RUHR-UNIVERSITÄT BOCHUM

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RUB

A Single Target Voting Scheme for Traffic Sign Detection

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1 What challenges does traffic sign detection provide?

- Real-time constraints
- High reliability
- Natural environment
  - Lighting conditions: time of day, artificial coloured light
  - Weather: fog, dirt
  - Suboptimal scene acquisition: motion blurr, sign occlusion

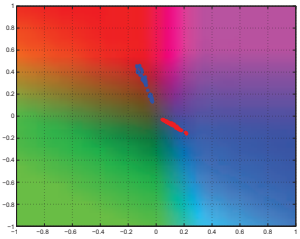
2 There are numerous detection methods

- Viola-Jones-like approaches
- Hough-like approaches (working on gradient images) [1]
  - Regular polygon detector, *Loy and Barnes* $\triangle_{LB}$
  - Radial symmetry detector, *Barnes and Zelinsky* $\bigcirc_{BZ}$
  - Bilateral Chinese transform, *Belaroussi and Tarel* $\triangle_{BT}$
  - Vertex Bisector transform, *Belaroussi and Tarel* $\bigcirc_{BT}$
  - **Here:** Single Target Vote for Upright Triangles, $\triangle_{new}$
  - **Here:** Single Target Vote for Upright Ellipses, $\bigcirc_{new}$

How does their performance compare?
How can the gradient image be computed to facilitate the voting scheme?
Are there ways to enhance the known voting schemes?

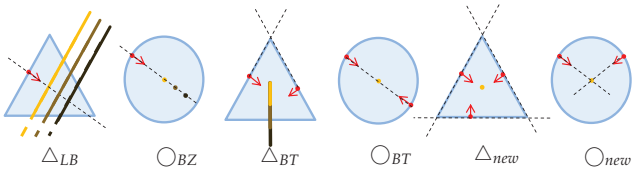
3 Looking at the preprocessing

- Conventional approaches filter interesting pixels by a fixed colour threshold (does not account for lighting and weather)
- **Here:** Introduce a pixel-wise likelihood to be part of a traffic sign based on colour representation in YUV space
- Learn colour from data set of traffic signs under various lighting and weather conditions
  - 50 red and 54 blue traffic signs from the German Traffic Sign Recognition Benchmark (benchmark.ini.rub.de)
- Take the gradient of this measure
- Adjust vote according to estimated likelihood of the voting pixels



4 Looking at the voting schemes

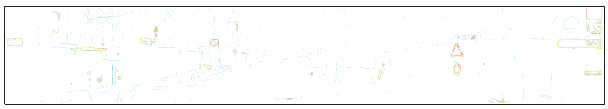
- Applied voting schemes are general shape detectors and do not fit the special appearance of traffic signs
- Many votes are based on only one adequate gradient → cluttered voting space by vast number of false votes
- **Here:** Collect as many data as necessary to pinpoint sign's location
- Consider sign's usual orientations and ignore gradients with unsuited direction

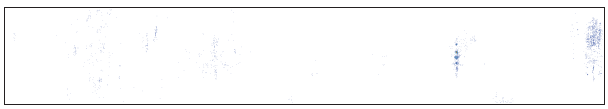


5 Looking at the performance

- Analysis performed on Stereopolis database: 847 images with 251 traffic signs (www.itowns.fr)
- For each image we considered the 10 most salient vote points by each voting scheme
- Consider it detected if
  - the position does not deviate more than 20% of the true sign's radius
  - the radius' relative error is below 45%
- Algorithms that take several data points into account perform significantly better
- Proposed preprocessing further enhances detection performance

	$\triangle_{LB}$	$\bigcirc_{BZ}$	$\triangle_{BT}$	$\bigcirc_{BT}$	$\triangle_{new}$	$\bigcirc_{new}$
Classic gradient	11%	65%	15%	44%	26%	62%
Colour threshold	63%	56%	63%	45%	70%	72%
Learned colour gradient	52%	90%	74%	86%	78%	91%
... with restricted orientations	48%	-	81%	-	81%	-
... with constant vote	41%	90%	70%	83%	74%	84%





[1] *Fast shape-based road sign detection for a driver assistance system*, IEEE/RSJ International Conference on Intelligent Robots and Systems 2004, *Angle vertex and bisector geometric model for triangular road sign detection*, IEEE Workshop on Applications of Computer Vision 2009, *A real-time road sign detection using bilateral chinese transform*, IEEE International Symposium on Visual Computing 2009, *Regular polygon detection*, International Conference on Computer Vision 2005