Traffic Sign Classification Using Artificial Intelligence

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Can self-driving cars learn the difference(s) between objects?

Overview

❖ Trained 3 different convolutional neural networks (CNNs) on ~4000 images of 5 different kinds of traffic signs:

Stop

Pedestrian Crossing

Signal Ahead

Speed Limit (25 MPH)

Speed Limit (35 MPH)

Model Quality

❖ Best model achieved 86% accuracy in differentiating between sign types

❖ Used LIME Image Viewer to determine what parts of the pictures were used by the models to make their predictions

Pros and Cons of CNNs

❖ Can achieve very high (99%+) accuracy

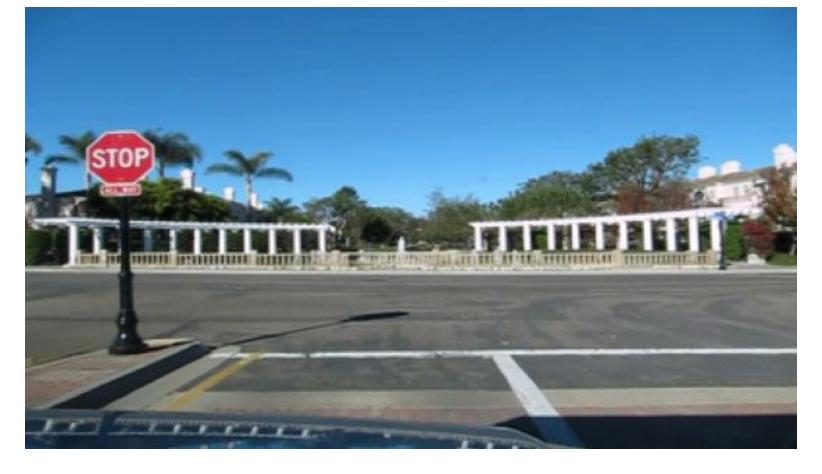❖ Relatively easy to create and implement thanks to Keras and Google Tensorflow

❖ High computational power requirements

❖ Need thousands to hundreds of thousands of examples on which to train

❖ "Black box" model -- we have no idea what the individual neurons are doing

Our model is ~90% confident that this is a stop sign...

...But it doesn't use the sign itself to guess "stop sign".

Medium/high level of confidence (>50%) that this is a stop sign...

...Based on the sky, road, and trees.

Why does this happen?

- ❖ There is more commonality between pictures than simply the signs themselves
  - ➢ E.g. pictures that contain stop signs also contain palm trees, blue skies, roads, and buildings
  - ➢ Increasing the diversity of training data will help differentiate traffic signs from the background

- ❖ The model, therefore, does not know where exactly it should be looking
  - ➢ Using bounding box data is a direct solution

Conclusions

❖   The most successful model achieved 86% accuracy, but it almost never looked at the correct thing in order to arrive at its predictions

❖   Amount of training data must be vastly increased in order to achieve further increases in accuracy

❖   Bounding boxes can also be used in training set

Recommendations

❖ Use images that do not share background features such as landscaping or other context.

❖ Create bounding box data, or use datasets that have bounding box features.

❖ Choose a model architecture that natively incorporates bounding boxes.

Future Work

❖ Use bounding boxes in training data to specify exactly where the model should look in order to make its predictions

❖ Use models capable of reading and predicting bounding box data

Thank You!