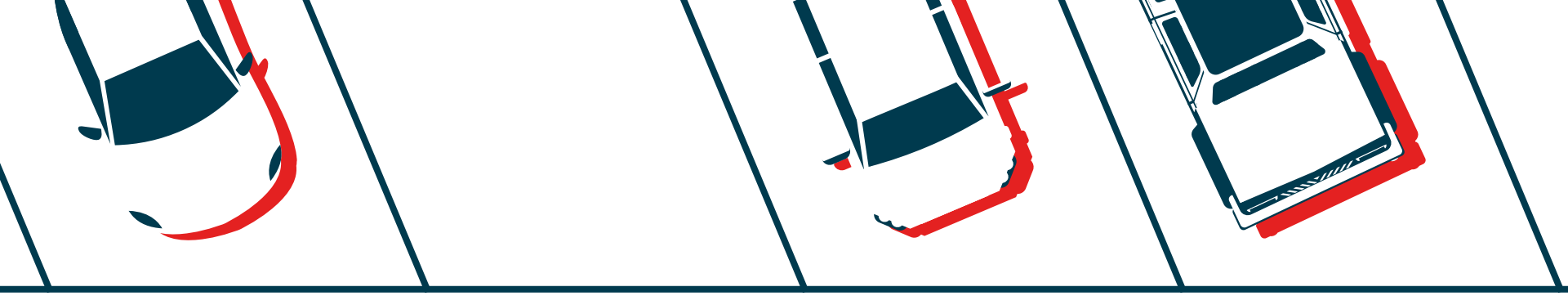
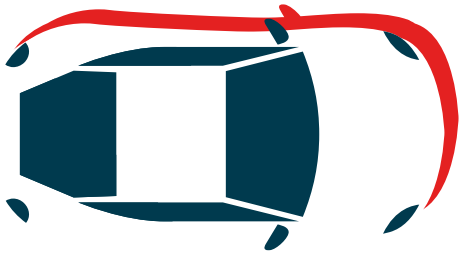


Final Presentation

Parking Lot Vehicle Classification

Team Members: Aniruddha Srinivasan, Coleman Todd, Fabianna Barbarino, Jacqueline Mioduski, Spencer Cho, Tyler Roosth



Problem Background

- Increased vehicle traffic as business growth occurs
- Security personnel need to identify a large number of cars simultaneously
- Analysts need to track heavier traffic flow

Goals & Objectives

Our main goal was to build a containerized app that detects and tracks vehicles across a parking lot and continually logs the driving patterns.

- ➢ Our 3 states are: parked, moving, and stopped
- ➢ Monitored through the user interface by security personnel or data scientist.

Vehicle detector can track at least 5 cars

Cameras will be 12 feet off the ground looking out. This has been successfully completed!

Bounding Boxes around the cars

The coordinates will be sent to our database. This has been successfully completed!

Tie the back-end with the front-end successfully

GUI should show data associated with the video playing. This has been successfully completed!

Implementation works as a desktop app on a GPU workstation/laptop

Evaluation of Alternative Solutions

Detection Algorithms

YOLOv8

Fastest

Most accurate for object detection

Mask R-CNN

Slower

Most accurate for object area

Tracking Algorithms

DeepSORT

An established method

Poor FPS

ByteTrack

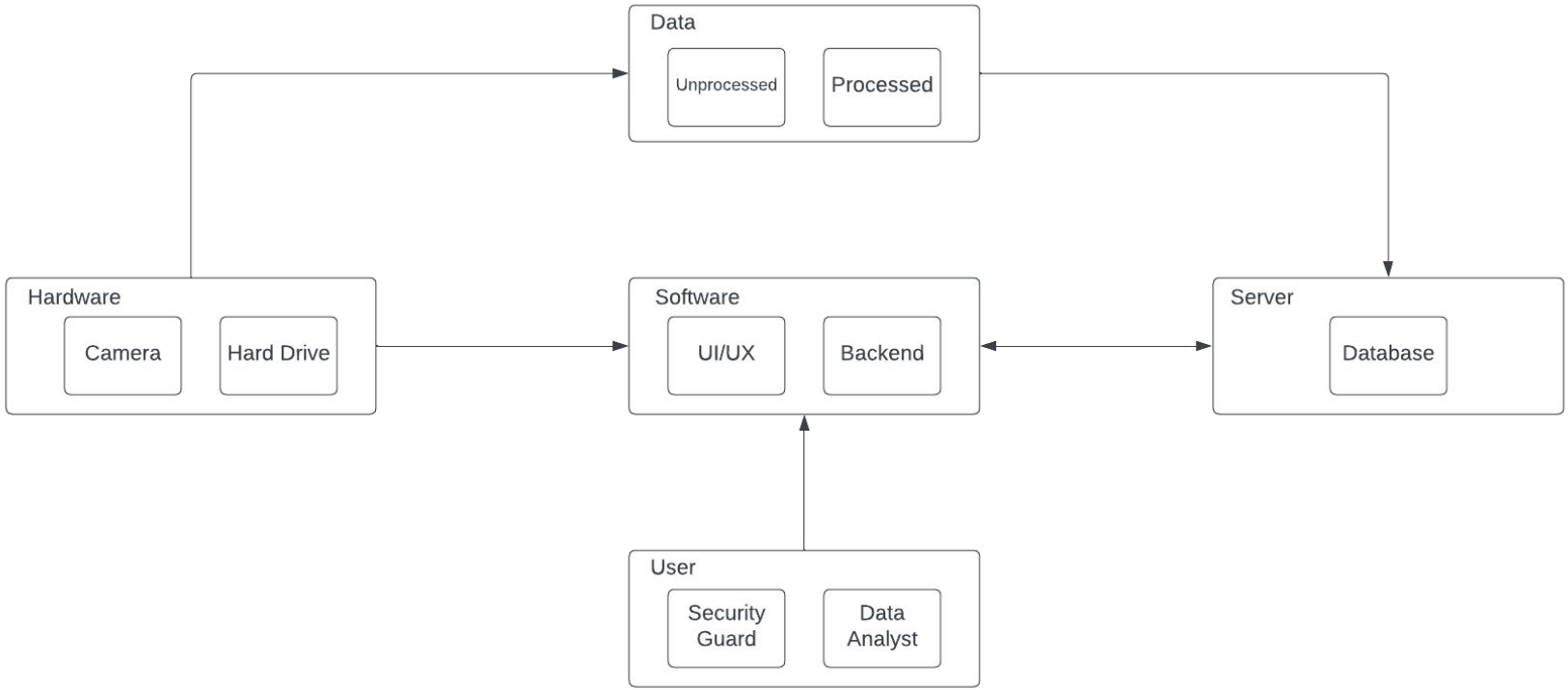
Higher FPS than DeepSORT

Better supporting documentation /tutorials

SMILETrack

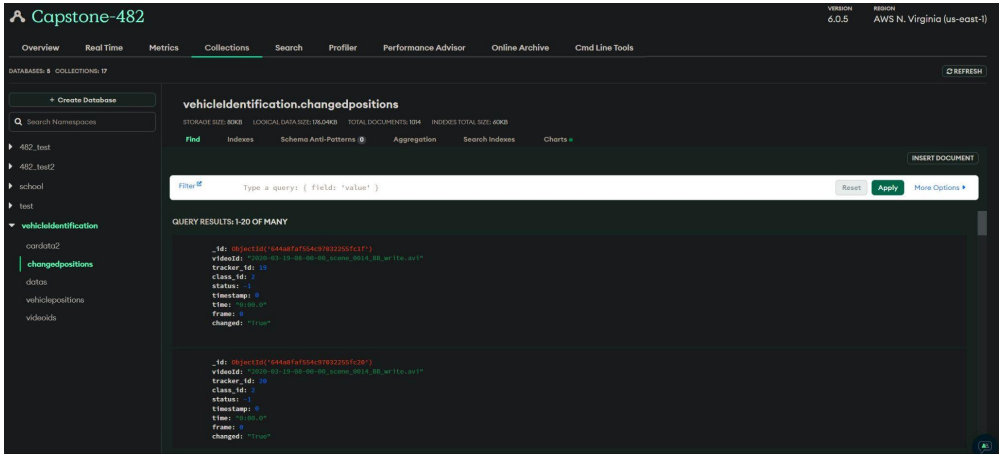
Cutting edge- Ranked the highest for HOTA, MOTA, & IDF1

System Level Description



Database

- MongoDB Database
- Information is stored into MongoDB Atlas
  - stored from ML side
- Connects using FastifyAPI and Fetched on Front End
- Contains information about the vehicles and videos
  - videoId
  - time
  - changed
  - status
  - tracker_id
  - And more



Approach for Design Validation

- **Main Goal: Full Stack Operation**
- Web Application able to view annotated video feed, clickable timestamp, 2 separate views, and view details of parked,stopped, moving vehicles.
- Business analyst view updates with data from MongoDB database. Has historical data in table that can be filtered by state
- Application and ML run in separate Docker containers smoothly with reasonable usage of resources

ML Detection

5 cars 10 FPS
Vehicle status
Optimized scenario

37 cars 11.77 FPS

Backend

MongoDB Database
Record position,
time, status,id, etc

GUI

2 separate views
Filter by status
Show relevant
information

Infrastructure

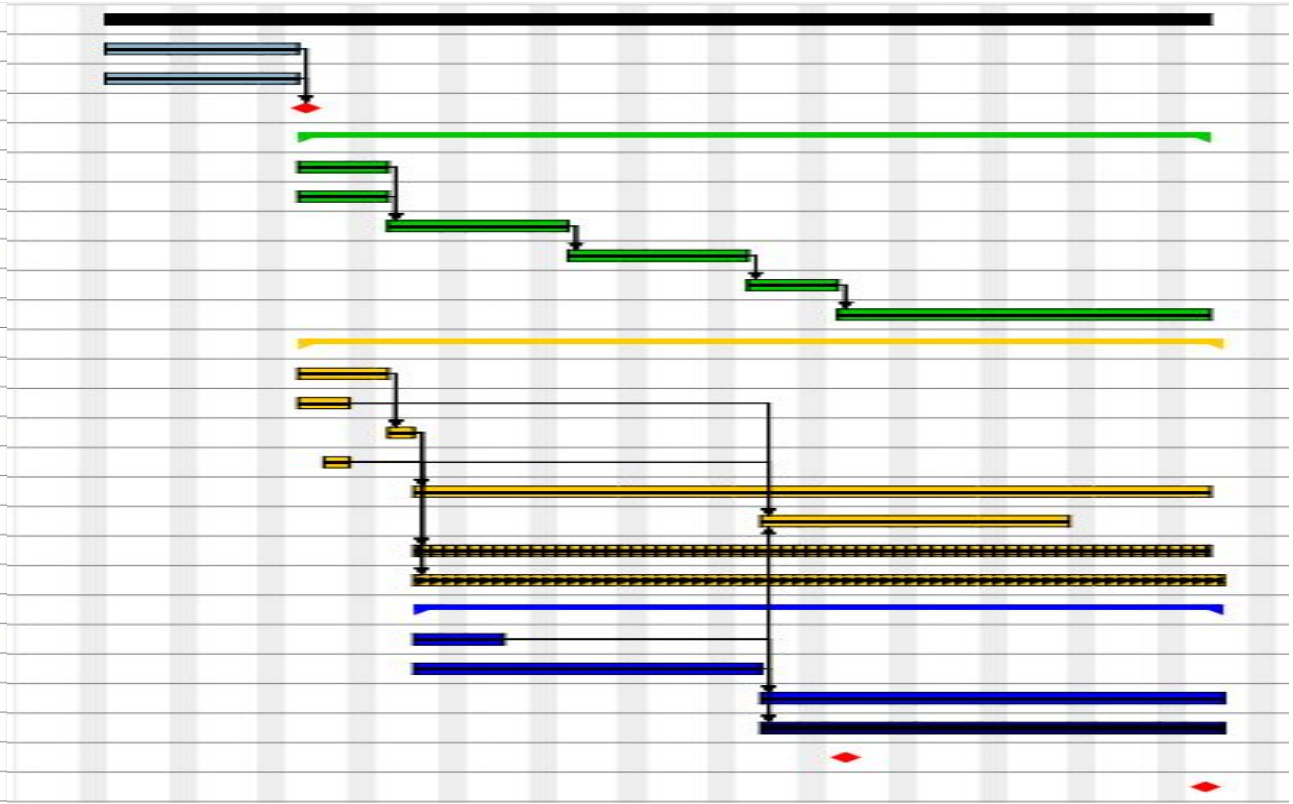
Runs in Docker
container
1GB VRAM Linux

DEMO

Link to Video

Timeline

Vehicle Classification Project	1/30/23	4/25/23
Project Proposal	1/30/23	2/13/23
Project Proposal Slides	1/30/23	2/13/23
Project Proposal Presentation	2/14/23	2/14/23
Vehicle Classification Machine Learning	2/14/23	4/25/23
Organize Machine Learning Data	2/14/23	2/20/23
ML Model Brainstorming	2/14/23	2/20/23
ML Model Implementation	2/21/23	3/6/23
ML Model Training	3/7/23	3/20/23
ML Evaluation	3/21/23	3/27/23
ML Tuning	3/28/23	4/25/23
Database	2/14/23	4/26/23
Database Schema Design	2/14/23	2/20/23
Database Server Setup	2/14/23	2/17/23
Database Table Creation	2/21/23	2/22/23
Database I/O Format	2/16/23	2/17/23
Database Management Software...	2/23/23	4/25/23
API Implementation	3/22/23	4/14/23
Security User Data Access Organization	2/23/23	4/25/23
Analyst User Data Access Organization	2/23/23	4/26/23
UI	2/23/23	4/26/23
User Interface Sketch	2/23/23	3/1/23
User Interface Prototype	2/23/23	3/21/23
User Interface Security	3/22/23	4/26/23
User Interface Analyst	3/22/23	4/26/23
CDR Presentation	3/28/23	3/28/23
Project Demo	4/25/23	4/25/23



Project Management and Teamwork

- Members divide into 3 pairs
- Tasked with module connections
- Assignments are flexible
- 2 in-person meetings weekly

ML Recognition

Aniruddha Srinivasan & Jacqueline Mioduski

Database Server Management

Tyler Roosth & Coleman Todd

User Interface

Fabianna Barbarino & Spencer Cho

Docker & Documentation

All Member & Rotating

Societal, Safety, and Environmental Analysis

Beneficial Impact

- ★ Increase in parking lot safety is a benefit to society

Detrimental Impact

- ★ Potential loss of privacy due to information being stored and cameras recording
- ★ Ethical concern

Safety Precautions we must take

- ★ Inclement weather may damage camera

Environmental Impact

- ★ Carbon emissions from streaming video footage, but these cameras have to be on.

Manufacturability, Sustainability, and Economics

Economics

★ creates a flexible, repeatable, efficient, & cost-effective process to assist parking lot monitoring

Sustainability

★ analytics may be used to reduce parking lot traffic density = lower carbon footprint

Manufacturability

★ will use existing architecture to gather, process, & store data

RESOURCES

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RESOURCES cont.

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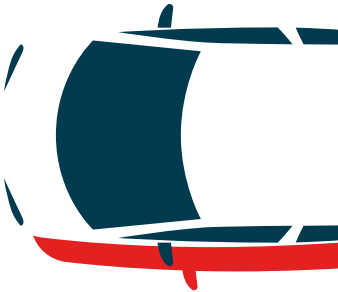

THANK YOU!

Do you have any questions?