TRAFFIC FLOW VIDEODETECTION

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Abstract: This paper deals with a traffic flow video detector. The detector consists from a cameras mounted on masts or bridges. The second part of this detector is software in traffic control and monitoring center. Data set presented in this paper has been recorded on the bridge in Bernolákova ulica in Žilina.

Keywords: Traffic monitoring, image processing, segmentation, differential images

1 INTRODUCTION

Main idea to create this type of detector is that is no need to mount adititional hardware components like induction loops. The traffic control center can be equipped with this type of detection software and can affect length of green phases and cycles in crossings. Another field of application is in road tunnels where can be counted the number of cars in tube and affect the ventilation controllers.

2 ANALYSIS

The analysis is based on fact that moving objects are causing differential image in image matrix subtraction. Formula for this operation is:

$$D_{(t)} = \left| I_{(t-1)} - I_{(t)} \right| \tag{1}$$

where:

- I(t) is image matrix
- D(t) is differential matrix

The differential matrix need to be processed to achieve satisfactory results, the processing is described below:

- Tresholding
- Dillatation
- Filling holes
- Sorting out smaller objects than threshold
- Finding objects centroids

Image processing is shown on Figure 1 and Figure 2.

Figure 1 Image and differential image

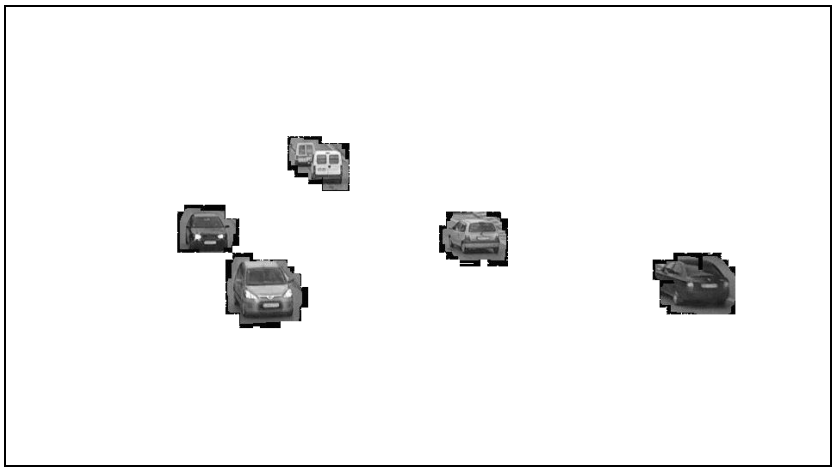

Figure 2 Moving objects extraction

In Figure 2 is shown moving objects extraction from image data. The next step is vehicle counting. The counter is a line across the lane; the line has two surroundings each on both sides of this line. When a moving object's centroid passes the line from ε_1 to ε_2 then it increments the counter in direction 1, otherwise when the centroid is crossing the couting line from ε_2 to ε_1 then it increments the counter in direction 2. The counting line is shown in Figure 3. Width of counting line surrounding ε is depending on maximum velocity of moving objects, camera angle and camera distance to scanned area. The ε shoud be wide enough for case when vehicle is moving with maximum velocity. Center of gravity shoud be in following frames passing both surroundings for worst case of incoming vehicle's position.

Figure 3 Counting vehicles

Vehicle measuring (categorisation) is used to counting vehicles of several sorts. For example 3 sets of vehicles:

- Motorcycle (bicycle)
- Personal motor car
- Truck (bus)

The decision for some sort of vehicle is based on their dimensions. For example motorcycle (bicycle) is vehicle with width less than 1m. Personal motor car is vehicle wider than motorcycle (more than 1m). The decision between personal motor car and truck is based either on their height (personal motor car is vehicle lower than 2m) or on their lenght (truck is vehicle longer than for example 6m).

3 CONSTRAINTS

Every traffic flow detector has some conditions when is sensing reliable and when not. This type of detector is sensitive for obstacles between camera and moving object. Typical obstacles are:

- Fog
- Snowing
- Dust on camera's cover glass

Scenes difficult to analyse are night scenes and raining (often causes mirroring of objects).

4 VIDEO COMPRESSION

Video flow compression can be made utilising recommendations in third author's PhD thesis [1]. This video compression is developed specially for purpose of transferring video signal (of traffic situation) thru xDSL network. At first are computed differential images and they are compressed using tresholding (differential image below certain level is containing near to only noise). Second the changes are compressed and send to receiver (the original image shoud be transferred as well (like "I" frames in MPEG algorithm) but stacionary mounting of camera allows longer sequences between I frames than compression algorithm designed for completely moving scene. The surrounding is stationary and by stationary mounted camera it allows higher compression rate.

5 CONCLUSION

This paper is a succession of third author's PhD thesis: Technological data transfer model in xDSL environment. It shows that traffic flow detector is not necessary any hardware device near the road. This idea of traffic flow detector is that cameras mounted on poles are transferring image data real time to surveillance center. The traffic flow detector is additional software for tracking, counting, and measuring (categorization) of vehicles. Extraction of moving objects based on differential images can be used in wide range of applications. **This work has been supported by the Grant Agency VEGA of the Slovak Republic, grant No. 1/0023/08 "Theoretical apparatus for risk analysis and risk evaluation of transport telematic systems".**

REFERENCES

[1] PIRNÍK R.: Technological data transfer model in xDSL environment, PhD thesis, specialization 26-27-9 telecomunications, University of Žilina

[2] ŠONKA M., HLAVÁČ V. (1992): Počítačové vidění, Grada a.s., Praha, ISBN 80-85424-67-3

[3] MA Y., SOATTO S., KOŠECKÁ J., SASTRY S. S. (2004): An Invitation to 3-D Vision – From Images to Geometric Models, Springer - Verlag New York, Inc., New York, ISBN 978-0387-00893-6