

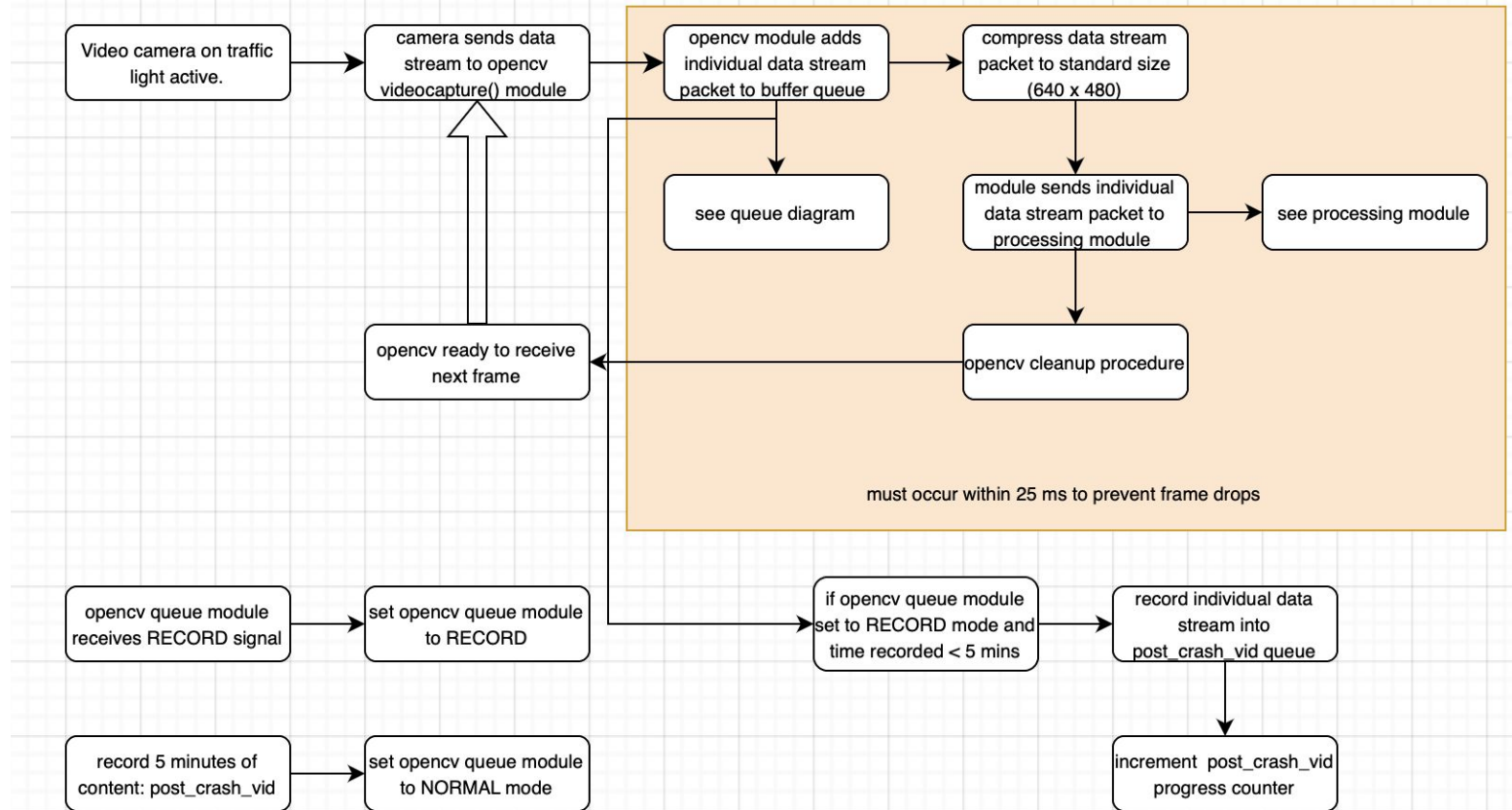
Application Area

- **Problem Area**
 - Mitigate loss in productivity due to car crashes (\$93 billion)
 - Lower emergency response time to crashes (9 minutes)
- **Smart Traffic Light**
 - Traffic Light capable of crash detection, traffic rerouting, and emergency alerting/recording/logging
- **Areas**
 - Software and Signals

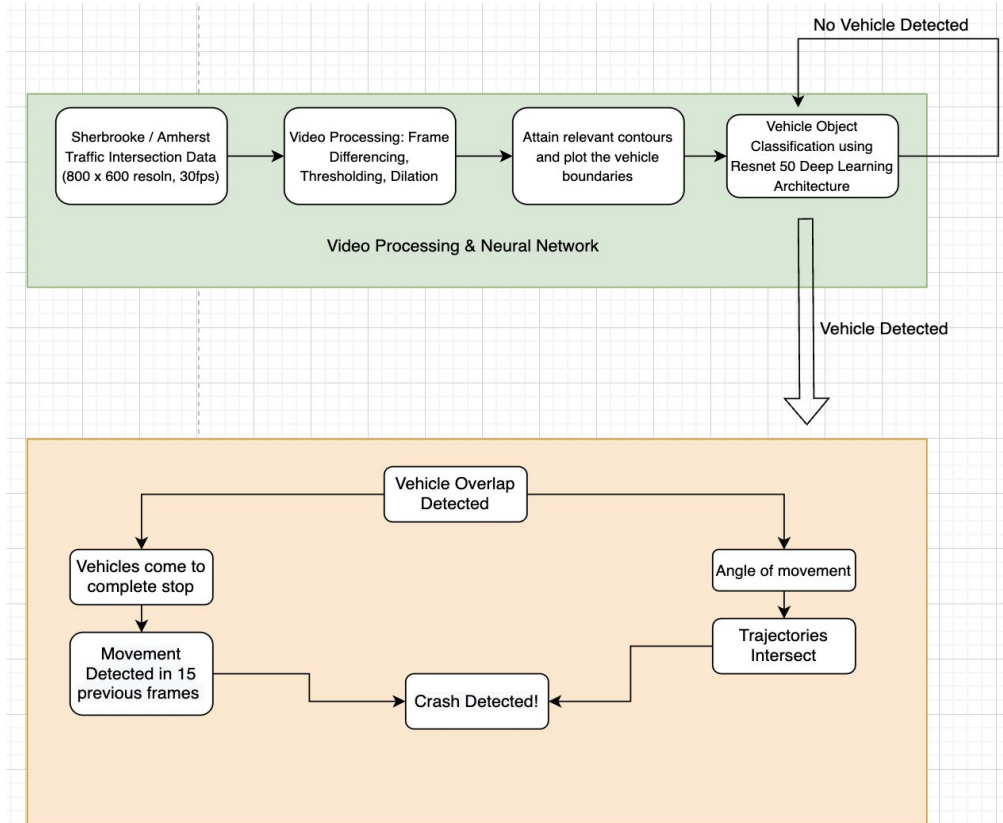
Solutions Approach

- Movement detection system
 - To detect relative speeds of moving objects
- Object classification of moving objects
 - Resnet 34/50 or Mobilenet depending on hardware constraints
 - To detect cars
- Rerouting around crashes
 - Open street map, constrained shortest path Dijkstra's algorithm
 - Decrease in productivity loss caused by traffic slowdowns

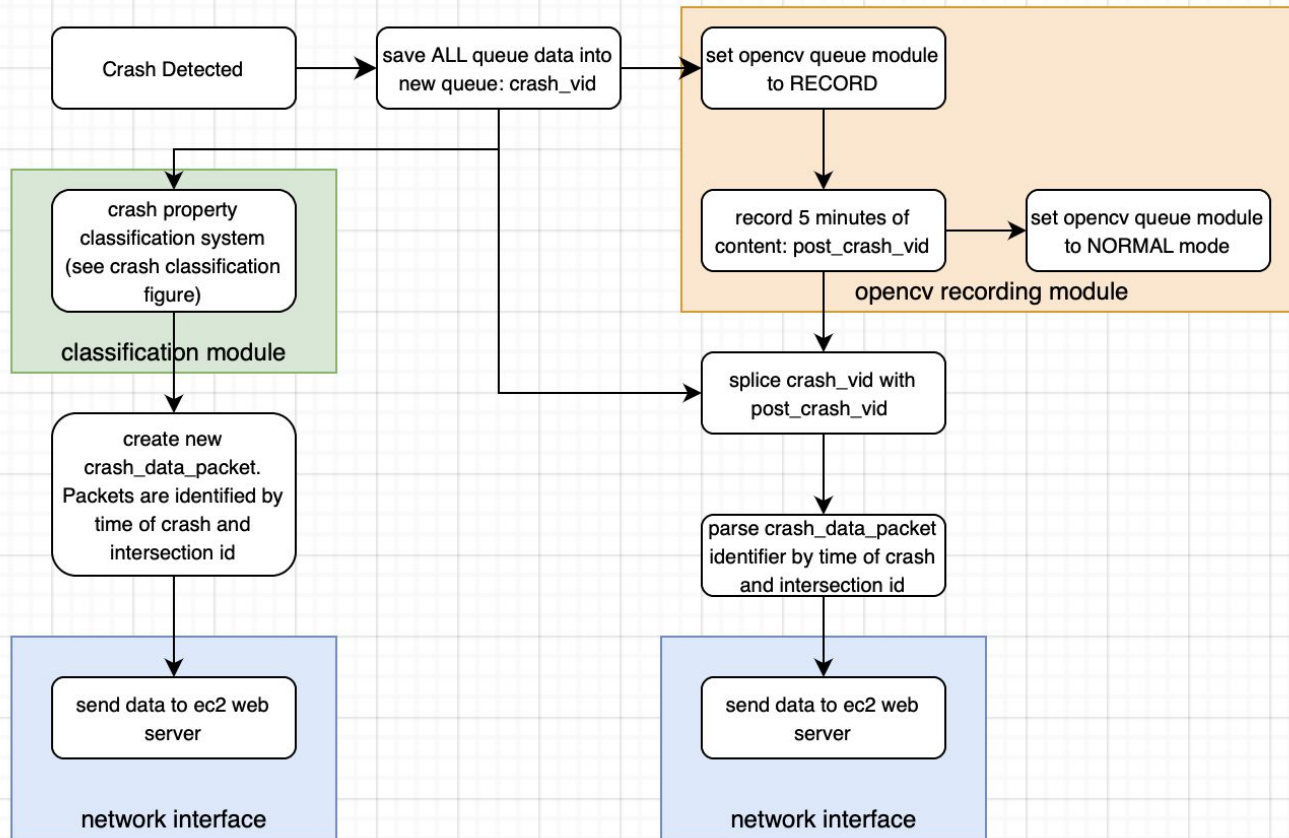
OpenCV video recording



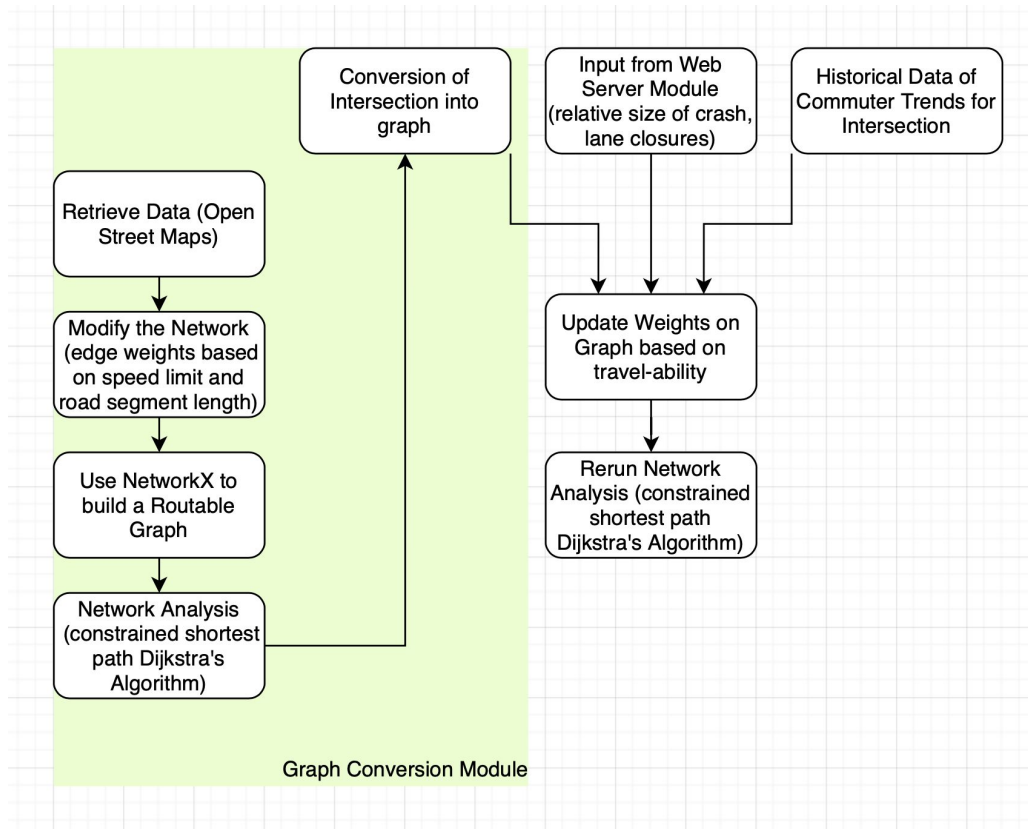
Classification / Object Detection module



Crash Detected Module



Rerouting



Web Server

- Receives data from crash detected module network interface
- Network packet sent to web server: `crash_data_packet`.
 - Signed by private key on crash detected module.
- Server initially receives:
 - Time of crash (original date and time in GMT)
 - Intersection id
 - First 1 minutes of footage from queue
- After 5 minutes receives:
 - Whole 6 minute video splice including before and after crash
- Responsibilities:
 - Map crash to intersections and pull severity metrics {0-10 scale}
 - Send data to rerouting module
 - Logs of all crashes

Implementation Plan

Components designed on our own:

- Video Preprocessing and Resnet 50 Neural Network for Vehicle Detection
- Queue based video logging
- Rerouting algorithm visual display

Components / Resources required:

- OpenCV resources
- Algorithms and Methods Inspired from papers and technical articles
- AWS Credit
- Google Collab
- Hard Drives

Metrics and Validation

Video Logging

- 25ms processing time constraint

Vehicle Detection

- Vehicles are classified correctly 95% of the time
- Motion / object detection accurate 95% of the time

Crash Detection:

- False Positives are 99% accurate (very high)
- False Negatives are 75% accurate

Metrics and Validation

Rerouting

- Visibly pleasing simulation of traffic flow
- Simulated 10% increase in traffic flow

Alerts

- Simulated 7.5 minutes emergency response time

Web Server

- After receiving initial packet, sends to rerouting module within 10 seconds
- All identified crashes are successfully logged and accessible

Risk Factors & Mitigation

- Neural Network Vehicle Classification is not working well
 - Pretrained Resnet 50 car detection Network can be used
 - Analyze the difference in performance and brainstorm reasons why
- Crash Detection Algorithm does not work well
 - Increase the thresholds for what speeds, deceleration and collisions count for a crash
- Routing is not significantly increasing traffic flow
 - Consider different rerouting algorithms, as long as there is a net benefit it is an improvement on the status quo

Schedule

Smart Traffic Light

Company Name

Project Lead

Project Start:

Sun, 2/6/2022

Display Week:

1

TASK	ASSIGNED TO	PROGRESS	START	END	Feb 7, 2022							Feb 14, 2022							Feb 21, 2022							Feb 28, 2022							Mar 7, 2022							Mar 14, 2022							Mar 21, 2022							Mar 28, 2022							Apr 4, 2022							Apr 11, 2022							Apr 18, 2022						
					M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S
Phase 1 Title																																																																																	
Research Crash Detection Algorithms	Jonathan	0%	2/6/22	2/13/22	[Bar from 2/6/22 to 2/13/22]																																																																												
Researching Rerouting Algorithms	Goran	0%	2/6/22	2/13/22	[Bar from 2/6/22 to 2/13/22]																																																																												
Research Message Transmission	Arvind	0%	2/6/22	2/13/22	[Bar from 2/6/22 to 2/13/22]																																																																												
Phase 2 Title																																																																																	
Implement Crash Detection	Jonathan	0%	2/13/22	3/6/22	[Bar from 2/13/22 to 3/6/22]																																																																												
Implement Rerouting Algorithms	Goran	0%	2/13/22	3/4/22	[Bar from 2/13/22 to 3/4/22]																																																																												
Message Transmission Handling	Arvind	0%	2/13/22	2/27/22	[Bar from 2/13/22 to 2/27/22]																																																																												
Breadboard Setup	Arvind		2/27/22	3/4/22	[Bar from 2/27/22 to 3/4/22]																																																																												
Breadboard Setup Part II	Goran		3/11/22	3/16/22	[Bar from 3/11/22 to 3/16/22]																																																																												
Phase 3 Title																																																																																	
Signal Handling Detection/Routing/Tri	Goran		3/11/22	3/25/22	[Bar from 3/11/22 to 3/25/22]																																																																												
Wifi Communication Breadboard	Arvind		3/16/22	3/23/22	[Bar from 3/16/22 to 3/23/22]																																																																												
Breadboard Capable of Message Trans	Arvind		3/24/22	3/31/22	[Bar from 3/24/22 to 3/31/22]																																																																												
Set Up Web Server/Live Video Buffer	Jonathan		3/11/22	4/1/22	[Bar from 3/11/22 to 4/1/22]																																																																												
Data Collection	Jonathan		3/11/22	3/25/22	[Bar from 3/11/22 to 3/25/22]																																																																												
Phase 4 Title																																																																																	
Signal handling Breadboard/Modules	Jonathan		4/1/22	4/8/22	[Bar from 4/1/22 to 4/8/22]																																																																												
Buffered Camera Recording on Crash	Arvind		3/26/22	4/2/22	[Bar from 3/26/22 to 4/2/22]																																																																												
Interim Demo	NA		4/4/22	4/6/22	[Bar from 4/4/22 to 4/6/22]																																																																												
Adjustments based on Feedback	Jonathan, Arvind, Goran		4/7/22	4/18/22	[Bar from 4/7/22 to 4/18/22]																																																																												
Final Presentation	NA		4/19/22	4/24/22	[Bar from 4/19/22 to 4/24/22]																																																																												