Safety assessment of pedestrian crossings with video analysis

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Research Project MOBIS:
„Development of a method for assessing safety of pedestrian crossings using automatic video analysis”

- Consortium:
  - Warsaw University of Technology
  - Motor Transport Institute
  - Neurosoft Sp. z o.o.

- Financing by National Centre for Research and Development (Applied Research Programme)

- Time frame: 3 years 2012 – 2015

www.projektmobis.pl
Problem significance

- Pedestrian fatality rate on roads (2013):
  - Poland 30,0 killed/mln pop
  - EU average 9,9 killed/mln pop (excluding PL)

- During 5 years (2007-2011) on zebra crossings:
  - 937 pedestrians were killed
  - 15 199 injured
- ~30% of Polish pedestrian accident victims are hit on zebra road crossings
  (in Germany 4%)

Field surveys and tests

- Aim: development and testing of a method for assessing the safety of pedestrians using automatic video analysis
- Basis: identification and recording of traffic conflicts (situations which could lead to an accident) between vehicles and pedestrians
- Assessments based on surrogate measures can hopefully use relatively short observation periods
- During the project, six field tests will be conducted at different crossings, using different safety improvement measures
Test site #1 in Warsaw

- Equipment setup, in each direction:
  - 1 overview (fish eye) camera
  - 2 directional ANPR cameras
- Video recording workstation

Camera snapshots at site #1

- Recording time: 88 days
- Average traffic:
  - ~10100 veh/day
  - ~3000 ped/day
Solutions for improving pedestrian safety

- **Speed cushions**
- **SignFlash system**

SignFlash = a system of active signage: yellow lights flashing when pedestrians are detected

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**Test site #2 in Wrocław**

- Equipment setup, in each direction:
  - 1 overview (fish eye) camera
  - 1 directional ANPR camera
- Video recording workstation
Camera snapshots at site #2

- Recording time:
  - 30 days „before“ (completed)
  - 30 days „after“ (in progress)

Determination of vehicle trajectories

- Algorithm for detecting and tracking the licence plates
- Vehicle trajectory
- Spot speed measurement
Speed verification using laser
- Laser speed measurement with high accuracy
- Error of camera speed measurement is the smallest near pedestrian crossing
- Errors could be reduced with a non-linear correction function to the level of ~3%

Comparison of average vehicle spot speed during field tests
Pedestrian detection – problems

- Poor lighting conditions – "ghosts" detected
- Shadows during sunny weather
- Need to carefully filter the results

Ghosts and other false detections

- False pedestrians: part of a vehicle, bicycle, motorcycle
Pedestrian detection results

- In-camera motion detection: 58% single, 66% ghosts
- Offline background subtraction: 78% single, 3% ghosts
- Optimized offline background subtraction: 88% single, 11% ghosts

- Improved detection algorithm – offline processing
- Problem with groups of pedestrians

Detection of dangerous situations

- Over 11 thousand vehicle-pedestrian interactions analysed
- Criteria for defining dangerous situations:
  - Dynamic braking in front of a pedestrian: $a > 4 \text{ m/s}^2$
  - Minimum distance between vehicle and pedestrian: $d < 1.5 \text{ m}$
Analysis of dangerous situations
Situation type A – veh. stops before the crossing

Vehicle speed when the veh.-ped. distance, $D_{\text{min}}$, is the smallest

$N_{\text{without SF}} = 3107$
$N_{\text{with SF}} = 2445$

Situation type B – vehicle passes in front of a pedestrian

$N_{\text{without SF}} = 561$
$N_{\text{with SF}} = 635$
Situation type C – vehicle passes behind a pedestrian

\[ N_{\text{without SF}} = 725 \]
\[ N_{\text{with SF}} = 838 \]

**Conclusions**

- The method used allows us to detect and determine vehicle trajectories with sufficient accuracy.
- Detection and tracking of pedestrians poses problems, especially with difficult weather and lighting conditions.
- Improved algorithm for pedestrian tracking promises to increase the accuracy of mapping pedestrian trajectories.
Conclusions

- A method has been developed for automatic detection of situations such as:
  - Dynamic/abrupt breaking in front of a pedestrian
  - Passing close to a pedestrian at high speed
- Analysis of vehicle speeds shows that both:
  - SignFlash system (active signage)
  - Speed cushions
  - cause a statistically significant reduction of speed of vehicles approaching the pedestrian crossing
- SignFlash has a moderate positive influence on driver behaviour