

MICHIGAN STATE
UNIVERSITY

Project Plan

Classifying Target Vehicles for Adaptive Cruise Control The Capstone Experience

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Spring 2020



*From Students...
...to Professionals*

Functional Specifications

- Currently Bosch employs people to manually label video data. This is a tedious and time-consuming process.
- Our goal is to develop a tool which automatically creates labels using machine learning.
- Process recorded video data to perform vehicle and lane recognition
- Automatically label target objects
 - “Target Object Present”
 - “Host Vehicle Changing Lanes”
 - “Target Object Cutting into Host Lane”
- Output a label file with 80% - 90% labeling accuracy

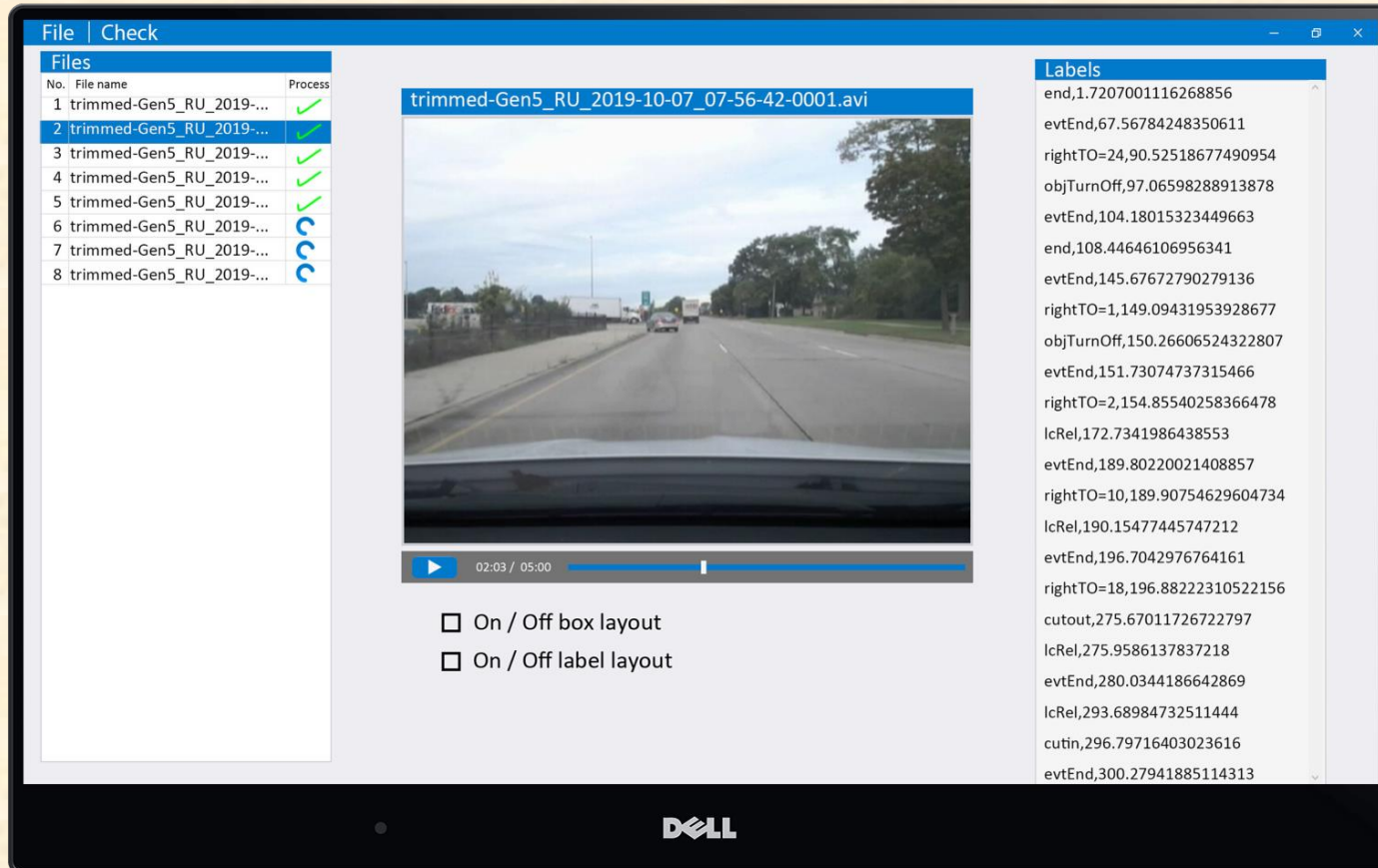


Design Specifications

- Desktop program
- Display box and Label Overlay on Video
- Display predicted Label Confidence Rating
- Creates a text file with labels and event timestamps
- Use Case: Save manual labor on dataset labeling



Screen Mockup: Main Screen

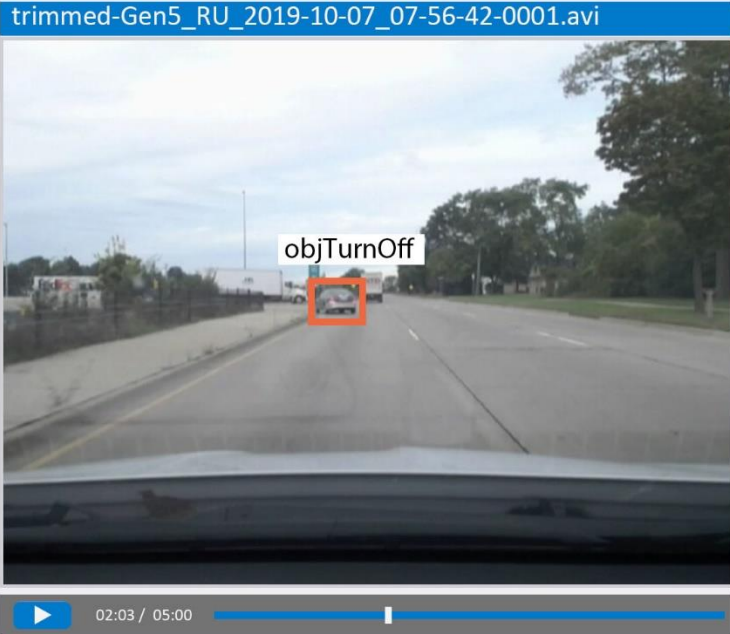


Screen Mockup: Overlays

File | Check

| Files | | |
|-------|--------------------------|---------|
| No. | File name | Process |
| 1 | trimmed-Gen5_RU_2019-... | ✓ |
| 2 | trimmed-Gen5_RU_2019-... | ✓ |
| 3 | trimmed-Gen5_RU_2019-... | ✓ |
| 4 | trimmed-Gen5_RU_2019-... | ✓ |
| 5 | trimmed-Gen5_RU_2019-... | ✓ |
| 6 | trimmed-Gen5_RU_2019-... | ✓ |
| 7 | trimmed-Gen5_RU_2019-... | ⌚ |
| 8 | trimmed-Gen5_RU_2019-... | ⌚ |

trimmed-Gen5_RU_2019-10-07_07-56-42-0001.avi



objTurnOff

- On / Off box layout
- On / Off label layout

| Labels | |
|-------------------------------|---|
| end,1.7207001116268856 | ^ |
| evtEnd,67.56784248350611 | |
| rightTO=24,90.52518677490954 | |
| objTurnOff,97.06598288913878 | |
| evtEnd,104.18015323449663 | |
| end,108.44646106956341 | |
| evtEnd,145.67672790279136 | |
| rightTO=1,149.09431953928677 | |
| objTurnOff,150.26606524322807 | |
| evtEnd,151.73074737315466 | |
| rightTO=2,154.85540258366478 | |
| lcRel,172.7341986438553 | |
| evtEnd,189.80220021408857 | |
| rightTO=10,189.90754629604734 | |
| lcRel,190.15477445747212 | |
| evtEnd,196.7042976764161 | |
| rightTO=18,196.88222310522156 | |
| cutout,275.67011726722797 | |
| lcRel,275.9586137837218 | |
| evtEnd,280.0344186642869 | |
| lcRel,293.68984732511444 | |
| cutin,296.79716403023616 | |
| evtEnd,300.27941885114313 | ↓ |



Screen Mockup: Confidence Rating

| Files | | Labels |
|-------|---|----------|
| No. | File name | Accuracy |
| 1 | trimmed-Gen5_RU_2019-10-07_07-56-42-0001_m0.avi | 85% |
| 2 | trimmed-Gen5_RU_2019-10-07_07-56-42-0001_m1.avi | 74% |
| 3 | trimmed-Gen5_RU_2019-10-07_08-14-23-0001_m0.avi | 100% |
| 4 | trimmed-Gen5_RU_2019-10-07_08-14-23-0001_m1.avi | 90% |
| 5 | trimmed-Gen5_RU_2019-10-07_08-14-23-0001_m2.avi | 80% |



Screen Mockup: Comparison View

The screenshot displays a comparison tool with two main columns: 'Output' and 'Manual'. The 'Output' column lists various event and object identifiers, with several lines highlighted in red. The 'Manual' column lists similar identifiers, with one line highlighted in red. A red arrow points from the highlighted line in the 'Output' column to the highlighted line in the 'Manual' column. An 'Information' box on the right shows 'Accuracy: 73.9% (17 / 23)'. The interface includes a 'File | Check' menu bar, 'Files' and 'Labels' tabs, and a status bar at the bottom.

| Output | Manual |
|-------------------------------|-------------------------------|
| end,1.7207001116268856 | end,1.7207001116268856 |
| evtEnd,67.56784248350611 | evtEnd,67.56784248350611 |
| rightTO=24,92.73546287932126 | rightTO=24,90.52518677490954 |
| objTurnOff,97.06598288913878 | objTurnOff,97.06598288913878 |
| evtEnd,104.18015323449663 | evtEnd,104.18015323449663 |
| end,111.23396814217548 | end,108.44646106956341 |
| evtEnd,145.67672790279136 | evtEnd,145.67672790279136 |
| rightTO=1,149.09431953928677 | rightTO=1,149.09431953928677 |
| objTurnOff,150.26606524322807 | objTurnOff,150.26606524322807 |
| evtEnd,151.73074737315466 | evtEnd,151.73074737315466 |
| rightTO=2,154.85540258366478 | rightTO=2,154.85540258366478 |
| lcRel,172.7341986438553 | lcRel,172.7341986438553 |
| evtEnd,189.80220021408857 | evtEnd,189.80220021408857 |
| rightTO=10,189.90754629604734 | rightTO=10,189.90754629604734 |
| rightTO=18,196.88222310522156 | lcRel,190.15477445747212 |
| cutout,275.67011726722797 | evtEnd,196.7042976764161 |
| lcRel,275.9586137837218 | rightTO=18,196.88222310522156 |
| evtEnd,280.0344186642869 | cutout,275.67011726722797 |
| lcRel,293.68984732511444 | lcRel,275.9586137837218 |
| cutin,297.71640302361689 | evtEnd,280.0344186642869 |
| evtEnd,301.94188511431327 | lcRel,293.68984732511444 |
| | cutin,296.79716403023616 |
| | evtEnd,300.27941885114313 |

Information
Mistake: 4
Lost: 2
Accuracy: 73.9% (17 / 23)

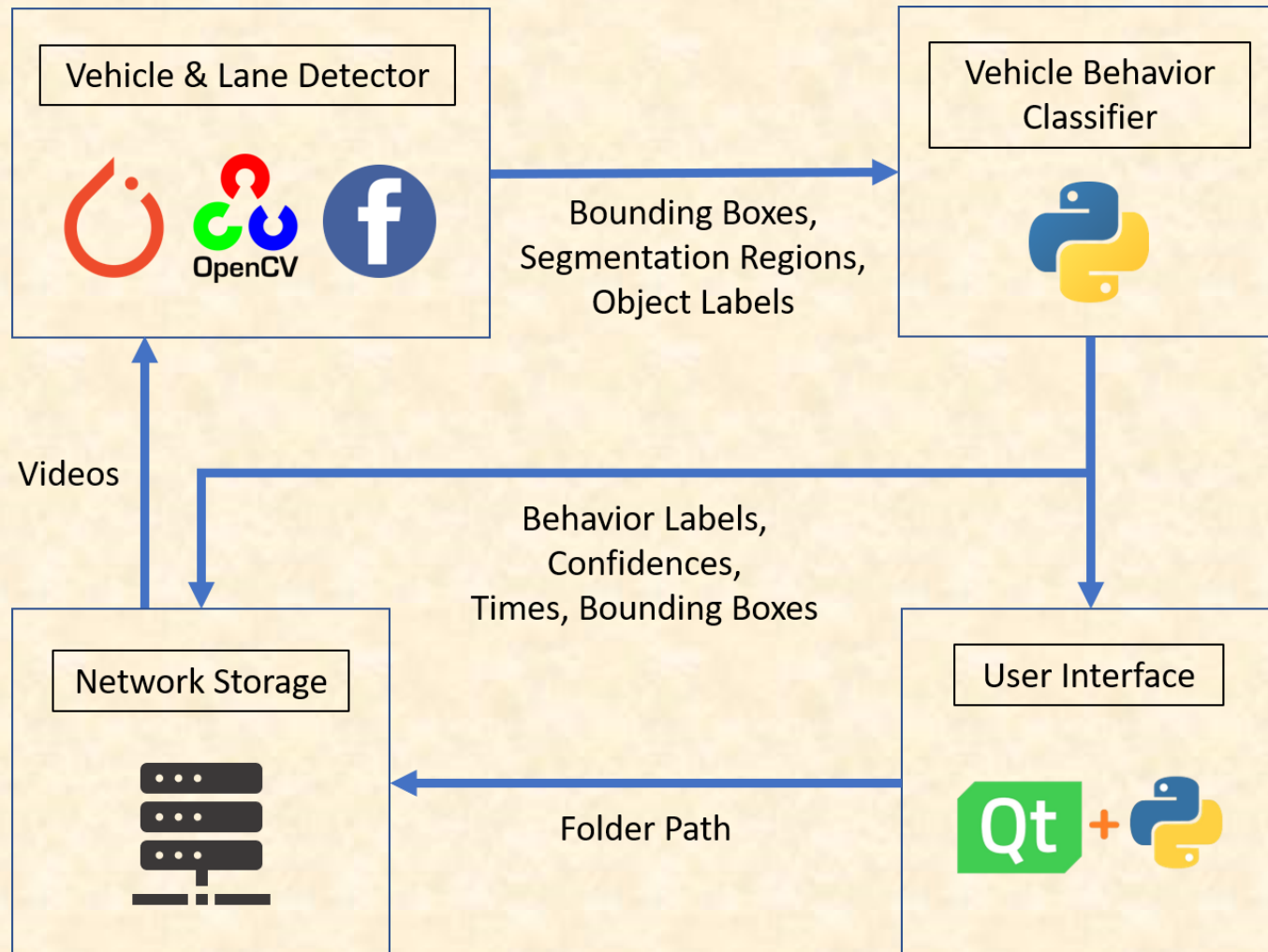


Technical Specifications

- The program takes an AVI video file as input and processes it with a machine learning model
- Facebook's Detectron2 for vehicle detection and semantic segmentation
- Canny edge detection for lane line detection
- Outputs a text file with label predictions and timestamps to events of interest
- Ray for concurrent processing of videos off of the python GUI thread



System Architecture



System Components

- Hardware Platforms
 - External Hard Drive containing video data
- Software Platforms / Technologies
 - Python
 - PyQt
 - OpenCV
 - Facebook's Detectron2
 - PyTorch
 - Ray



Risks

- Large Data
 - Managing the large amount of compressed data
 - Programmatically access compressed videos using a Python library
- Model Accuracy
 - Fine-tuning the feature extraction model
 - Consider cloud computing environment such as Google Cloud Platform
- Bad Data
 - Low quality data points in the dataset
 - Locate and remove those data points
- Algorithm Integration
 - Label generation and computer vision algorithms
 - Research box / line collision test and common computer vision algorithms

