

Project proposal - Recent Tesla Model X AutoPilot Accident Analysis and Possible Solution via Object Detection and Image Segmentation

- What is the problem that you will be investigating? Why is it interesting?

Based on recent report

[1]“Tesla said autopilot was activated during a fatal Model X crash last week in California.”
<http://money.cnn.com/2018/03/31/technology/tesla-model-x-crash-autopilot/index.html>,

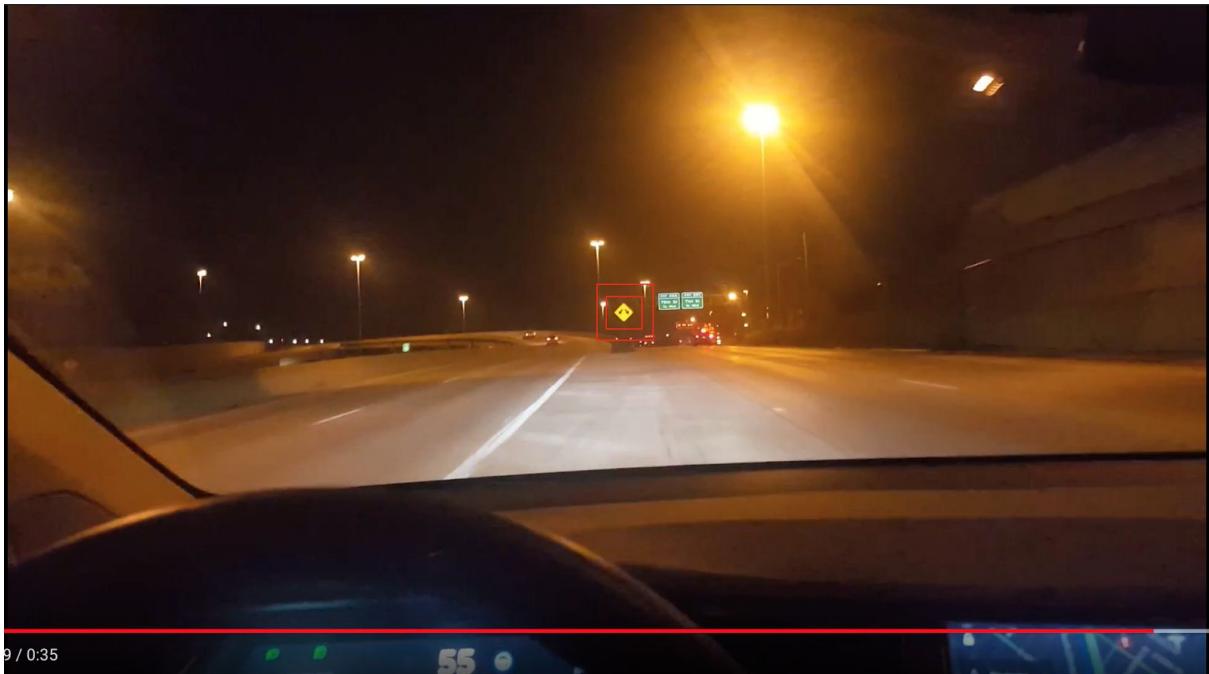
[2]“Tesla car involved in fatal crash in California 'was on Autopilot' when it hit concrete barrier”
<https://www.independent.co.uk/news/world/americas/tesla-fatal-car-crash-latest-california-autopilot-self-driving-vehicles-walter-huang-road-accident-a8283591.html>

[3]“U.S. opens probe into fatal Tesla crash, fire in California”
<https://www.reuters.com/article/us-tesla-crash-ntsb/u-s-opens-probe-into-fatal-tesla-crash-fire-in-california-idUSKBN1H32OT>

One tesla model x was involved into a crash in California which the car hit concrete barrier while its Autopilot feature was on. The project will be mainly working on analysis the accident and come up with potential solution that could avoid the accident or similar accident via Object Detection and Image Segmentation.

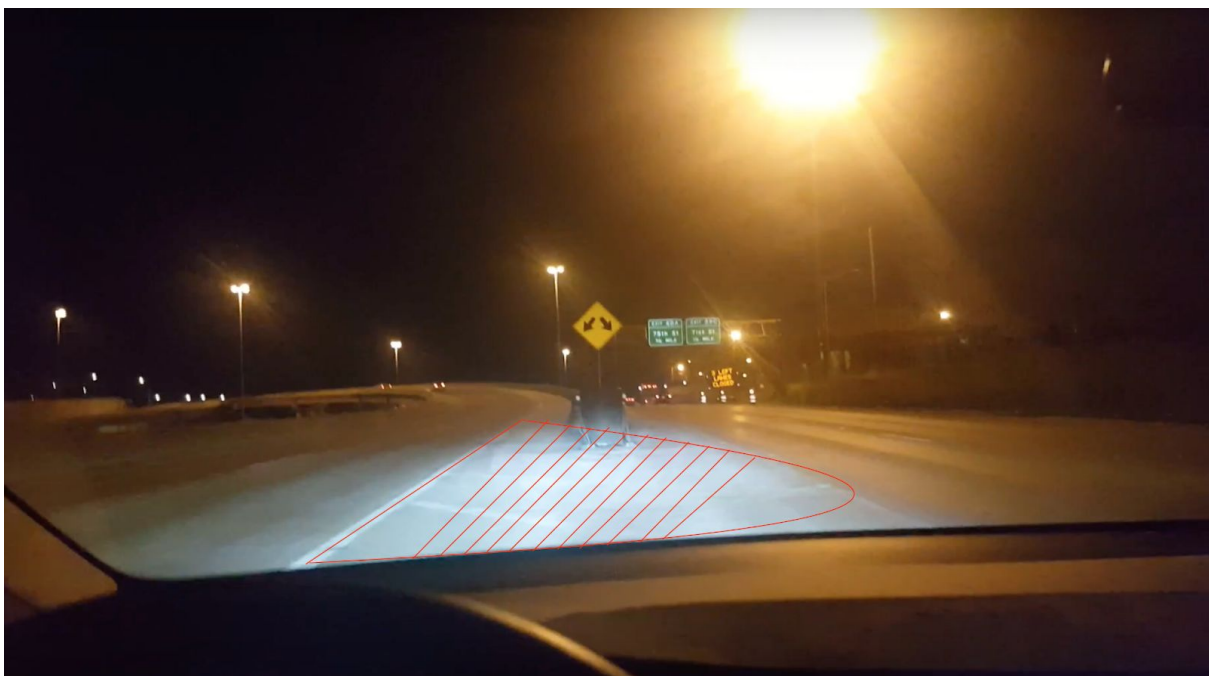
The interesting part of this would be this is a real life problem and its solution could be a combination between Object Detection and Image Segmentation.

By using **Object Detection**, we would be able to recognize the **traffic sign** as following



See the bounding box upon on the yellow [Category: Lane split road signs](#)

By using **Image Segmentation**, we would be able to recognize the **segmentation** as following



See the segmentation indicating HATCHED ROAD MARKINGS, DIVIDING CHEVRON MARKINGS, CHEVRON ROAD MARKINGS WITH SOLID LINE, LANE REDUCTION HATCHED ROAD MARKINGS <https://www.drivingtesttips.biz/road-markings-lines.html>

- What reading will you examine to provide context and background?

Problem background

Some tesla owner tried to reproduce the accident, video posted on youtube

https://www.youtube.com/watch?v=WX0bR_EQ47E

<https://www.youtube.com/watch?v=6zK2Om8Q0IA>

“What We Know About Last Week's Accident”

<https://www.tesla.com/blog/what-we-know-about-last-weeks-accident>

Modeling (Object Detection and Semantic Segmentation)

“Multi Lane Detection using Instance Segmentation”

http://benchmark.tusimple.ai/static/files/poster_lane_3.pdf

“A 2017 Guide to Semantic Segmentation with Deep Learning”

<http://blog.gure.ai/notes/semantic-segmentation-deep-learning-review#deeplabv3>

“Fully Convolutional Networks for Semantic Segmentation”

<https://arxiv.org/abs/1411.4038>

“SegNet: A Deep Convolutional Encoder-Decoder Architecture for Image Segmentation”

<https://arxiv.org/abs/1511.00561>

“Pyramid Scene Parsing Network”

<https://arxiv.org/abs/1612.01105>

“Rethinking Atrous Convolution for Semantic Image Segmentation”

<https://arxiv.org/abs/1706.05587>

“Faster R-CNN: Towards Real-Time Object Detection with Region Proposal Networks”

<https://arxiv.org/abs/1506.01497>

“Mask R-CNN”

<https://arxiv.org/abs/1703.06870>

- What data will you use? If you are collecting new data, how will you do it?

For **test** dataset

Since the accident happened at bay area, I should be able to drive to the place where the accident happened and record the car driving video, I will use the video as test dataset.

For **train** dataset

TuSimple Lane Detection Challenge for Lane Segmentation

<http://benchmark.tusimple.ai/#/t/1>

cocodataset for Object Detection

<http://cocodataset.org/#home>

- What method or algorithm are you proposing? If there are existing implementations, will you use them and how? How do you plan to improve or modify such implementations? You don't have to have an exact answer at this point, but you should have a general sense of how you will approach the problem you are working on.

The problem will be solved via two part, **traffic sign detection** and **lane detection**.

For **traffic sign** detection, I will use Object Detection, which I will implement faster R-CNN referring to paper <https://arxiv.org/abs/1506.01497>

For **lane** detection, I will refer to <https://arxiv.org/abs/1802.05591> to implement corresponding algorithm

- How will you evaluate your results? Qualitatively, what kind of results do you expect (e.g. plots or figures)? Quantitatively, what kind of analysis will you use to evaluate and/or compare your results (e.g. what performance metrics or statistical tests)?

For **test** dataset, I will drive to the place where the accident happened and record the car driving video. This video would be my test dataset.

Besides that, I will run the model against videos below, and manually verify if it could meet my expectation.

https://www.youtube.com/watch?v=WX0bR_EQ47E

<https://www.youtube.com/watch?v=6zK2Om8Q0IA>

For metrics, I will run the model against public dataset provided by cocodataset and TuSimple Lane Detection Challenge to collect the evaluation metrics. By this I will have the metrics which includes 1) Confusion matrix 2) Precision Recall for each class