Self-Driving Vehicle Project Proposal
AV-Consulting X PT. Toyota Astra Motor

01

A Self-Driving Vehicle?

Why there should be? Is that even Possible?
Let's find out.

According to BPS, as of 2018....

109,215
Of traffic accidents occured

29,472
Of traffic deaths occured

213,866
Million of rupiahs material loss

But there's hope for us!

90%

Reduction in traffic deaths

40%

Reduction in travel time

£5 billion

Consumer savings

Seriously?

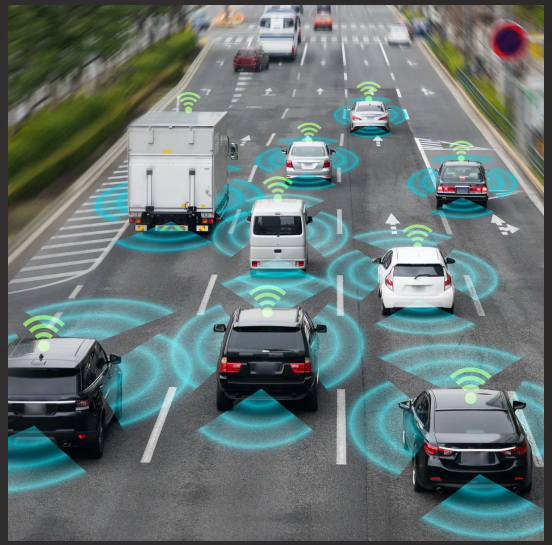
Of course! But the data shown on the latest page? That was the prediction that could happen in the US and UK. But how?

How they did that?

Self-Driving Vehicle

Is a vehicle that is capable of sensing its environment and moving safely with little or no human input.
So, no more driving!

We hope this to happen in our country too!



Our Objective

02

Prepare your data...

Data Requirements and Preprocessing to create such model. *sigh*

Just kidding. Lyft got the dataset already!

Lyft Level 5 have 2 kind of open source data:

- Prediction Dataset
- Perception Dataset

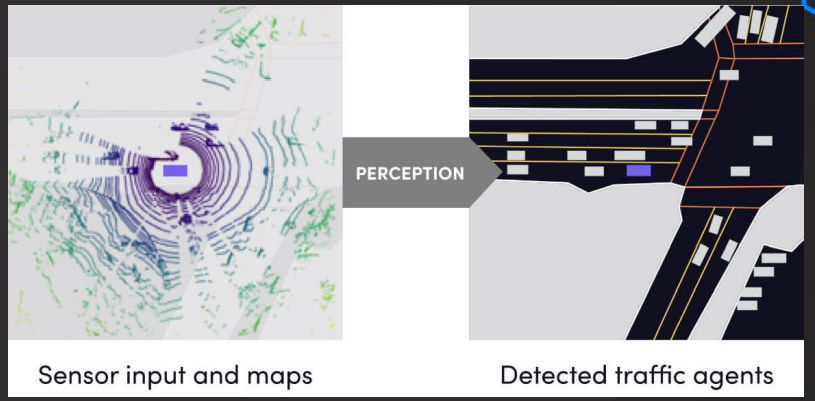
Prediction Dataset is used by the vehicle to predict what should the vehicle do.

Perception Dataset is used by the vehicle to detect an object through lidar and camera.

Perception Dataset

Use raw camera and lidar inputs from our fleet of autonomous vehicles to train perception systems. To supplement the data, they've included human-labeled 3D bounding boxes of traffic agents and an underlying HD spatial semantic map.

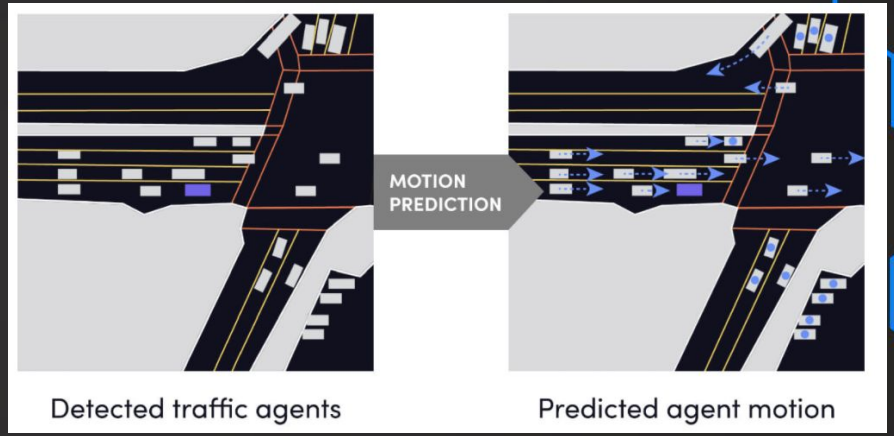
The rasterization uses the HD semantic map and projected lidar point cloud to show the state around the vehicle. You can use this example solution as a starting point for your own experimentation.



Prediction Dataset

A raster generates a bird's eye view (BEV) top-down raster, which encodes all agents and the map. The network infers the future coordinates of the agent-based upon this raster.

The dataset is provided in zarr format. The dataset consists of frames and agent states. A frame is a snapshot in time which consists of ego pose, time, and multiple agent states. Each agent state describes the position, orientation, bounds, and type.



Data Structure

- scene - Consists of 25-45 seconds of a car's journey in a given environment. Each scence is composed of many samples.
- sample - A snapshot of a scence at a particular instance in time. Each sample is annoted with the objects present.
- sample_data - Contains the data collected from a particular sensor on the car.
- sample_annotation - An annotated instance of an object within our interest.
- instance - An enumeration of all object instance we observed.
- category - Taxonomy of object categories (e.g. vehicle, human).
- attribute - Property of an instance that can change while the category remains the same.
- visibility - (currently not used)
- sensor - A specific sensor type.
- calibrated sensor - Definition of a particular sensor as calibrated on a particular vehicle.
- ego_pose - Ego vehicle poses at a particular timestamp.
- log - Log information from which the data was extracted.
- map - Map data that is stored as binary semantic masks from a top-down view.

Each snapshot in the data consists of two forms of information: image data and LiDAR data.

This is how a Self-Driving Vehicle sees

03

Model Creation

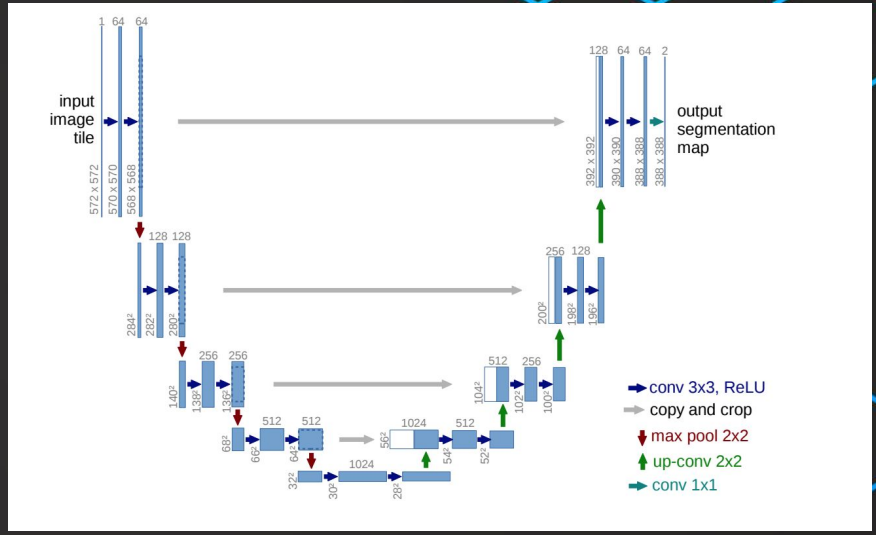
While the dataset is ready, let’s create a model that recognizes object.

To segment an image...

U-Net Architecture Model

Lyft mentioned on their website that they uses U-net neural network segmentation architecture that was trained on the lidar portion of the dataset.

Don't worry, we're an expert in this.



We'll handle the Hyperparameter as well!

Epoch

How many times to train the model

Activation

How the model should interpret the output

Optimizer

How the model learn and reduce the error

Layers

How many layers to use

Filters

How many filters/units on each layer

Regularization

Early stopping, Dropout, Penalties, and much more...

04

Evaluate the Model

We want to know how it performs, so let's evaluate it.

List of metrics to evaluate

01 Accuracy

02 Precision

03 Recall

04 F1-Score

05 Log-loss

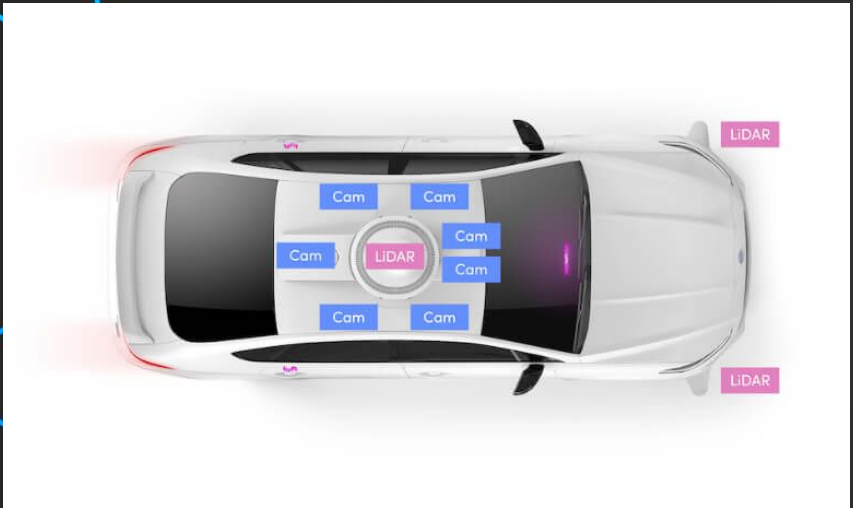
06 Cohen Kappa

05

Deployment

Let’s attach this model to a new Self-Driving Car

The car should be ready!



Lidar

The car should be equipped with 40 and 64-beam lidars on the roof and bumper. They have an Azimuth resolution of 0.2 degrees and jointly produce ~216,000 points at 10 Hz. Firing directions of all lidars are synchronized.

One more thing...

Camera

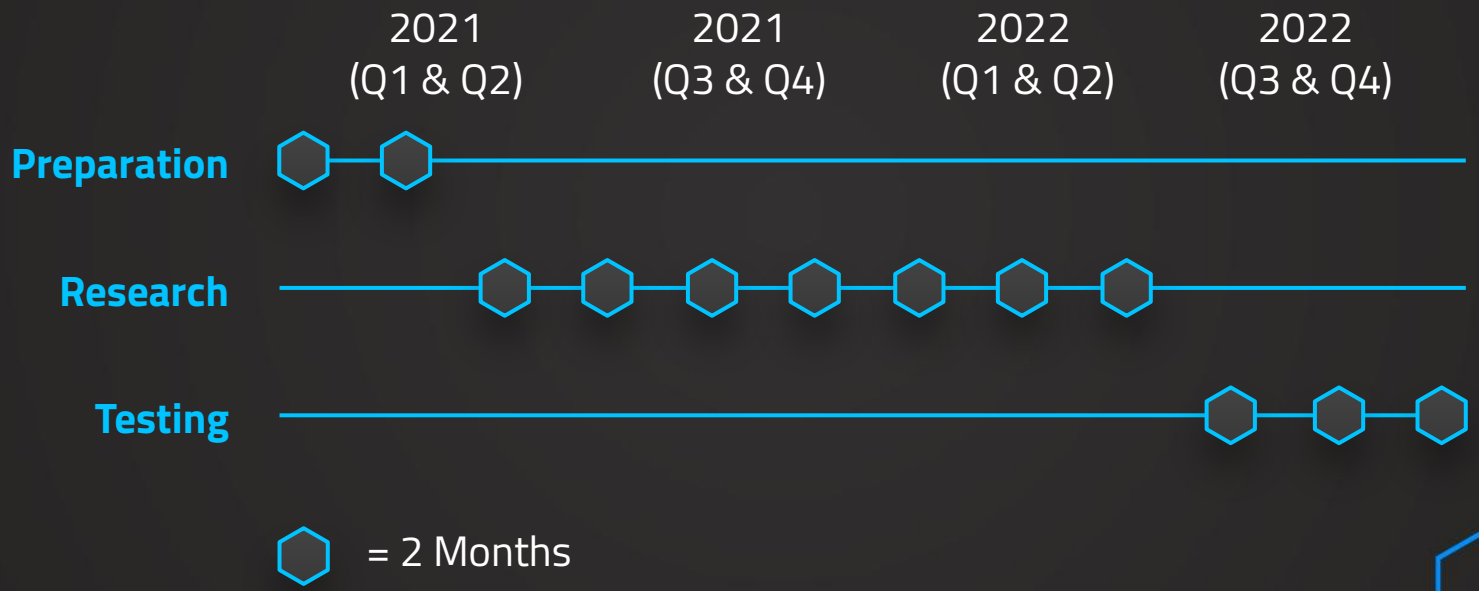
The car should also equipped with six 360° cameras built in-house. One long-focal camera points upward. Cameras are synchronized with the lidar so the beam is at the center of each camera's field of view when images are captured.

06

Timeline & Budget

Right, this one is important to discuss.

Project Stages



Budget List (Labor)

Details	Unit	Day	Hours	Rate (USD)	Total (USD)
Project Lead	1	244	8	$30	$58,560
Researcher	10	244	8	$20	$390,400
Consultant	2	244	8	$20	$78,080
Total					$527,040

Budget List (Tools & Production Research)

Details	Unit	Rate (USD)	Total (USD)
Test Vehicle Production	5	$5,000	$25,000
Lidar	15	$200	$3,000
Camera	5	$200	$1,000
Total			$29,000

Budget List (Summary)

Details	Total (USD)
Labor	$527,040
Tools & Production Research	$29,000
Total	$556,040

Thanks

Does anyone have any questions?

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