PROJECT PRESENTATION

Anti-Collision

AI Driver Assistance

2024

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Problem Statement

- Road traffic accidents remain a top cause of fatalities and injuries worldwide
- Many accidents are avoidable
- Despite safety advancements in vehicles, driving environments are becoming more complex
- Urgent need for improved real-time hazard detection systems

Our project:

Develop a machine learning-powered dashboard cam

Objective:

Provide timely alerts to drivers using advanced object detection algorithms

Aim:

Enhance road safety and reduce accident risks

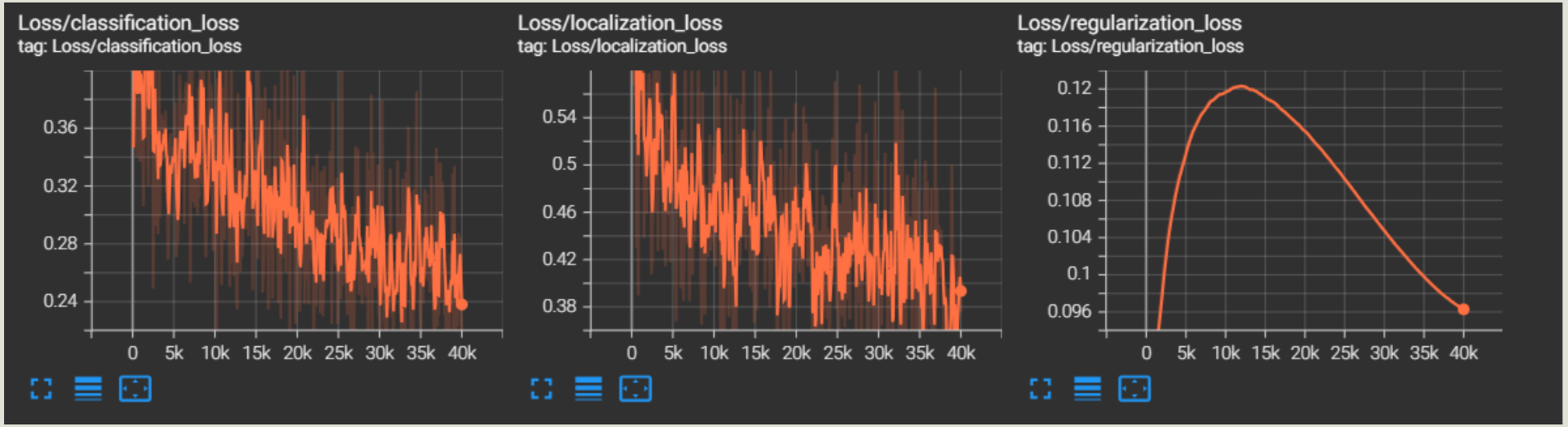
METHODOLOGY

1. **Model Architecture:** Uses a streamlined Quantized MobileNet V2 trained on ImageNet dataset and fine-tuned on the BDD-100K dataset
2. **Input Resolution:** Processes video frames resized to 224x224 pixels, matching the model's input requirements for optimal performance.
3. **Processing Speed:** Maintains a real-time processing capability of 30 frames per second (FPS), suitable for dynamic road environments.
4. **Detection Accuracy:** Achieves an average precision (mAP) of 70-75% on standard datasets for detecting vehicles, pedestrians, and road signs.
5. **Camera Specification:** Utilizes a 4K HD camera capable of capturing clear footage under various lighting conditions.

METHODOLOGY

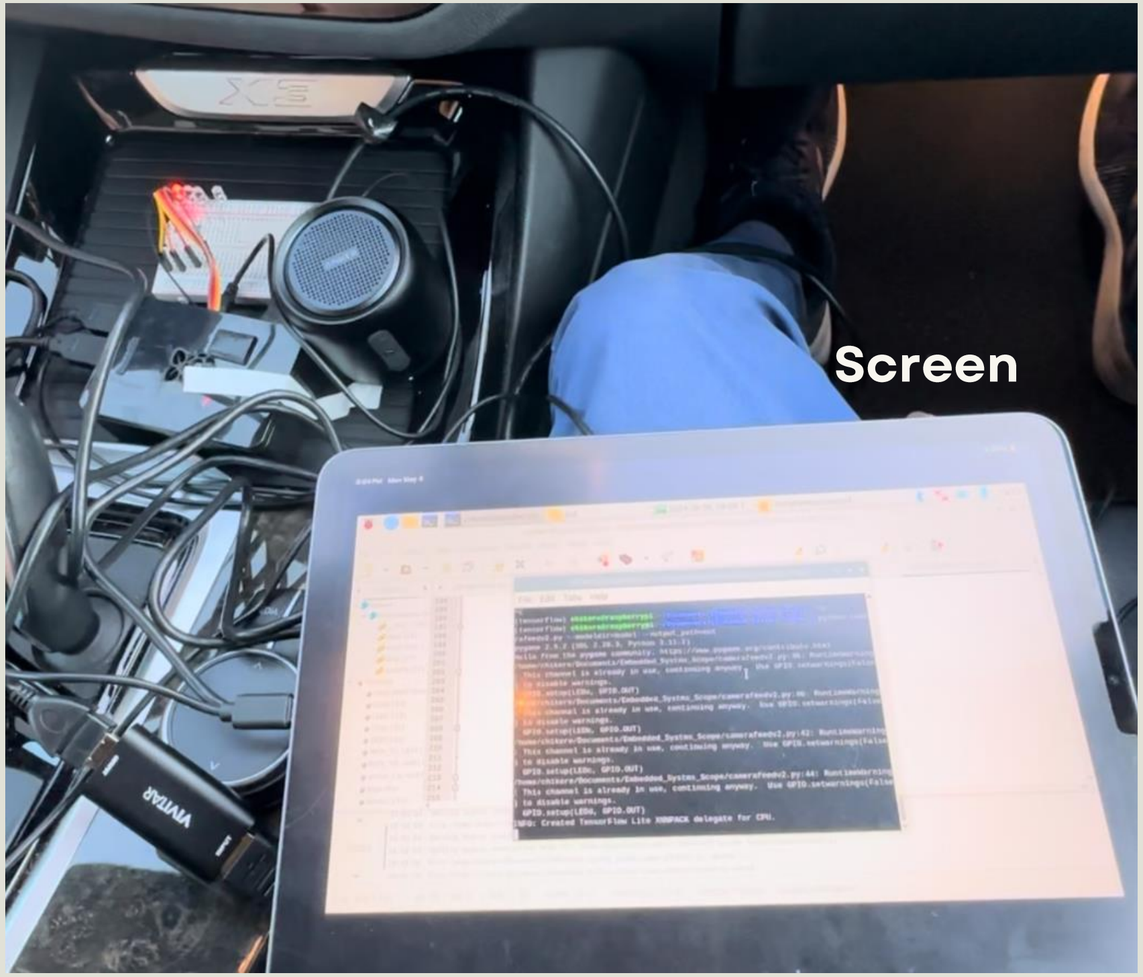
1. **Processor and Memory**: Operates on an ARM Cortex-based processor with a system memory usage constrained to 500 MB, ideal for edge computing.
2. **Detection Range:** Capable of identifying objects within a detection range of up to 120 meters, providing sufficient response time for drivers.
3. **System Latency:** Features an end-to-end latency of less than 200 milliseconds from image capture to hazard alert, ensuring timely driver notifications.
4. **Model Quantization:** Employs 8-bit quantization to reduce the model size and computational demands, facilitating deployment on resource-constrained devices.
5. **Audio response:** Eqipped with a speaker t play warning sounds when hazards are observed.
6. **Light indicators:** LEDs to provide visual warning

Results - training



Results - Setup

To test out our platform in a real world scenario, we carried out outdoor tests where we positioned the setup as a dashboard system and drove around.



Results

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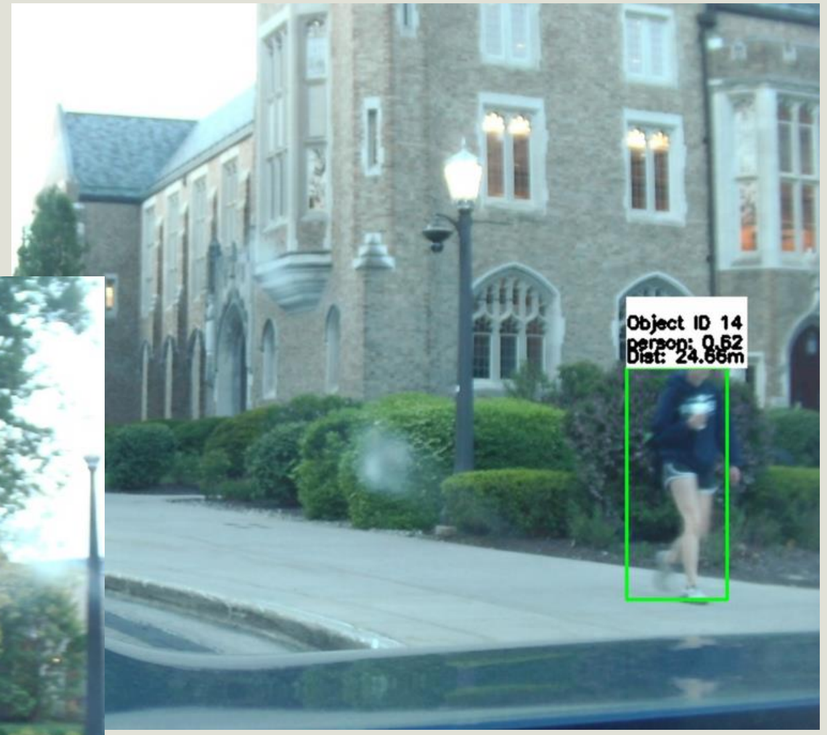

Results - Demo

Car Detection

Results - Demo

Pedestrian Detection

Challenges faced

- The Raspberry Pi 4 has limited CPU and GPU capabilities, which can hinder the real-time processing of complex algorithms necessary for car detection and distance estimation.
- Achieving high accuracy in object detection and distance estimation is challenging with the limited computational resources of the Raspberry Pi 4.
- Environmental conditions (e.g., lighting, glare) can further impact the performance of sensors and algorithms.
- Bias for person class in model training set - unequal representation
- Distance estimation fixed to focal length of camera - rigid approach - not generalizable to other camer models
- Estimation of distance other labels that are not ‘car’ is not accurate because model looks for objects that are about 1.8m in length for estimating distance.
- 40K training steps -> training more can impact accuracy

Future work

- More accurate classification -> traffic sing - detect specific signs
- Improve the person classification label -> use another segmentation model such as YoloV8
- Refine the distance estimation algorithm in order to be applicable to more cameras
- Add more specific sounds
- More feedback objects -> currently just lights and sound

Q/A