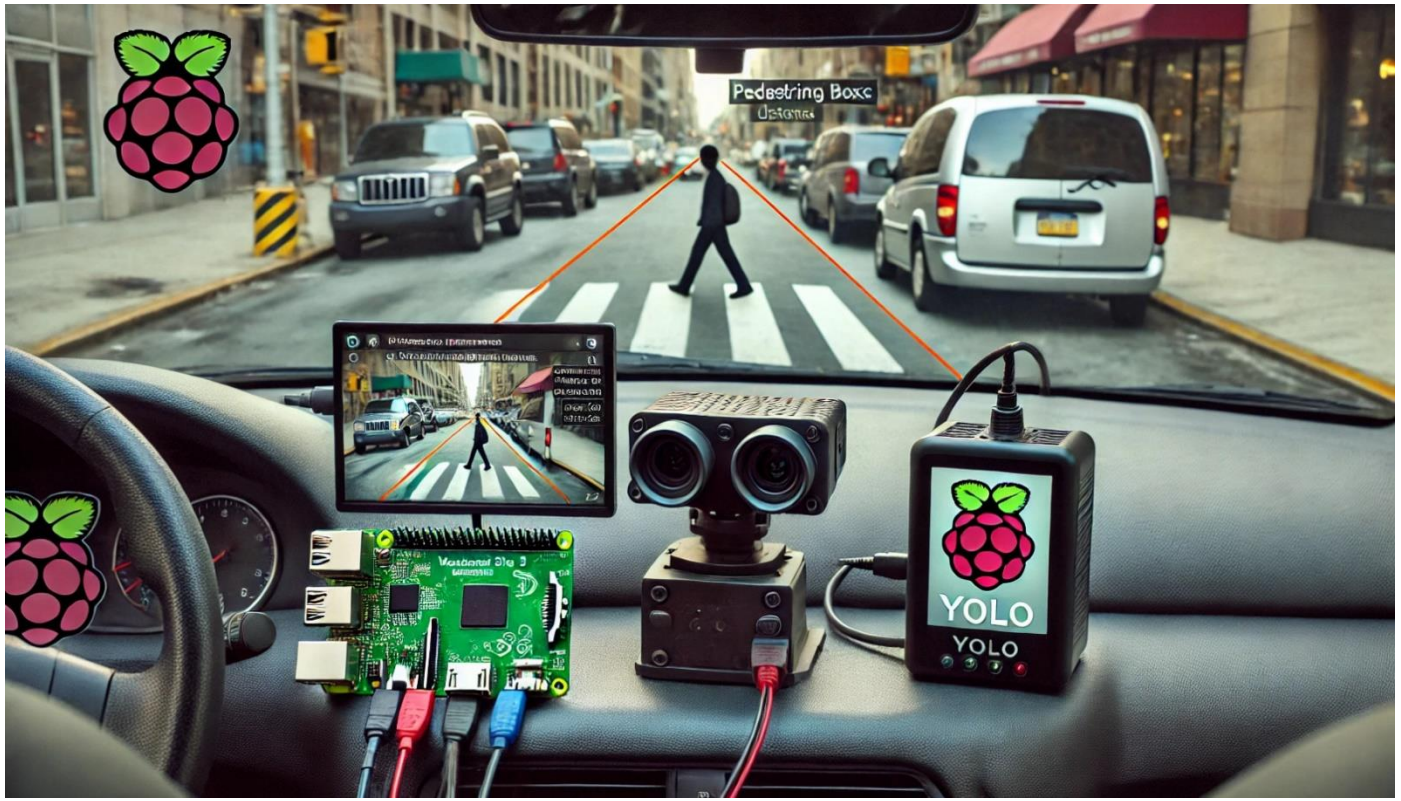
Raspberry Pi 5:
A mini computer in the car!

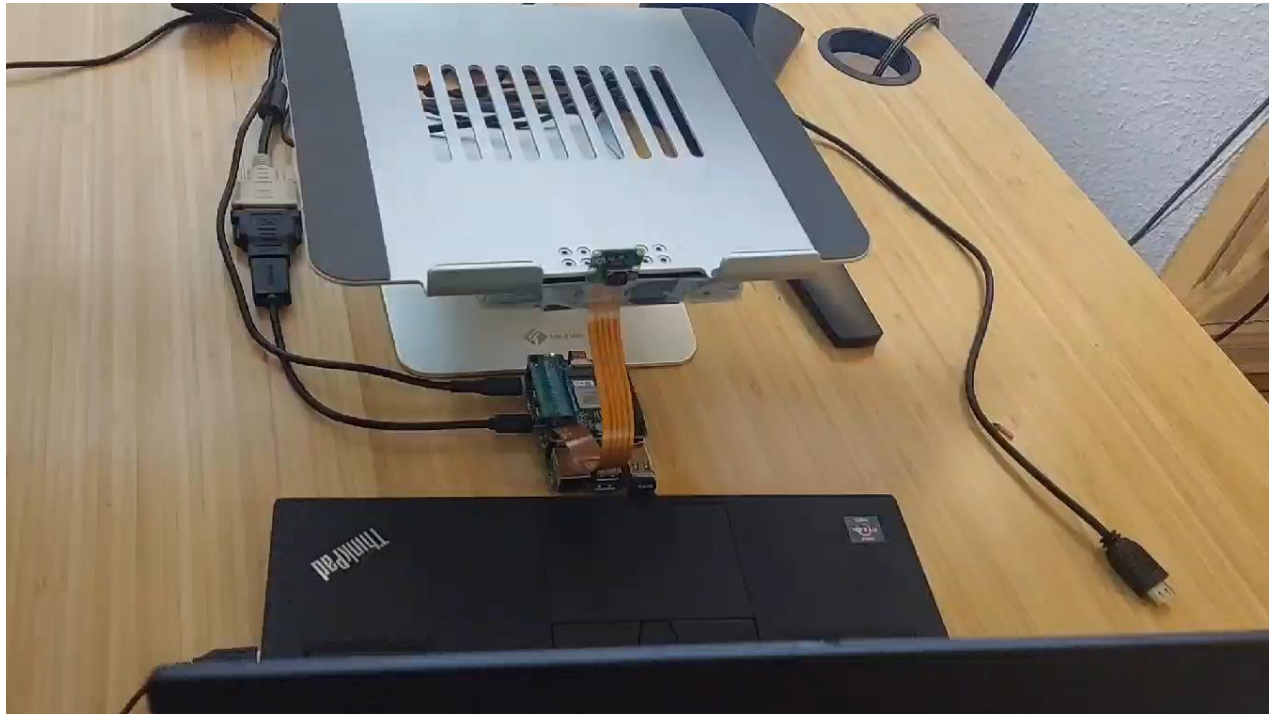


Setup in the self-driving car!

Demo - Raspberry Pi 5:

Setup:

- Use the Raspberry Pi Camera to detect a traffic video playing on my laptop!
- Use my phone to capture what is happening on the monitor that connects to the Raspberry Pi



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Demo - Raspberry Pi 5:

Conclusion and Outlook

- Conclusion:
  - Used YOLO Object Detection to enhance safety in Autonomous Driving
  - Deployed Apps in Streamlit: Suitable for uploaded video & video streaming
  - Demo - Raspberry Pi 5: Object detection works well

- Outlook:
  - Improve the performance of real-time lane detection in Raspberry Pi 5
  - Add warning function also in Raspberry Pi 5