Image Sequence Based Cyclist Action Recognition Using Multi-Stream 3D Convolution

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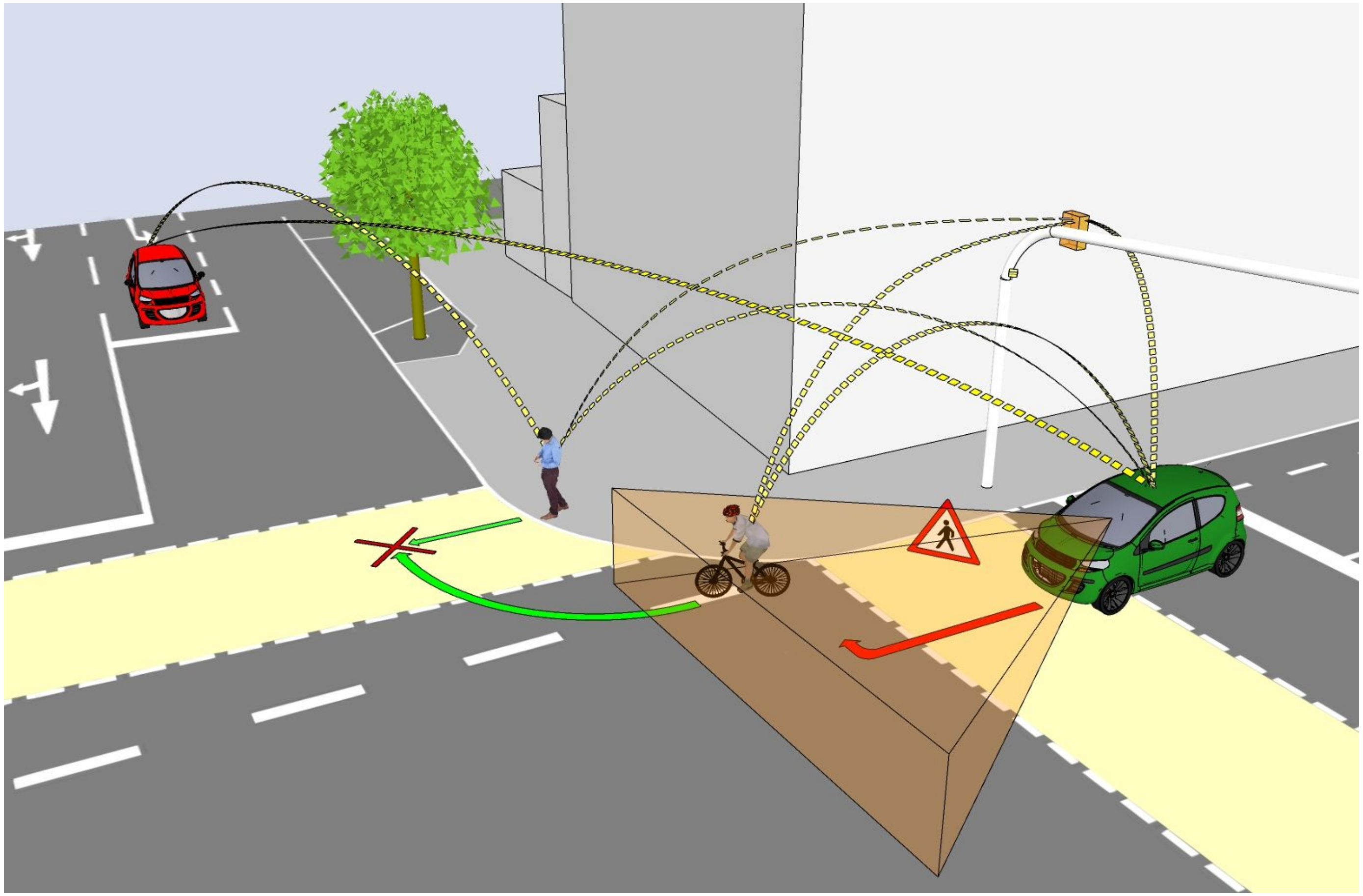
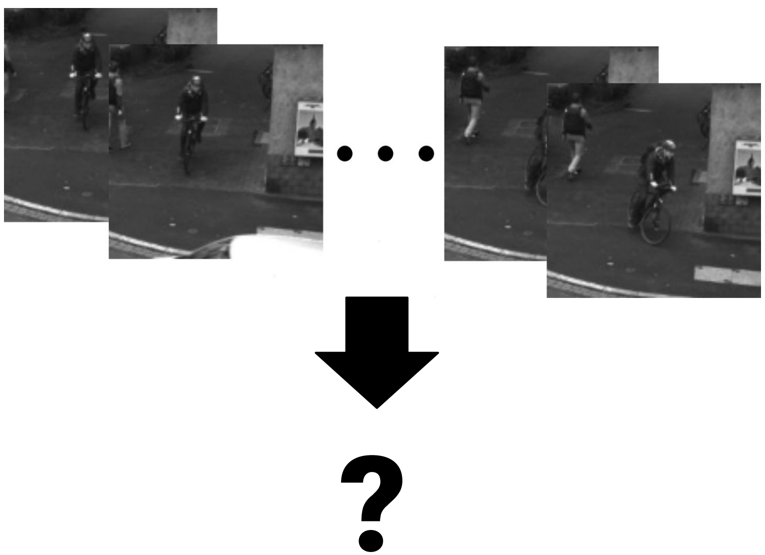
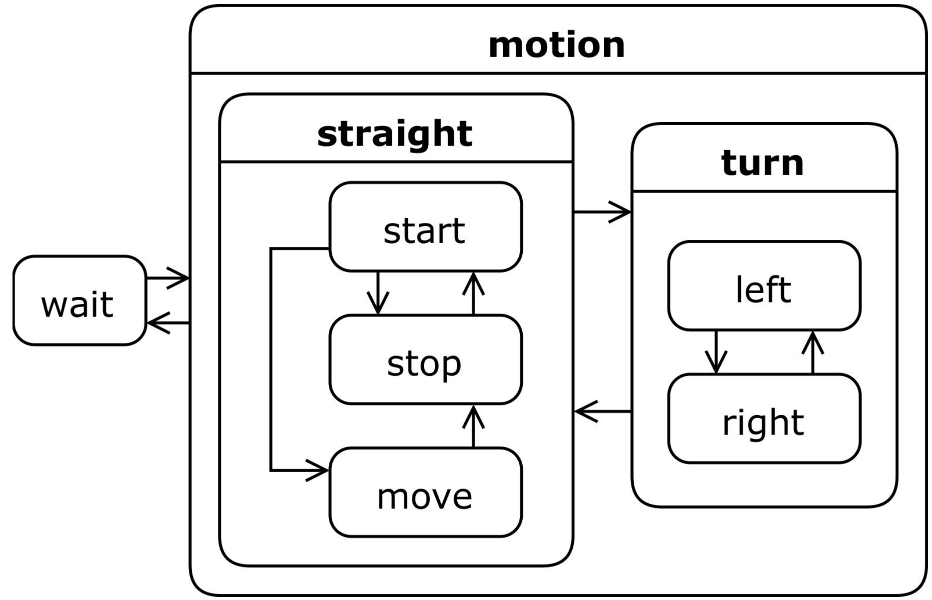
Motivation



Cooperative intention detection of vulnerable road users in urban areas as basis for automated driving.

Goals





- Identify cyclist motion states at all times using video data.
- Detect transitions between motion states as early as possible.
- Create reliable state estimates.

Research Intersection

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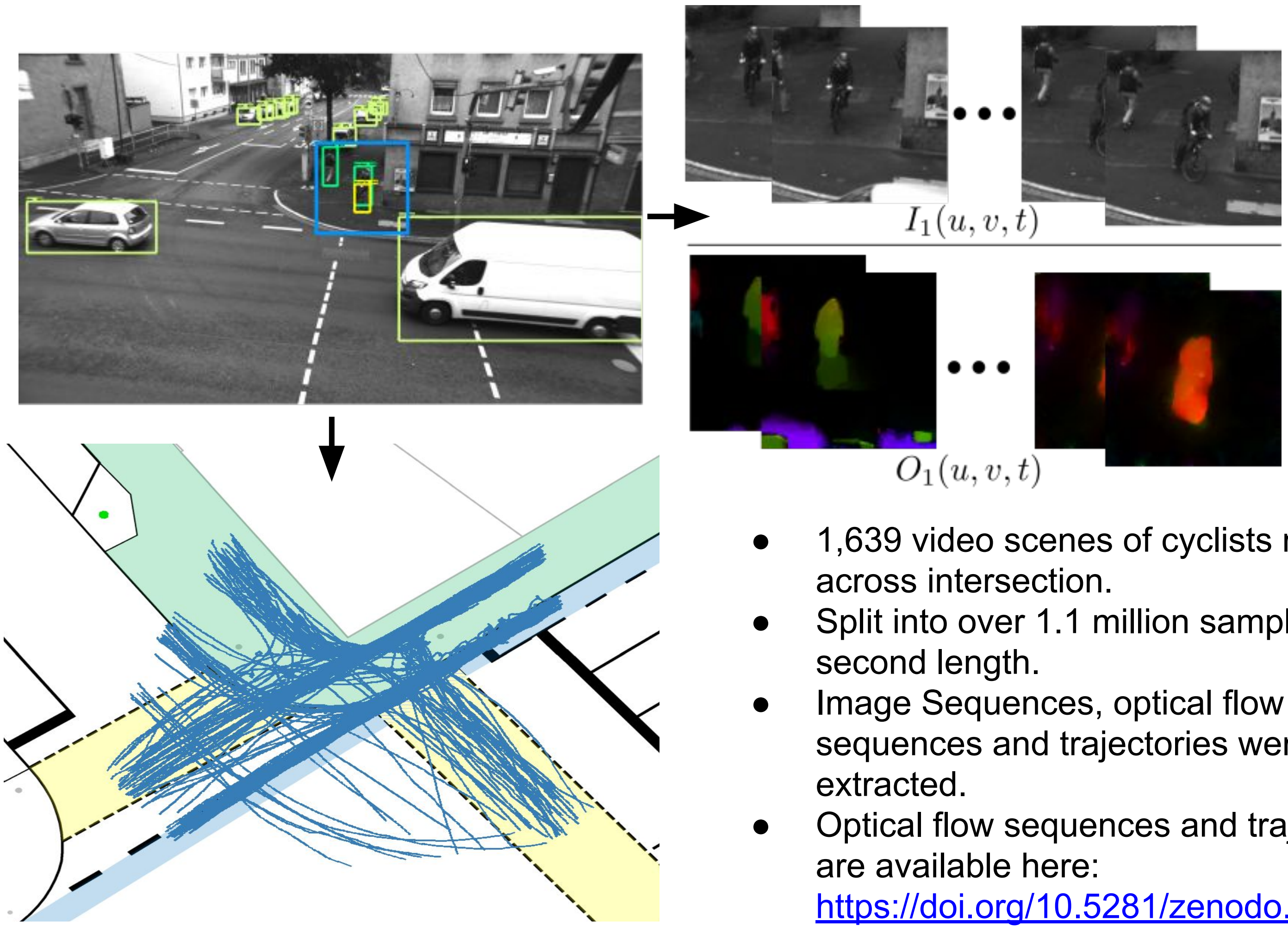
Dataset



- 1,639 video scenes of cyclists moving across intersection.
- Split into over 1.1 million samples of 1 second length.
- Image Sequences, optical flow sequences and trajectories were extracted.
- Optical flow sequences and trajectories are available here: https://doi.org/10.5281/zenodo.3734038

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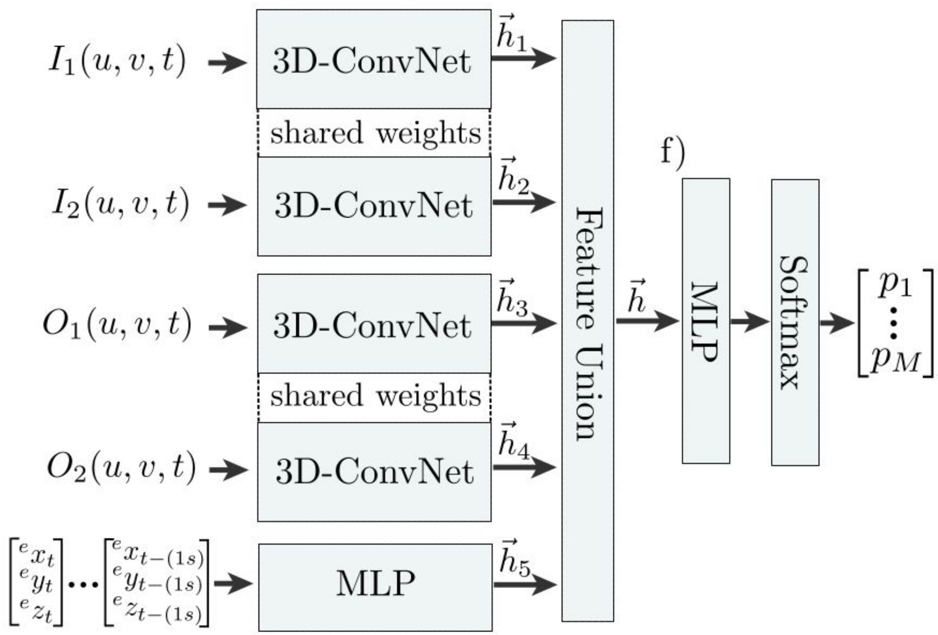
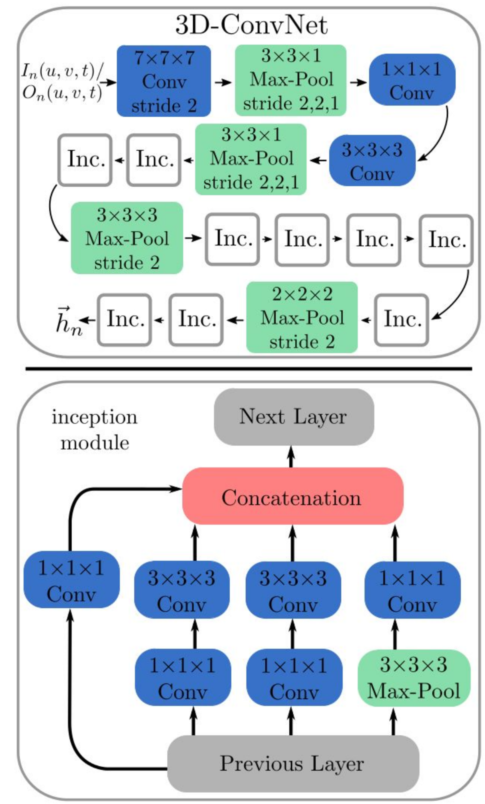
Method





- Multi-stream architecture using image sequences, optical flow sequences, and trajectories.
- ConvNets use Deepmind's I3D architecture [1].
- Motion state is classified in every time step.

[1] J. Carreira and A. Zisserman, "Quo Vadis, Action Recognition? A New Model and the Kinetics Dataset," in 2017 IEEE Conference on Computer Vision and Pattern Recognition (CVPR), July 2017, pp. 4724–4733.

Results

baseline model									
	wait/motion		*turn/straight*		*left/right*		*start/stop/move*		
$F_{1,seg}$	0.813		0.550		0.909		0.400		
	wait	*motion*	*turn*	*straight*	*left*	*right*	*start*	*stop*	*move*
$F_{1,seg}$	0.604	0.878	0.491	0.569	0.956	0.863	0.311	0.557	0.390
$\bar{t}_d$	0.081 s	0.062 s	0.180 s	0.063 s	0.012 s	0.029 s	0.033 s	0.265 s	0.157 s

MS-Net									
	wait/motion		*turn/straight*		*left/right*		*start/stop/move*		
$F_{1,seg}$	0.825		0.697		0.932		0.567		
	wait	*motion*	*turn*	*straight*	*left*	*right*	*start*	*stop*	*move*
$F_{1,seg}$	0.635	0.884	0.431	0.761	0.908	0.954	0.312	0.497	0.656
$\bar{t}_d$	0.060 s	0.032 s	0.217 s	0.036 s	0.015 s	0.013 s	0.011 s	0.509 s	0.071 s

- Compared to a baseline model (trajectory only), the method using motion sequences leads to more accurate predictions and faster detection of transitions between motion states.
- The use of optical flow sequences alone leads to similar results compared to a model using motion sequences, optical flow sequences, trajectory inputs.
- The inference time of the model was measured at 41 ms.

Thank You

Thank you for watching!

I hope to talk to you at the poster presentation!