CLOUDVISION

GOVERNMENT

TEAM

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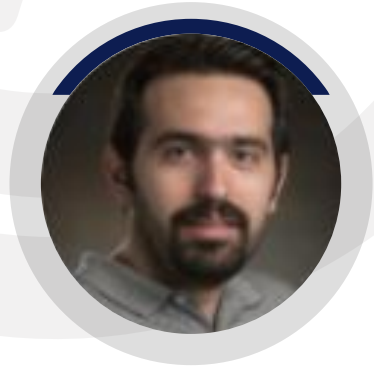


REZA HOJABR

OBJECTIVE

Use public camera data for making our community a cleaner and safer place to live by collecting free, accessible city footage to:

- Detect and analyze overflowing garbage in streets
- Detect and analyze traffic flow data (cars, buses, taxis and pedestrians)

EXPECTED IMPACT

- Compared to traditional routing of going street by street, optimizing waste collection routes using camera data can make our neighbourhoods cleaner while at the same time we can save on costs incurred from garbage transport, and also reduce their carbon footprint.

- Detection and analysis of traffic flow data to optimize traffic lights and public transportation can create higher efficiency travel to save more time from the people living in the city, and can reduce the carbon footprint in instances when an empty bus would normally complete the entire route.

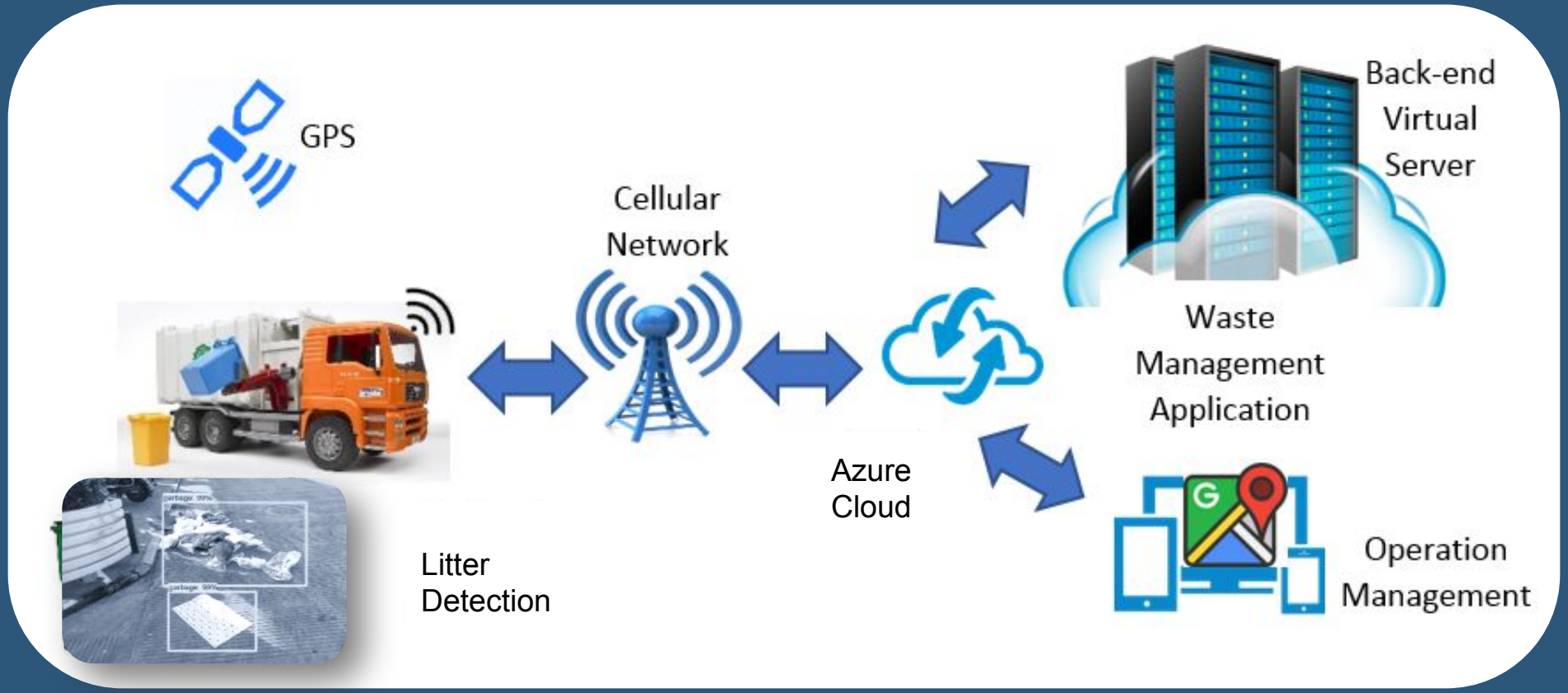
ASSUMPTIONS

- Existing public camera infrastrure is a great opportunity for data collection and analysis in order to optimise waste and traffic flow management.

- Access to most public camera data is available in real-time

- Waste management facilities are operated/funded by municipalities or private companies partner with municipalities to access to camera and residents data

SMART WASTE MANAGEMENT



PROBLEM STATEMENT

As students, garbage overflow is a common problem at the Thunderbird student residence at the University of British Columbia. It leads to foul-smelling, trash-riddled streets that attract wild animals and make the problem worse.

How many times have you seen and smelled overflowing garbage in your neighborhoods?

Imagine if these streets could instead become multi-functional spaces for people and kids to use and overall increase the quality of living and cleanliness.

Sho.F @ShoFrex Dirty Back Street Alley in Vancouver, 2018

SMART WASTE MANAGEMENT: ROUTE OPTIMIZATION

- **Prioritize the routes for waste collection vehicles** for the areas with overflowing waste containers to have cleaner neighbourhoods
- **Skip areas that are still clean** resulting in a smaller carbon footprint and waste management costs
- **Detect an unusual amount of garbage overspill so** it can be addressed immediately instead of waiting for the next collection cycle

Wang, Ying & Zhang, Xu. (2018). Autonomous garbage detection for intelligent urban management. MATEC Web of Conferences. 232. 01056. 10.1051/matecconf/201823201056.
http://www.rapidis.com/route-planning-waste-collection/?lang=en

SMART WASTE MANAGEMENT: SERVICES

- **Notifications to people** for the garbage collection so people can take out their garbage out ahead of time or notify the property and business owners in the neighbourhood, if there is an occurring littering or overflow issues.

- **Recommend customized garbage bins** (size and types) based on historical patterns for each building, neighbourhood or facility**.**

- **Dynamic adjustment to garbage collection cycles:** based on historical patterns and special events holidays, events, etc.

Fixed Schedule

Smart Schedule

https://ville.montreal.qc.ca/portal/page?_pageid=8197,90275788&_dad=portal&_schema=PORTAL

TRAFFIC FLOW MANAGEMENT

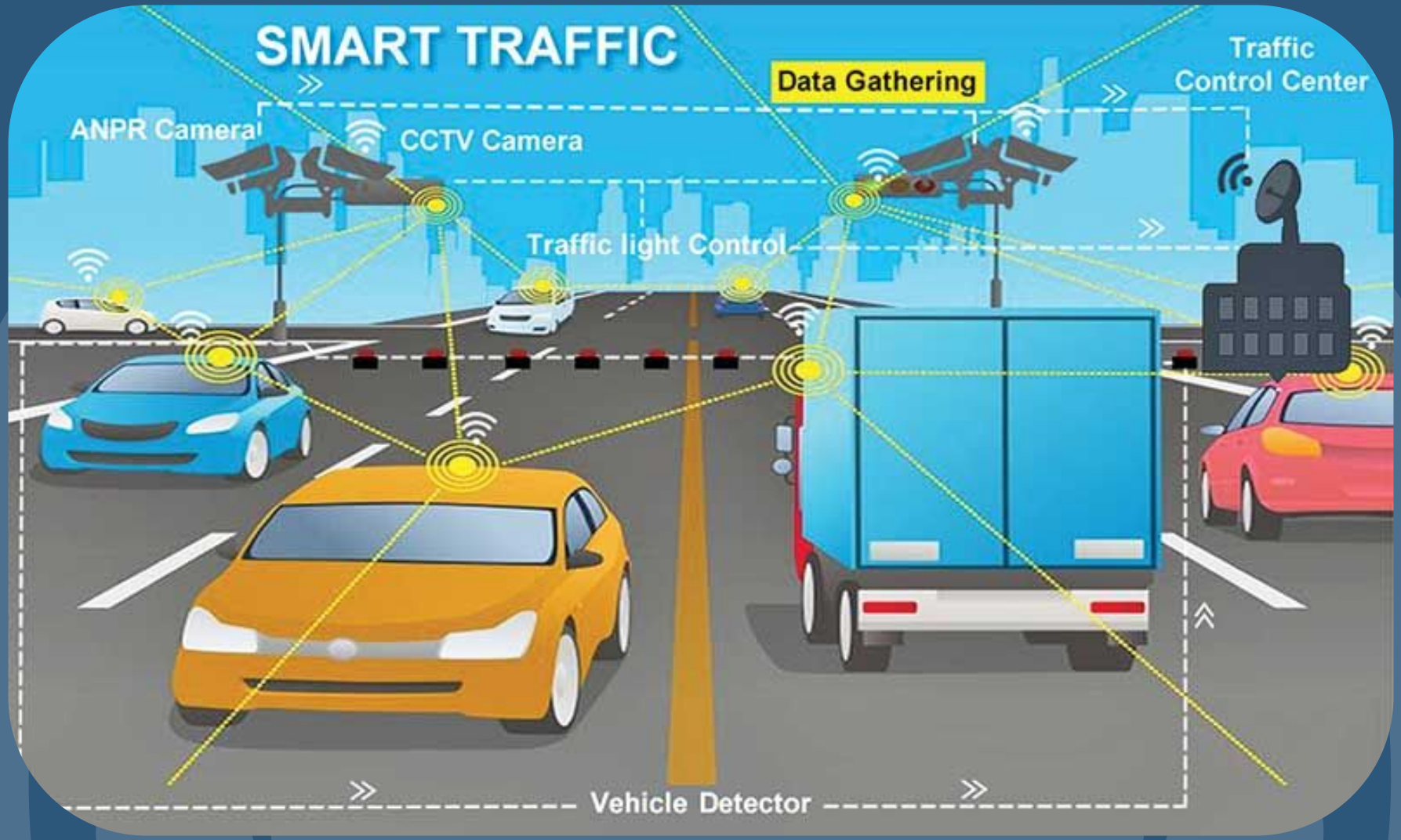


photo credit: https://www.observerbd.com/news.php?id=147812

PROBLEM STATEMENT

We went to a concert in Queen Elizabeth in downtown vancouver from the University of British Columbia. We took public transportation to avoid the hassle of parking and traffic, however the frustration of waiting for a bus in the rain ruined the night (thanks, human recency bias).

How many times has delays in public transportation affected your day to day life, whether it be a fun event or important obligation?

Imagine an optimized public transportation system which mobilizes based on the people who are waiting at bus stops, and not based on a fixed schedule.

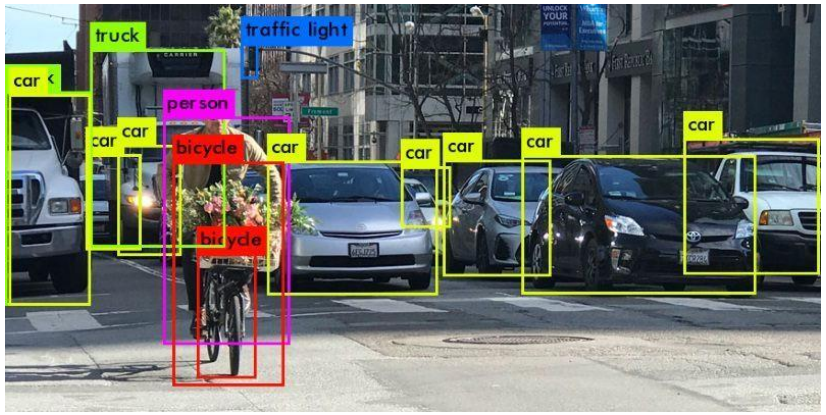
* Recency bias is a human cognitive bias that gives "greater importance to the most recent part of an event"

SMART TRAFFIC MANAGEMENT: DYNAMIC TRAFFIC LIGHT

- **Adjust traffic light timing** based on the flow of people and cars during the time of the day and the day of the week or for special event so traffic light dynamically get adjusted and thus the day-to-day congestion and pollution are reduced

- **Detect the frequency of the cars doing left turn** so the left turn light can be adjusted dynamically or the left turn lane can be justified

- **Combine the data from different intersections** to optimize the flow of traffic not only based on the flow in each intersection but also based on the the flow of traffic in neighbouring intersections



https://montrealgazette.com/news/local-news/traffics-cops-are-maestros-of-busy-downtown-intersection

https://heartbeat.fritz.ai/introduction-to-basic-object-detection-algorithms-b77295a95a63?gi=40da9e7a855e

SMART TRAFFIC MANAGEMENT: ROUTE OPTIMIZATION

- **Use the numbers of the people in bus stops** to optimize the frequency of buses required so waiting times and carbon emission are minimized.

- **Use the numbers of the people in public areas** to notify taxi providers so the taxis in those neighbourhoods can go to the congested areas.

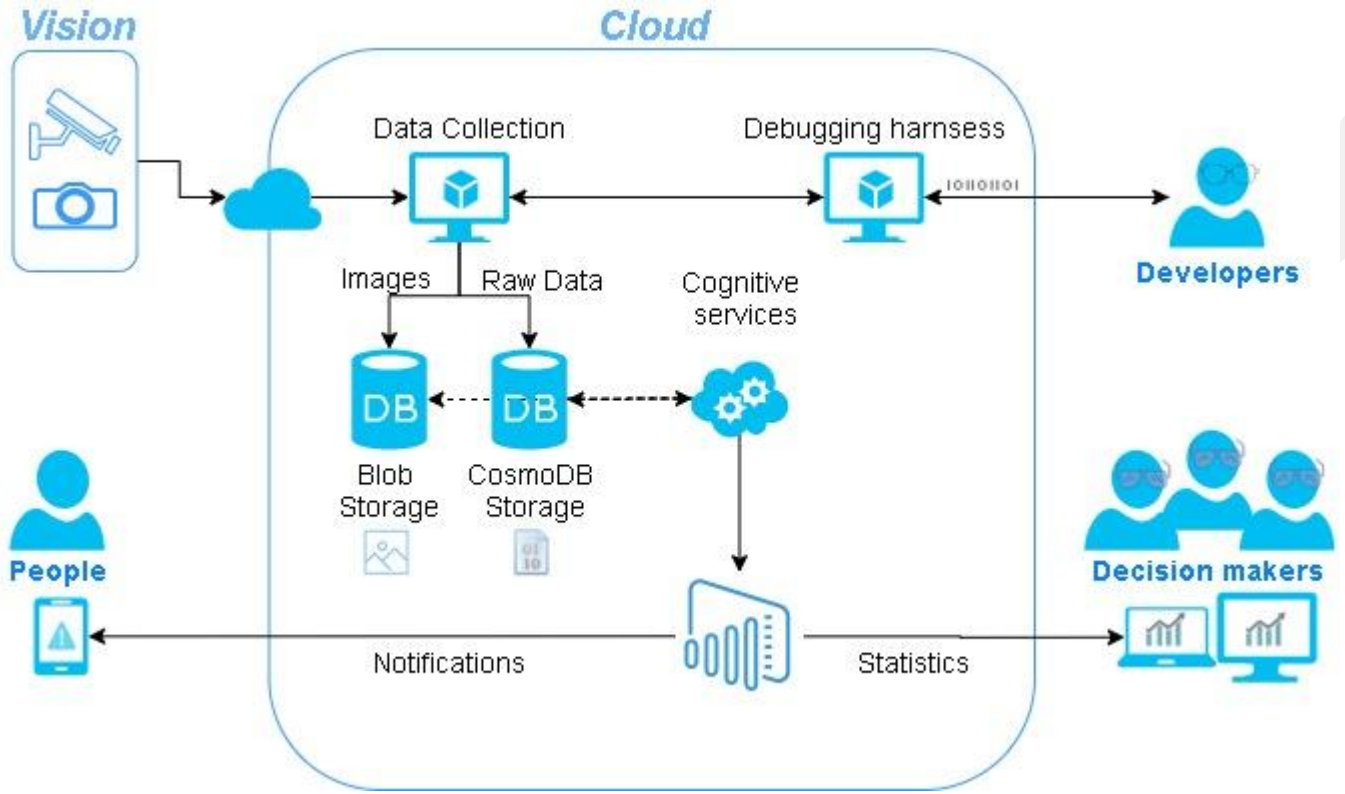
- **Detect anomaly**
  - Sudden change in #peoples:
    - Decreased: notify the city so they can investigate if there is an issues
    - Increased: need for services and immediate action
  - Sudden change in the flow of the traffic: Road problem?

People waiting for transportation

Public transportation available in other areas

SOLUTION ARCHITECTURE

- Use existing camera infrastructure in public areas to collect data
- Using Microsoft Azure virtual machine to classify objects of interest such as garbage bags, people, cars, buses, and taxis
- Analysis to detect problem areas where optimized routing, dynamic mobilization, and sending notifications are useful



OUR APPROACH

- We have implemented our systems almost entirely in python, run them on VMs on Azure cloud and used a combination of the Azure cognitive services and the local object detection models to perform our AI tasks.

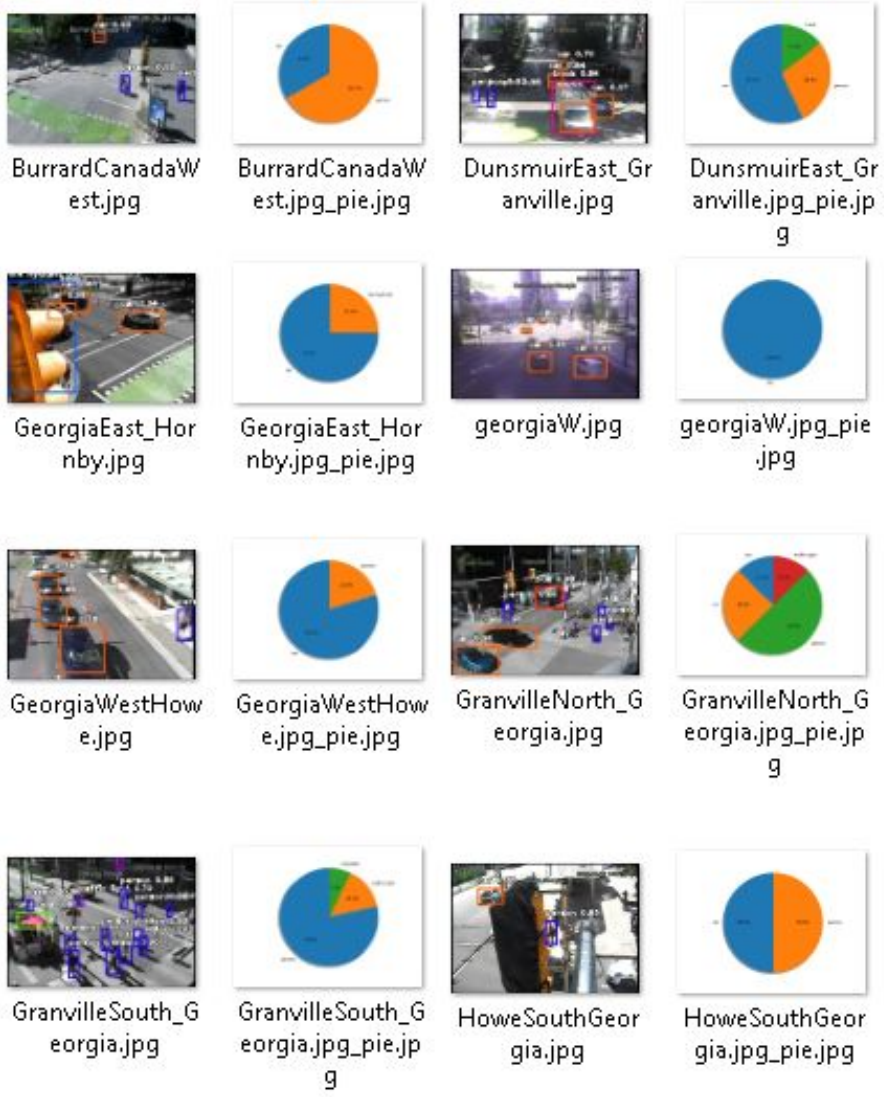
  Please refer to our video or http://cloudvision.ml/ for the detailed information and the open sourced code.

RESULTS: GARBAGE DETECTION

- Identified the number of garbage bags and cardboards using computer vision.
- Used YOLO-v3 CNN model with darknet framework.
- Achieved a mean average precision of 65.2% by training only 800 images

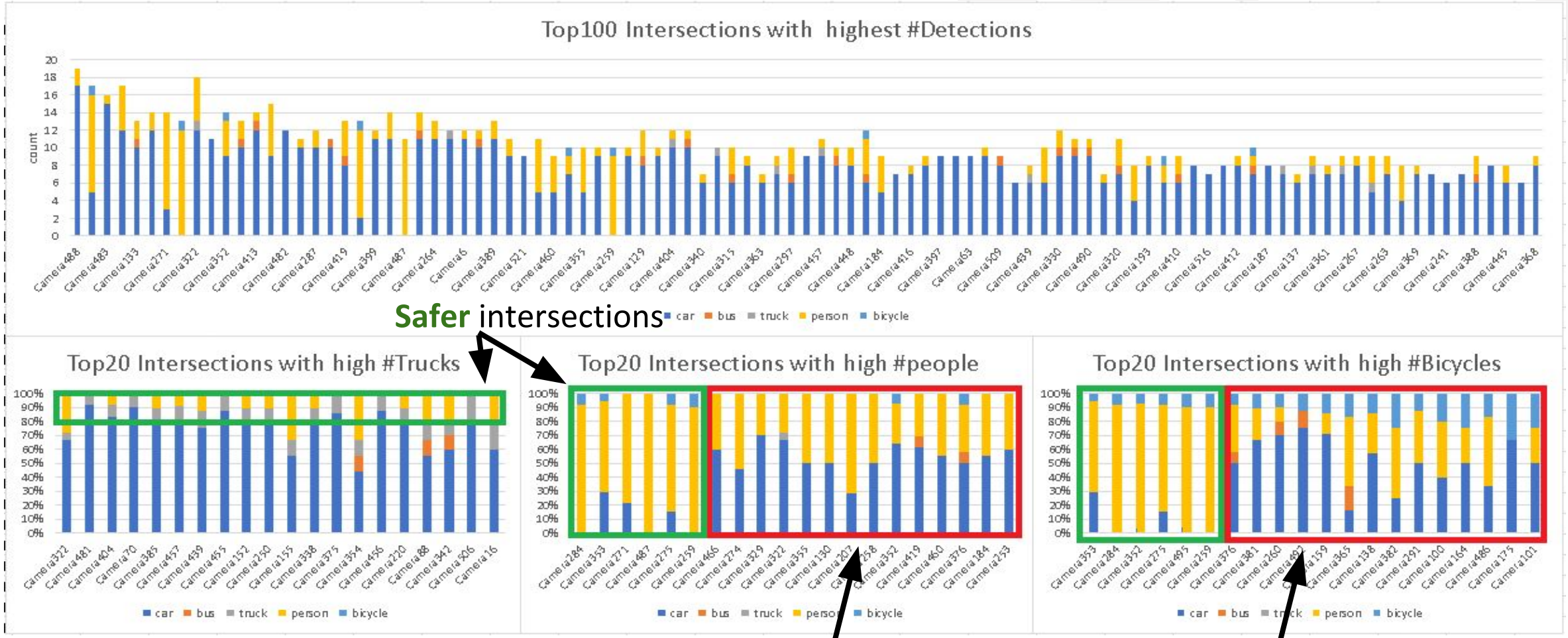
RESULTS

- Identified the number of cars, trucks, buses, trucks, people.
- Used pretrained YOLO-v3 CNN model.
- Achieved a throughput of ~10 images/sec to download and process the images



RESULTS

- Observing the statistics, we can identify the interactions with more danger for people/bikers:



THANK YOU!

INFO@CLOUDVISION.ML

HTTP://WWW.CLOUDVISION.ML/