LOW-COST SYSTEM FOR DETECTING TRAFFIC OFFENCES

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ABSTRACT

This paper describes the implementation of a prototype installation for automatic detection of traffic offences with the use of video camera real time analysis. In this paper, we focus on the technical aspect of the installation as well as on the possibilities to implement algorithms to detect offenders. The project of the installation assumed the use of low-cost series of components and reducing infrastructure requirements in the place of assembly of the equipment.

INTRODUCTION

There are many solutions for the detection of traffic offences worldwide. In Poland, the traffic enforcement camera is the most popular device. In the world there are networks of automated traffic offences detection systems. An example of the speed control system and compliance with traffic lights was launched in the UK (SAFECAM). Many manufacturers offer solutions to control both speed and other offences (e.g., SODI, RADAR).

Speed measurement systems, which currently applies worldwide rely on specialized equipment to measure vehicle speed. Most arrangements are based on a fixed frequency wave emissions and measure their reflection from a moving vehicle. Other solutions include laser meters or inductive loops placed in the road.

The aim of this work is to describe a prototype and a concept of the installation to detect offenders. Installation is intended to provide the ability to detect violations at a low cost. Regards both the purchase price of equipment, price of the hardware, and the cost of local infrastructure.

The paper will present a implementation of the measuring device both the hardware and analysis software for the device.

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CONCEPT

The aim is to create system based on standard, commonly available components, for detecting a variety of traffic offences. The system is intended to detect following offences:

1. Breaking speed limit - in a particular place or along the road.
2. Driving on a red light.
3. Overtaking in unauthorized locations
4. Parking in unauthorized locations
5. Ignoring the STOP sign.

Implementation of the system of different offences is possible by means of dedicated algorithms for their detection.

This work presents a hardware implementation of the concept and principles of implementation of basic elements of software installations to the detection of these offences.

For each offence system must identify the vehicle in the testing area and must automatically locate and recognize the licences plate.

REALIZATION

Design concept aims to minimize the need for creating dedicated infrastructure for the system. Therefore, to communicate with the device GSM network will be used. Currently, network coverage in Poland, where HSDPA transmission is available is still negligible. By contrast, it can be assumed that almost everywhere (with appropriate antennas) can be reached EDGE connection.

Establishment of a transmission in EDGE forces reducing the amount of information sent from the device describing detected events. Therefore, the system assumes the need for processing the video signal in real-time in the immediate proximity of the video camera.

The exact method of implementation to communicate with an external system, the type of data collected, and how they are transmitted is described in the work.

Traffic analysis device consists of a image processing unit for image analysis and two video cameras (for different offences amount of cameras may vary). Cameras are connected with wires to the computer. These devices should be installed in close proximity. You can use a common assembly point for all the elements. All devices are powered from one power source 230V (standard in Poland).

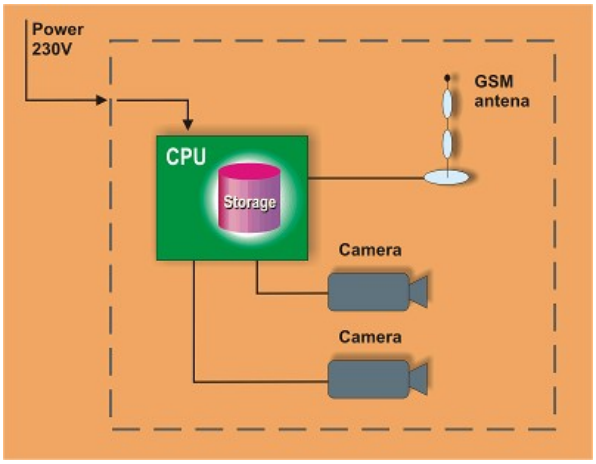


Figure 1: Diagram of the device.

Hardware architecture:

1. Computer for real-time image processing.
2. Wireless communication module (GSM).
3. Camera for offences registration
4. Camera for vehicle and driver identification.

Examples of installations for the detection of speeding and failure to detect the traffic light.

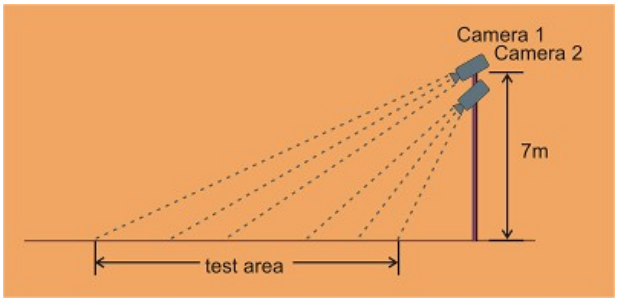


Figure 2: Detecting breaking speed limit

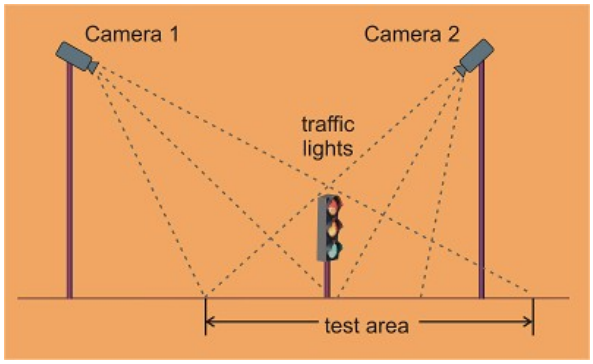


Figure 3: Detecting traffic lights violation.

Software - the basic algorithm for image analysis.

1. Image processing from two cameras in real-time.
2. Vehicle detection and tracking.
3. Licences plate detection.
4. Licences plate identification.
5. Offences detection

A key element is the installation of appropriate camera (performance and image quality). The installation uses 3.1Mpix camera with a resolution of 2048px x 1536px. Depending on camera parameters it would be possible to recognize face of the driver and vehicle registration plates. An important parameter characterizing camera is the exposure time for a single frame. For sharp image of a fast-moving vehicles it is necessary to have a short exposure time. Conducted tests showed that it is important to scan the camera matrix consistent with the expected direction of movement of vehicles. Another important factor is that camera should scan all lines at once and not the even and odd lines in separate passes (interlacing). Tested camera for a single frame, with exposure time of 10ms, gave for vehicles travelling at speeds of around 100km/h picture completely unreadable (the apparent difference between adjacent lines of the image).

Tests showed that for single frame at 1ms (which gives about 0.5μs for exposure of a single line of the image) there was no change in the image quality for a range of speeds for moving vehicles. This allows to say that the image quality is not dramatical, even for vehicles travelling at speeds around 200 km/h, which allows for effective application of this solutions anywhere.

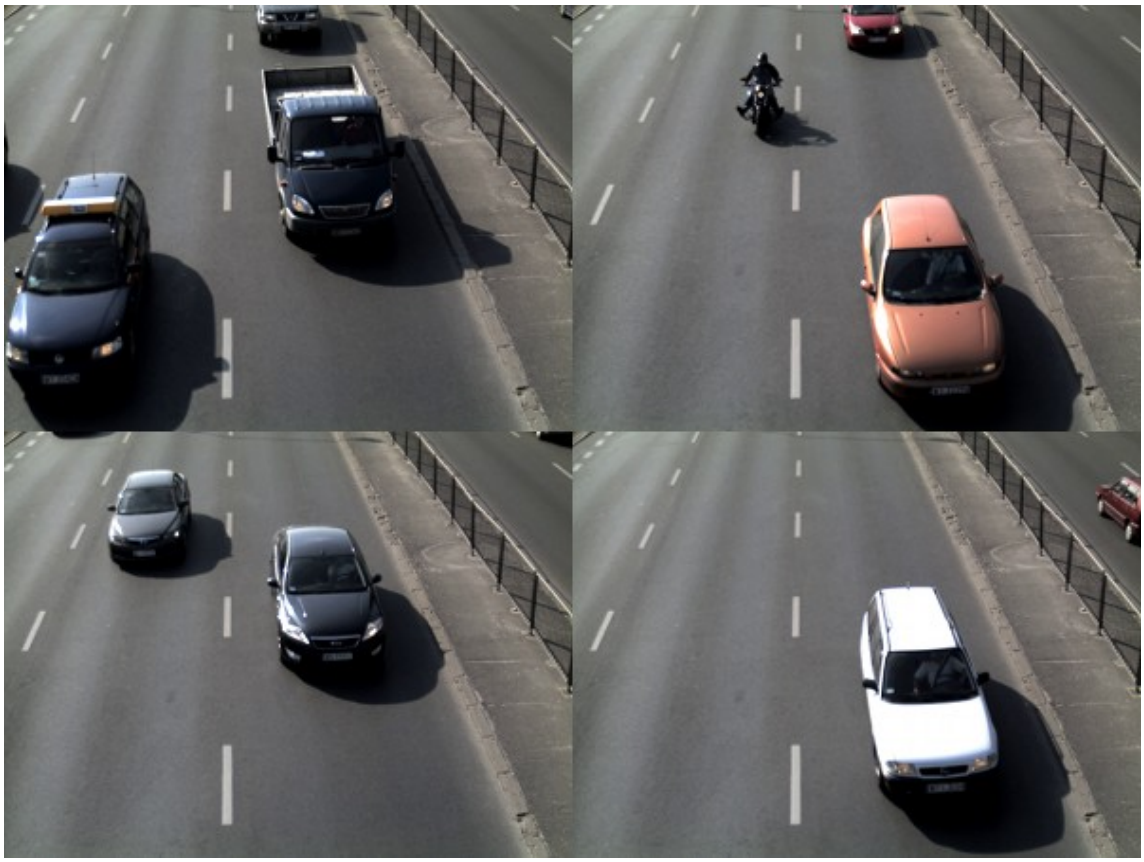
Device parameters:
Processor CORE 2 QUAD Q8200 2.33GHz LGA775 BOX AV3100DN + single lens 12VM412ASIR
Bitrate: 4MB/s (32Mbit/s).

Vehicles are identified using algorithm for vehicle detection presented in this paper.

TESTS

System tests were carried out in two stages. The first stage consisted of recording a large amount of test material in place of measuring the different lighting conditions.

For registration materials have been used existing infrastructure on Puławska street in Warsaw.



In the second phase we tested algorithm on the recordings. Tests were conducted using the library libanpr. The last phase of testing was:

1. Verification whether the equipment will be possible to analyse images from cameras in real time (to examine sufficient capacity).

2. Check if the image quality from the cameras is sufficient to achieve the detection algorithm of offence (whether it is possible to locate the vehicle and the automatic location of the licence plate).

SUMMARY

Presented results show that the implementation of cheap and simple system described by the concept is possible. In order to achieve the detection of specific offences would be necessary to implement dedicated algorithms. The creation of such algorithms may be the subject of future work. It is possible to implement specific extension of the algorithm to detect other offences. It should be also confront the idea of a solution to the existing legal regulations in different countries of application.

Description of the exact idea of the system in the realities of the organization in Poland can be found in the work.

In the future, one can also consider the integration of solutions from other sources of information of traffic speeds, such as inductive loops.

Another aspect for further research is to examine the potential for reducing energy consumption of the entire device in order to be able to supply it from it's own energy source or from solar or wind generators.

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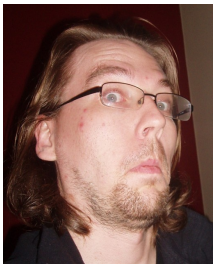

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