Traffic Sign Tracking Using Optical Flow

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Introduction

Traffic sign inspection and evaluation is mostly done manually by human inspectors. This process is both inefficient and costly.

To automate this process, time stamped images are collected and traffic signs are detected to be either automatically or manually evaluated.

Most current detectors are accurate but computationally expensive. Also, in a sequence of consecutive frames the detectors cannot report that the bounding boxes belong to the same traffic sign.

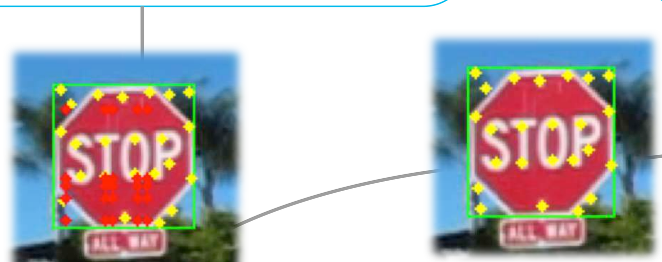
We provide a traffic sign tracking system that reduces the number of iterations needed by the detector by exploiting the temporal and spatial information in the consecutive images.

Method

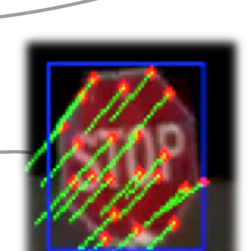
Detect the traffic signs
Run the detector

Extract Feature Points
(SIFT, SURF, Harris Corner, Minimum Eigenvalue Corner)

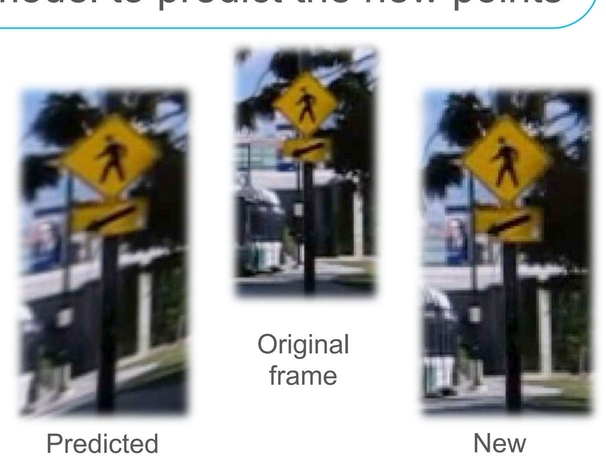
Randomly Generate Extra Points
Enough to compute the transformation



Estimate The Optical Flow
We use the Lucas-Kanade model to predict the new points



Compute The Hommography
Estimate the traffic sign transformation



Predict The New Bounding Boxes
Report the confidence

Results

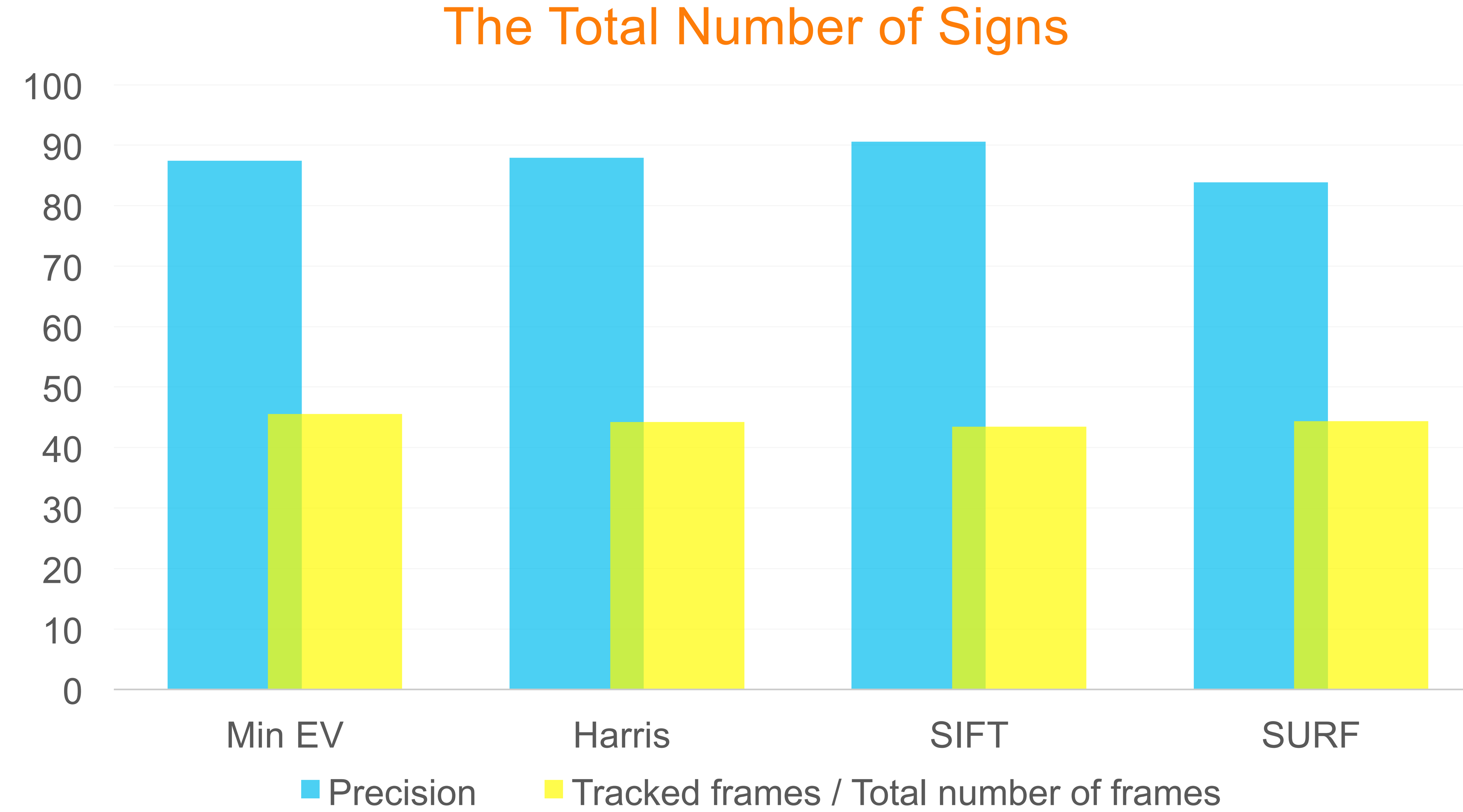
Tracking Precision Per Video

Video	Min EV (%)	Harris (%)	SIFT (%)	SURF (%)
1	84.72	87.56	90.48	81.64
2	81.63	85.97	93.02	84.21
3	88.56	88.98	89.69	87.43
4	92.05	91.49	92.27	84.12
5	87.10	86.84	89.25	87.91
6	91.07	90.57	91.32	87.69
7	87.14	83.92	88.08	73.91

Precision:

$$AP = \frac{TP}{TP + FP}$$

Average Precision And Ratio Of Tracked Signs To The Total Number of Signs



Discussion

- The SIFT feature points perform best in tracking the traffic signs compared to the other features.
- The Tracking system allows to omit the use of the detector in almost half of the frames which results in a more efficient traffic sign detection system.
- The Tracker uses the temporal information to recognize that the traffic sign is the same across multiple frames.
- The dataset that the tracker was tested with is the LISA dataset. The images provided in this set are at least 5 frames apart. Therefore we may assume that the tracker would have a better performance on a full consecutive set of frames.

Future Work

Using the tracker to reduce the detector's false positives

- Explore the use of optical flow estimation and object tracking to reduce the false positive rates in the detecting phase thus increasing the accuracy of the system.

Use the tracker to produce training examples

- Augment the training dataset by adding the tracked traffic signs to the training set to improve the detector's performance

Acknowledgements

- This Research was part of the Robotics Institute Summer Scholar Program 2017 in Carnegie Mellon University.
- This research was sponsored by Carnegie Mellon University Qatar.
- Thank you to my mentor Dr. Christoph Mertz and the Navlab team for their support and guidance.

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