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The Design of an Electronic Device for Vehicle Count in Various Traffic Conditions

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Abstract: The authors present the work carried out for design a complete hard and soft solution for develop an electronic device able to assist the operator and count the vehicles in different traffic conditions: urban and extra urban cross lines, national roads and highroad. The important characteristics of the device are: possibility to identify 8 vehicle category, the displacement direction and the count time. The soft interface offers for the operator a lot of facilities as: large scale of data processing in Excel format, possibility to store the data in a common database. This device was used in the last year in different conditions in order to test its reliability.

Key words: data collection, traffic, road, flow, vehicle category.

Appendices

E.C.	Electronic Counter
USB	Universal Serial Bus
U.E	European Union

1. Introduction

Road traffic management is becoming increasingly reliant on the availability of real-time traffic flow data. Traffic congestion is one of the most important problems that affect the environment and citizen's health. This phenomenon has spread out in all cities especially in large size with effect on economy, communications and quality of life.

Vehicles counting are an important aim for traffic management and optimization in various conditions. The count techniques were developed in the last decade by different companies. All the designed traffic count equipments used automatic data collection and data storage in databases in addition with statistical data evaluation software (Enrique et al. 2010).

Considering the requirements for traffic data counting systems, the most important are: rigorous data storage, vehicle class identification, time counting including the milliseconds detail, speed (Aldrin and Magne 1998).

Special issue is proposed for cross line counting. In this way, supplementary information is refereeing to the displacement direction. Few techniques are used for identify the vehicles direction in the case of cross lines: intrusive way using loop or pneumatic sensors, and no intrusive way using the video image processing in order to identify the displacement direction. In many cases the continuous counting is not necessary. For instant, in the case of periodic census of traffic, or for developing a lights design, a few days' vehicles counting is an agreed procedure (Worsley 2007).

Increasing urban mobility and routing optimization methods of data collection are conditional on the conduct of traffic. Data collection and processing to obtain indicators that characterize moving vehicle flow is important to realize as quickly and affordable. If the sample data collected is strictly determined as the time, their processing is important to make in a short time and with minimal cost (Gritzalis et al. 2010).

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2. Vehicle Counter Design

The traffic counters are used in various situations by the traffic operators. There are common few devices produced in different countries by companies as: Jamar Technologies, Traffic Diamond or TDC companies. (As of January, 21, 2017 some examples of this devices could be seen by accessing the following websites: http://diamondtraffic.com/productlist/Portable-Counters, http://www.jamartech.com/TMBs.html, http://www.tdcsystems.co.uk/).

The aim of the research team involved in the field of road traffic is to develop new equipments able to register the traffic data parameters. This equipment must respond to the major needs regarding the traffic data counting: vehicle detection from the point of view of arrival time; vehicle class (Abbess and Sands 1997).

In this way a diagram of the counter function was drawn in order to identify the design priorities in accordance with the traffic operator needs (fig. 1).

The counting interface must be easy to use by the operators and must be reliable for action in different exploitation conditions. Considering the fact that the counter is a hand device it was necessary to assure the possibility of using it with both hands (Filip 2010; Palubinskas 2012). The hardware of the device must assure a few functions:

- Time adjustment;
- High storage memory;
- Individual storage for 12 registers (in accordance with the needs of traffic counting in cross road);
- Identification of each vehicle class;
- Possibility to keep the data in a backup memory;
- Status of device charging;
- Memory available for multi session counting activities.

The software designed must be available to offer "just in time" the various data in accordance with the traffic management requirements.

The demands for the delivered files as output parameters must respect following:

- Data format easy to be charged in common editors or programs as: Excel, MathCAD, or Notepad;
- Complete data format delivered;
- Data classification options using multi – criteria requirements: vehicles displacement direction, vehicles class, registered time delay, etc.;
- Interactive files combined in order to identify traffic macro characteristics.

Considering the mentioned aims of an easy to be used equipment, the research team designed the device presented in figure 2.

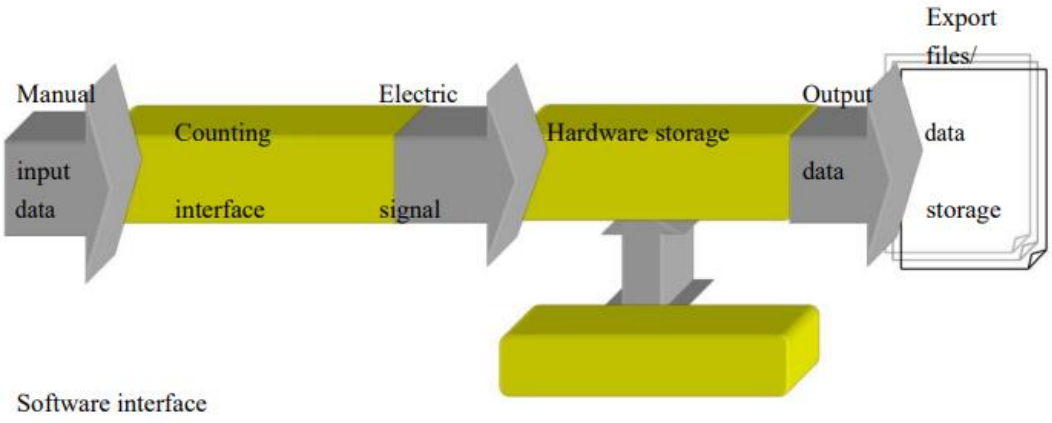

Fig. 1 The diagram of the counter hard and software work input and output.

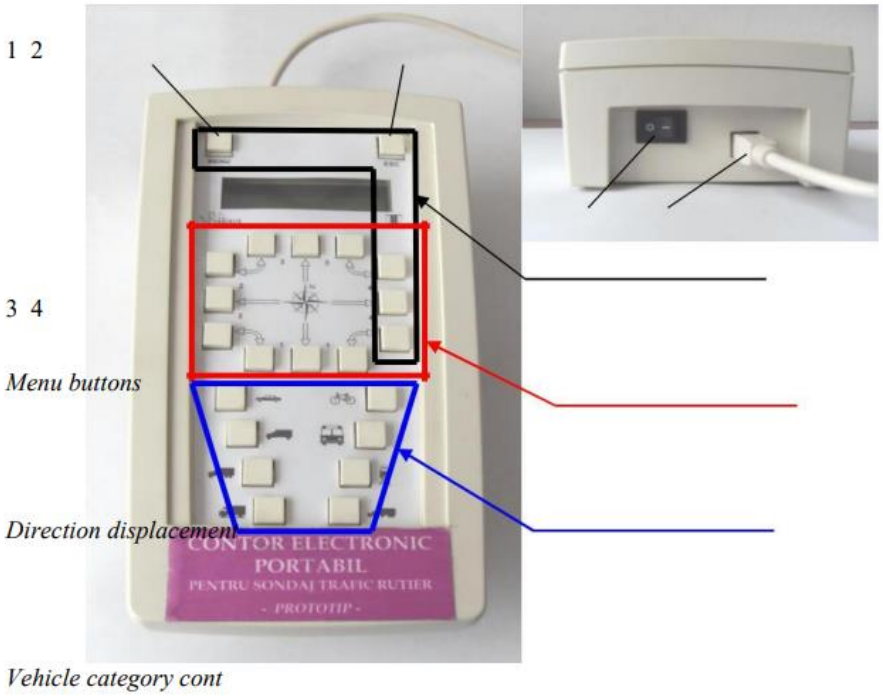

Fig. 2 The designed equipment; 1 – button for activate de soft menu; 2 – ESC function button; 3 - ON/OFF; 4 – power supply cable.

The main characteristics of the designed Electronic consist of:

- Input data keys with a design which assures the use with both hands;
- A main menu with a continuous option selection;
- Charging device included in the body of E.C.;
- Fast data transfer via USB cable;
- 8 register for the vehicles classification;
- Operating interface in two languages (English and Romanian) optionally selected by the operator.

According to the U. E. demands the vehicles are classified in 13 classes. However the E.C assures only 8 classes as input recognition signals. The reason is the fact that the probability to find on a road more than 8 vehicle classes is bellow 0,1% for the urban traffic.

As a compulsory demand of the project the identification of the displacement directions (the vehicles come from and go to), was detailed and designed for easy operation. A significant work carried out by the E.C. authors consists of the software design. In this way two parts of the software were developed individually and finally assembled in one single entity (Hossam et al. 2015; Chakravarty et al. 2010).

The basic software consists of the data storage and data delivered through the computer via USB cable.

Regarding the data evaluation, was developed an interface which provide the possibilities for a large statistic calculations of the registered files. Easy to use this interface work by simply menu buttons actions.

3. Operating Methods

The menu settings keys allow the access for set a new recording data, or closed a work session. As important preparation step for data collection, the menu functions assure a complete evaluation of: clock sets, battery charge, data and interface language. For mark a vehicle which crosses the road, are necessary two actions: first one represents the displacement direction and second the vehicle category. All the information regarding to the operator actions are displayed in real time (fig. 3).

The data discharge and evaluation are made in connection with a PC using the soft designed in this purpose (fig. 4.a).

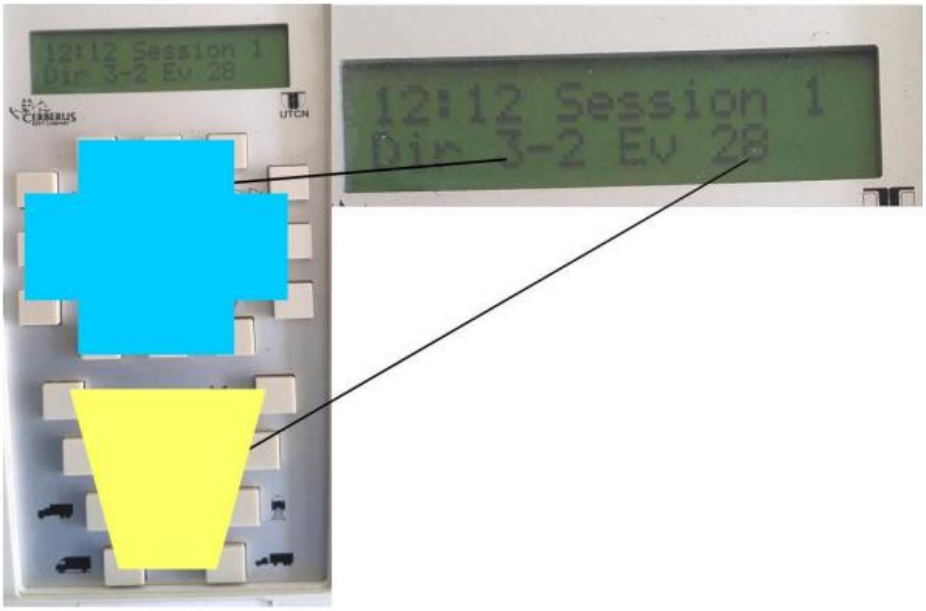

Fig. 3 The real time data display.

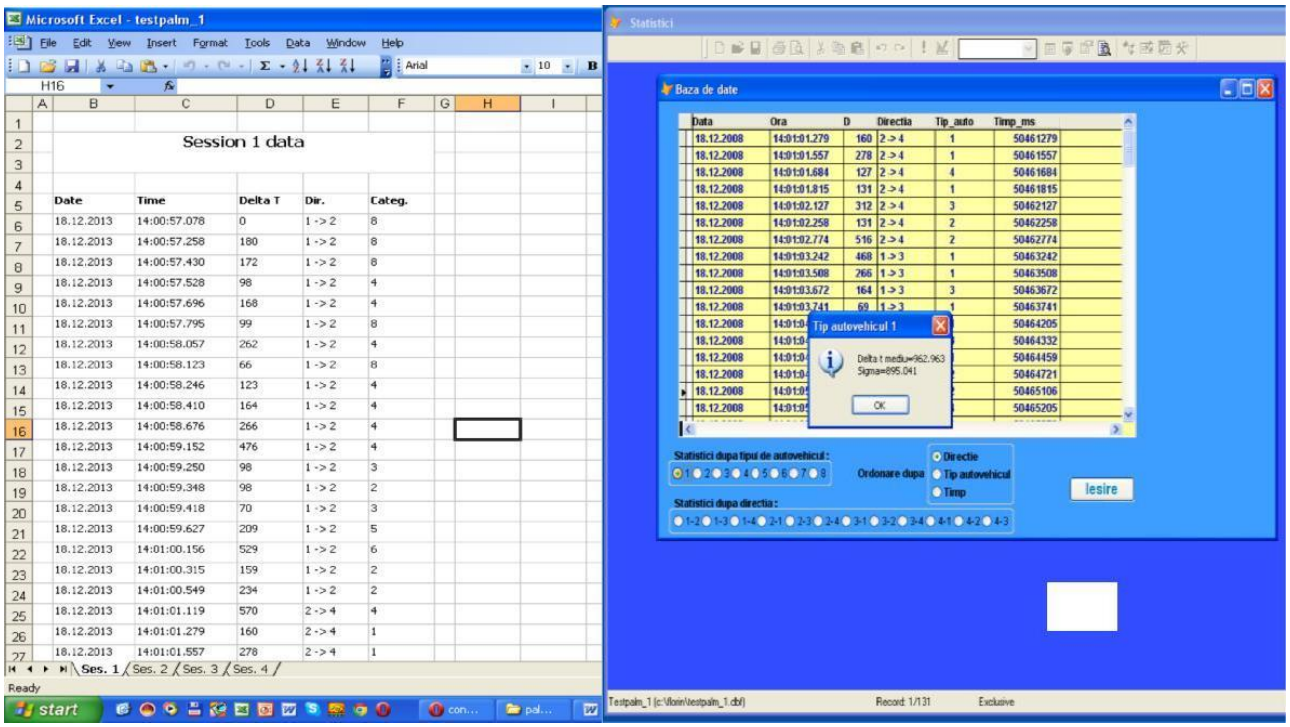

Fig. 4 Software designed: *a)* - data files delivered from the counter in Excel format*; b)* – Statistical data evaluation interface.

The data are delivered to the PC in Excel format, with tabulator separators for allow the future data processing. Also as an information the discharged data are available for the operator. The basic information's available are: observation data, time, direction, vehicles category and the delay time between two consecutive vehicles.

Depending by the data post processing needs, a post processing interface allow developing statistical evaluation selecting the random parameters: displacement direction, vehicle category or time delay (fig. 4 b).

Fig. 5 Opportunities for traffic counter operations: direct traffic data storage.

The calculated parameters are: mean vehicle flow by hour, standard deviation, frequency and cumulate rate frequency (Filip and Cristea 2009; Slinn et al. 2005).

4. Test and Results

The purpose of the project was to develop an equipment to be used by large categories of traffic operators. In this way the equipment reliability was a priority: 3 devices were delivered to be used by the traffic operators from the National Road Agency and two Traffic Safety departments of city halls in Cluj-Napoca and Zalau. The conclusions of the users were noted and represented reasons to optimize de final project of the counter (fig. 5).

6. Conclusions

We propose a complete device: electronic equipment - software that provides the electronic counting traffic which can flow 12 vehicles driving directions simultaneously and individualization of eight categories of vehicles.

Component software provides the communication structure numerator - microcontrollers allocation of each vehicle registered its characteristics, (direction of travel, time passing and vehicle category).

By downloading data via USB the results are delivered directly as traffic parameters used for traffic optimization projects.

Testing equipment in laboratory and field conditions showed the following benefits: reduce the number of operators required traffic monitoring vehicle movement by 1/3, the time required for data transfer and the processing is reduced by over 90%. It was also considered the possibility of extending the scope of using such equipment to recover data from video monitoring, way that similar benefits are obtained.

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