AUTOMATIC TRAFFIC DETECTION SYSTEM

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ABSTRACT

This article presents the concept of automatic traffic detection system. Idea of the system is based on image processing and distributed database. This work focuses on presentation of test installation set-up.

INTRODUCTION

Nowadays, systems for automatic identification and vehicle control are used around the world. There are used various measuring techniques, such as loops or radars. Most of them need a special infrastructure to operate. Therefore, the systems based on image processing are used more and more frequently.

Image processing based systems can be used for:

- automatic counting, detection and classification of the vehicles,
- traffic management assistance,
- control systems and toll collection.

An essential element of those system is an ANPR (Automatic number plate recognition) module. This module uses the image from the camera to automatically read the registration number. While using this technology, fast and reliable identification of the vehicle is possible.

SPECS is an example of the solution mentioned above. This system was created in Great Britain in 1999. The system is able to detect vehicles in subsequent segments of the road using a network of cameras. The system allows detecting vehicles in subsequent segments of the road using a network of cameras. Consequently, it can estimate average speed of the vehicle using information from number plate registration module. Moreover, it enables detection of speed limit violations. The results of their operation in different areas of Great Britain showed significant improvement in security. On the roads under control, the number of static accidents fell by more than a half. Compliance with the recommended speed for drivers additionally improved traffic flows.

Another example of a similar system is the system Safe-T-Cam that belongs to the Roads and Traffic Authority in Australia. It was established in 1995 with the purpose of limiting the number of accidents involving heavy vehicles by detecting such offences as:

- violations of speed limits
- driving outside the designated hours of driving
- detecting unregistered vehicles

The system consists of twenty four cameras installed on the main roads of New South Wales.

In addition to these, there are also analogous systems in other countries, including Trajectcontrole (Netherlands), Tutor (Italy), Abschnittskontrolle (Austria).

CONCEPT OF THE SYSTEM

The basic elements of the system are a camera and a small computer. This device realizes several crucial functions for the system. Firstly, it is used as a capturing device which grabs visual data from the camera. Secondly, it is used as a processing unit, which runs an image processing algorithm. As a result, it returns information data about vehicle: direction of the move of the car, the time of appearance of the car and type of it. Subsequently, the calculated results are stored into local database and each two minutes are sent by GSM to data warehouse on the server. Then, based on these data, system draws diagrams and displays them on website. These diagrams can be used to analyse monthly, weekly or daily density of the traffic.

TEST INSTALLATION

The main goal of the installation was to provide information about the traffic on the main road leading through the city. The primary objective was to provide information on vehicles entering or leaving the city. This would enable the tracking of both local and transit traffic for local authorities.

Originally the device was supposed to be installed in the following locations (Figure 1).

Figure 1: Planned device locations

Unfortunately, the implementation of the assembly resulted in a number of problems. First problem was the inability to mount devices on street lighting poles.

Another considered variant was to build some dedicated poles for devices along the road. Unfortunately, such an option was also abandoned due to problems with the permission from the provincial roads management office.

Some alternatives were considered for the power supply. The first option was to connect device to a power source of lighting poles. The specification of this connection is that the power supply of the lighting poles is only available in certain parts of a day, because the lighting is integrated with a global switch that turns the power on or off across the lighting network. While the change in the rules governing the activities of this network does not make sense, it seems reasonable to use this lighting to power the device. It is possible to use gel batteries, the load during operation of the lightning and power supply unit when there is a lack of power.

An additional positive aspect is the characteristics of the power consumption of the device. The main element that consumes electricity in the device is heating. This element requires the vastest amounts of power in winter and at night, during a period where it can be powered directly from electricity network. For instance, in summer, when the device operating at power from the battery is the longest, it is also when device have the lowest power consumption (comparing to other seasons).

It is also possible to use the power installation using batteries and solar batteries.

Figure 2: Final device locations

In view of these problems the device was assembled on existing city office infrastructure. For this purpose we used the city office buildings and connected devices to the existing electricity network of those buildings. The final locations of devices are illustrated on figure.

In fact, the space for mounting the devices is not optimally selected from the point of view of maximizing the effectiveness of the system. They were selected from strictly limited possible sites of operation.

After launching the devices, it appeared that problems connected with lighting and coping with weather conditions occurred. The first device was mounted in a way that is directly positioned at a short piece of road.

Figure 3: Image captured by first device.

It was a true test for the algorithm but there were no problems with the reduction of visibility (rainfall, glare of the sun, street light).

Figure 4: Night

Figure 5: Sunlight

Figure 6: Fog

Figure 7: Rain

In contrast, in the case of the second device has a problem with both rainfall and with the glare. It resulted from the position of the main camera, which is set to observe a larger area of the road.

ANALYSIS OF COLLECTED TRAFFIC DATA

Information about traffic are collected in data warehouse. Based on these data, system draws diagrams and displays them on the website. These diagrams can be used to analyse monthly, weekly or daily density of traffic. Figure 8 shows weekly density of traffic in Jabłonowo Pomorskie. Data is collected on 26.02.2009 at 15.19.

Nowadays the rules, which regulate measurement of traffic concentration are based on temporal (in our opinion not sufficient enough) measurement in specific hours and days. Then the results are used to enumerate average number of cars of all categories, such as cars, lorries, buses or tractor-trailers, during whole day. There are some constant factors, which help to make this calculation as reliable as possible. Even though, the results could be more accurate if this measurement would be carried during the whole day or week.

Our solution gathers information about traffic type and intensity, which can be used to make needed statistics. Besides, our device offers more functionality. For instance, it can be placed in the main crossroads of the city and thanks to it, model traffic in the city.

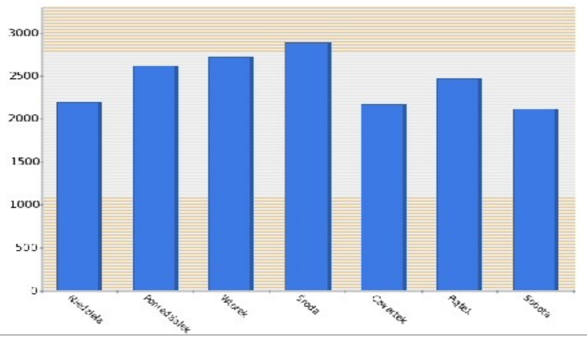

Figure 8: shows weekly density of traffic in Jabłonowo Pomorskie.

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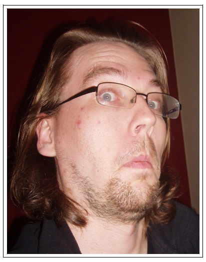

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