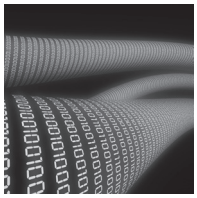

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Option of technique of railway crossings securing implementation to a safe crossing of tram tracks and a road

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ABSTRACT

Through the analysis of urban traffic in the City of Zagreb we have come to the results that are crossings the tram track and roads also potential dangerous points. Because we have the large experience in the securing rail road crossings it was concluded that the use the technique from the railway traffic can be useful for the safety of traffic.

Level crossing protection is the consequence of having level crossings on a railway line. Its aim is to avoid collisions between trains and road traffic. From the point of view of the railway, the requirement to be met by such protection is quite simple: it has to stop all road traffic before the passing of a train. From the point of view of road traffic, however, the protection must stop the train in order to safeguard road traffic when crossing a railway line. In other words, level crossing protection can only be the compromise in the conflict of interests between the two parties.

The requirements on the railway side of the level crossing are, in general, determined by the technology used in order to provide a fail-safe system.

In this work we show the application potential of technique securing rail road crossings on the crossing of tram track and roads. By the use of the Train Detection System it is possible control the road traffic lights.

KEYWORDS: Road signing, tram infrastructure, train detection system

1. Introduction

In the cities with developed tram traffic there is always a problem of organization, implementation and maintenance of the schedule. The particular problem of organization of public transport carried by the rail vehicles is that the trams are operating across the same traffic areas where traffic vehicles also operate. Unlike railway vehicles, it is very difficult to control the trams especially in busy city traffic. To determine the position of the tram, with satisfactory accuracy, it is possible to use a geographic positioning system (GPS).

In order to have quality control and regular maintenance of tram traffic it is necessary to have an information management center. The information management

system, in order to achieve an optimal traffic regulation, should be supplemented by some other additional information systems: global information system (GIS), traffic light control system, urban bus transport information system etc. The data from the satellite geographic positioning system can be transferred from the moving vehicle (tram), using existing communication transmission systems directly the traffic control center. With monitoring and processing these data in real time, it is possible to have all the necessary parameters and indicators related to the traffic control. These parameters are then inputs for different traffic simulation tools which have to help in modeling and optimization of the traffic.

City transport system consists of several subsystems which have to be coordinated. Generally, the main role of any fleet dispatch center is to determine the identity of the vehicle, its current position and availability in order to ensure continuous real-time planning and organization of the traffic, to avoid traffic congestion (so-called: the plugs) and to optimize the fleet management. Due to the fact that urban population is increasing the urban public transport is also increasing. Congestions are usually inevitably appeared in the city downtowns. As it is well known, motor vehicles are the biggest environmental polluters. In densely populated urban areas, motor vehicles with their large concentration on the streets, unfavorable working conditions and improper engine air circulation are the primary environmental pollutants in cities. Organization, implementation and maintenance of the schedule directly increase traffic efficiency and reduce transportation costs. The particular problem of organization of rail vehicles public transport is the fact that for example trams are operating (beside special tracks) on the public traffic areas where road vehicles also driving.

The tram, as is known, act in the traffic as the railway vehicles, and the security of their movement actually depends only on the human factor. To reduce human error during operation of the vehicle in the city traffic (that may cause threat to the participants of traffic) it is necessary to install into the trams some systems which will automatically take certain elements of control.

European Union has started an initiative CIVITAS with which EU wants contribute to achieving sustainable, cleaner and more energy efficient transport in cities across Europe and improve the quality of life of citizens, combining the latest technologies and acting with the full participation of citizens. The objectives of CIVITAS initiative are to promote and implement sustainable, cleaner and more energy efficient measures in urban transport and to implement integrated measures based on new, innovative technologies and public policies that suit the needs of citizens.

One of the main goals of CIVITAS is to shorten the travel time by public transport by introducing the benefits of the tram on the crossroads equipped with the traffic lights. To enhance the mobility of all kind of vehicles by coordinated traffic lights management, it is necessary to introduce a system of „intelligent intersection" which is capable to inform car drivers about availability of the nearby free parking place and free garage. The introduction of traffic-dependent real time adaptive management of public urban transport on the crossroads equipped with the traffic lights gives a priority to the public transport vehicles by using the technology of intelligent transportation systems.

2. Determination of the position of the tram vehicle

Certainly, one of the most important inputs (information) for the management of traffic lights is accurate information about the current position of the tram. Standard methods of identifying the position of railway vehicles using track circuits or magnetic detectors didn't show satisfactory results as the proper tram position principles. Also, to determine the position it is possible to use geographic positioning system (GPS), but he also didn't give satisfactory results. Given that the conditions for determining the position in the road transport are specific, this significantly undermines the accuracy of the system in terms of availability in relation to the positioning of the air or at sea. It is known that the tram traffic in large part takes place in conditions where the surrounding buildings narrows the horizon, which leads to total or partial loss of signal.

Another way of determination of rail vehicles presence is detection with rail-wheel detectors. Rail-wheel detector, on the standard railway infrastructure, is a standard part of the safety signalling systems. In this system rail-wheel detector has few roles: switching on and switching off of the safety signalling systems or some of its part, counting of the axles (wheels), speed measuring etc. The rail-wheel detectors control and run directly circuitry for indication of the state of the track/section. Rail-wheel detectors are installed close to the rails on the track and the circuitry for state indication is installed in relay rooms in the stations or in standing chambers and cabinets near to the track.

Electronic rail-wheel detector or "Electronic Treadle" is an electromagnetic device which permanently produces a constant magnetic field that closes over the rails, so the wheel bandage as metal part enters into this magnetic field what cause a change in the magnetic flux. Housing of the rail-wheel detector should be made of plastic material resistant to impact, shock, heat and weather condition.

Safety signalling systems for railway section occupancy control produced by Croatian manufactures of the safety

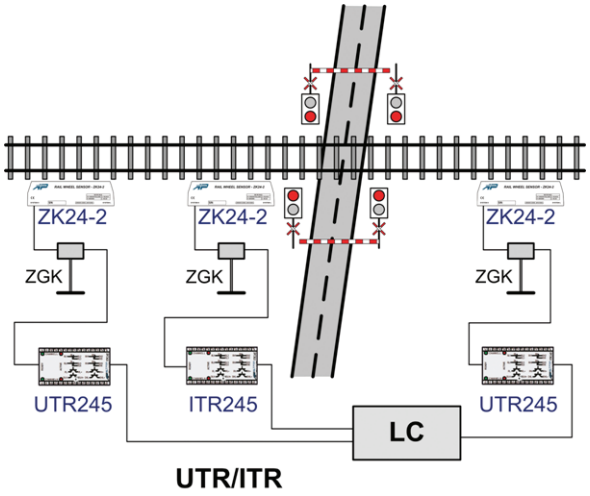

Fig.1. Train presence detectors [Altpro]

signalling systems "Altpro d.o.o." is shown on the figure 1. This system is used for section occupancy control in railway stations (or marshalling yards) on open track and as the train detection system for railway level crossing systems (crossing between road and railway track). The system is based on the microprocessor module with configuration 2 of 3 processors with the safety structure of the internal software program. Also, it has the capability for "fail-safe" communication between two indoor devices in two distant stations in accordance with EN 50159-1 in order to control occupancy of the long section as the part of the inter-station dependency. Then, the system has capability of local or remote (modem) control and PC diagnostic.

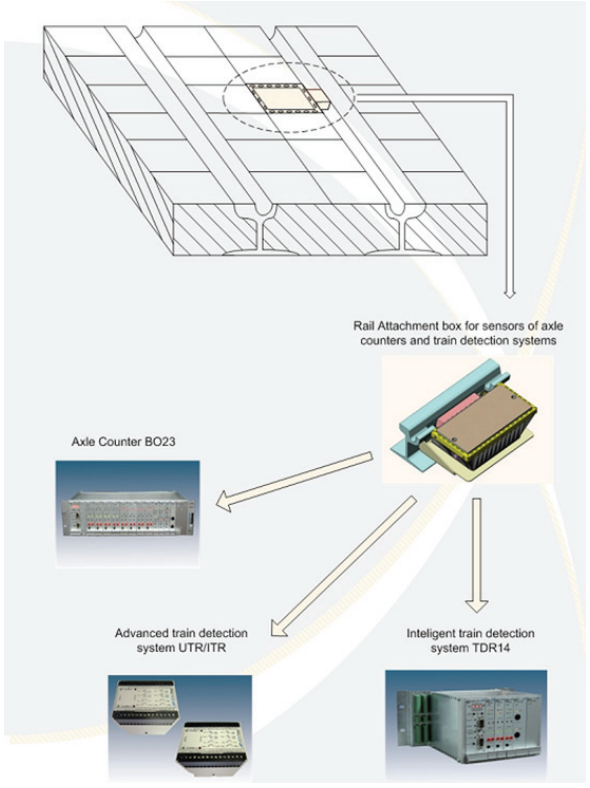

Fig.2. Tram wheel detectors [Altpro]

3. Equipment set for Traffic lights Control system

Traffic light control system switch on detection-communication devices on the tram rails. Given the specificity of the tram rails in relation to the railway rails, it was selected an innovative solution to fixing the rail-wheel detector. In a specially constructed housing is mounted detection system TDR14 with wheel detector ZK 24-2 produced by Croatian manufacturer "Altpro d.o.o." what is shown on the figure 2.

According to the plans of the CIVITAS ELAN project for city of Zagreb, it is planned to set new regulation of the traffic through Frankopanska Street in the downtown of the city. Between the two tram stops in

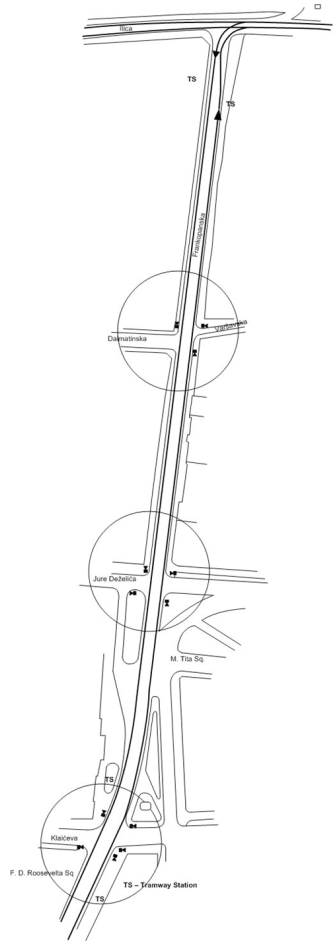

Fig.3. Tram traffic in Frankopanska Street

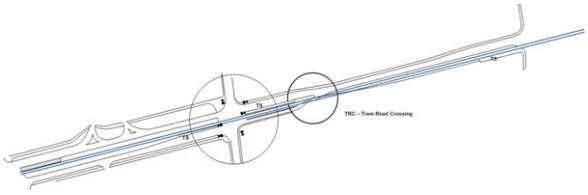

Fig.4. Tram traffic in Vukovar Avenue

Frankopanska Street and Maršal Tito square there are two crossroads equipped with the traffic lights what is shown on figure 3.

Because of completion of the project, it was decided to use the same system for control of the road traffic in Vukovar Avenue introducing tram level crossing in the same street as shown in Figure 4.

The newly tram level crossing has the same characteristics as the railway level crossing. Moving from the tram stop at the intersection between Vukovar Avenue and Svetice Street towards the east, a tram wheel detector bill be activated and thus stops the transport of the road vehicles in the same direction through the Vukovar Avenue. After leaving the tram level crossing area road traffic is re-enabled again by turning on the green light on the newly installed traffic lights. In the opposite direction tram level crossing will be activated by the tram wheel detector which is positioned on the beginning of the stopping distance of the tram related to speed 60 km/h. Just to note that in this case the regulation is performed for just one direction and one road track.

4. System upgrade

Modular system Multi Section Digital Axle Counter BO23 (Altpro) is primarily designed for railway section occupancy control. Section occupancy information ("section occupied" or "section free") is to be transferred to the central logic unit of the traffic light control system. Principle of the work is shown on figure 5.

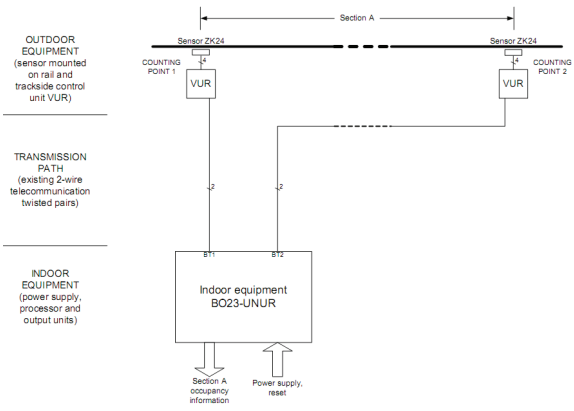

Fig.5. Axle counter BO 23 [Altpro]

For safe operation of the system, which meets very strong safety requirement (safety integrity level SIL 4), it is necessary to ensure power supply and a specific interface that connects the device with the traffic lights control system. The design of the interface depends on the technology and principle of the work of the traffic light control system. In this particular application of the tram level crossing system interface actually is not necessary due to the fact that the system works independently on the traffic lights. In this case the trams just operate/drive related to the signals on the traffic lights on the crossroad and safety of the traffic depends only on the reliability of the car and tram drivers. Figure 6 shows the road signalization on the tram level crossing area.

6. Conclusion

The traffic efficiency is affected by the maintenance of the schedule. And for this purpose it is necessary to continuously control the light road signalization by using tram motion detection system. If it is intention a full control of the tram traffic, it is necessary to introduce an additional autonomous system in order to have a safe flow of traffic. The development of semiconductor technology directly affects the development of systems for automatic monitoring and control of the traffic. The main target of development of this system is primarily finding algorithm of the tram routes according to which is possible afterwards to determine and define the overall dynamics of the tram traffic. Based on this data can be carried out optimization of the system and increase the safety of urban transport. The most important result of the data obtained is certainly the possibility of applying this system as the part of the integrated urban traffic system. Then it is possible to solve the traffic problems caused by the tram delays using some

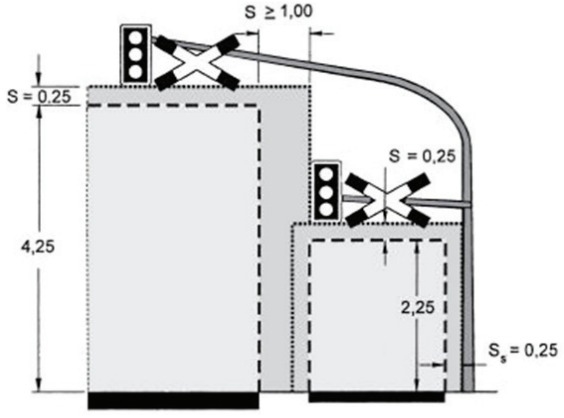

Fig.5. Road signalization on the tram level crossing area

other transport solutions. These data further can be used for optimal planning of junctions on which the passenger continues its travel using some other transport solutions and some other transport service providers.

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