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The solution for the identification of vehicles in vehicle parks

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Anotácia:

Po krátkom úvode do automatizovaných systémov identifikácie vozidla, článok prináša praktické riešenie pre identifikáciu vozidla a príjem informácií o vozidle. Použité technológie nevyžadujú na vodičovi zastavenie vozidla alebo otvorenie okna. Základom systému je bezdrôtová technológia RFID. Ďalej sú tu uvedené technické – hardvérové požiadavky a opísané zásady použitia softvérového balíka ITG-Bus Tracking

Abstract:

After a brief introduction into automated vehicle identification systems, a practical solution for identifying and receiving information about vehicles that passing by the entrance or exit gate is presented in this paper. Suggested method do not require of driver to stop vehicle or to open the driver's window because RFID wireless technology is used. The basic elements of the hardware are presented as well as principles of the application software for ITG-Bus Tracking.

Introduction

Automated **V**ehicle **I**dentification Systems are some of the most developed information systems in the transport area in the last ten years. AVI systems will be an important source of real-time traffic data for other information systems.

AVI systems rely on vehicles and enable real-time traffic data collecting to monitor traffic flow, detect incidents, collect data and/or inform the public. Data is traditionally collected by placing sensors in the road to measure the point speed of vehicles as they travel past the sensor. This point speed data is very useful in determining traffic conditions and detecting incidents.

RFID has capability to give a more comprehensive measurement of traffic conditions such as the travel time between two instrumented points. The travel time data considers not only the speed at the endpoints of a link, but also the conditions between the endpoints. The AVI System could provide travel time data which can be used as a source of real-time traffic data in other traffic systems.

The AVI System involves the deployment of thousands of vehicle tags, referred to as AVI Tags, the installation of multiple AVI Reader Field Site Systems and the development of a computer system, the AVI Data Processing System, to collect and process data to calculate travel times.

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This paper presents a practical solution for identifying and receiving information about vehicles passing by the entrance or exit gate, with no need to stop the vehicle or to open window, RFID wireless technology is used.

As the vehicle moves into the reader's area of interrogation, the reader is activated and begins signaling using electromagnetic waves. The transponder subsequently transmits its unique ID information to the reader, which in turn converts it, through the software technology, into useful information.

After signal detection, reader compares data from vehicle, with data base. If the access is allowed, sends controlling signal to lift up a barrier.

Basic advantage of using the system is fast control completing on entrance or exit gate including data keeping. It is possible to record date, time of passing through, number of barrier, vehicle ID, etc. After identification of the transponder, data is submitted to the supervision center. Modem for data transmission provides permanent connection to the control center.

Depending on the configuration of the system, it is possible to meet following goals:

- Control of vehicle movement on departure platforms:
  - Automatic evidence of arrival onto departure platforms
  - Automatic evidence of departure from departure platforms
- Control of vehicle movement on arrival platforms:
  - Automatic evidence of arrivals
  - Announcement of bus arrivals

Prior the realization of the system there were defined starting technical and operating demands as:

- readers with accessories should be mounted on an appropriate way on the entrance or exit depot gate
- every vehicle has its own identification device
- every identification device has a unique eight-digit code
- the system identifies vehicles 24 hours per day
- the method of mounting the identification device on vehicle must be simple and vandal-proof
- the method of installing the equipment on gates must be simple and vandal-proof
- the equipment should work in all climate conditions
- the simple and reliable data transmission from the identification location to the supervision center should be assured to provide immediate update of data
- the relevant data should arrive to the supervision center in a form suitable for further computer processing
- the system should have an expansion possibility to increase the number of check points and vehicles
- the system should have an upgrade possibility, such as combining of similar systems (remote-control and guidance of vehicles, the announcement of vehicles, which have the priority of depart guaranteed on the intersections, etc)

Technical solution

This system offers an integration of the basic hardware elements manufactured by the Nedap Company and the software modules developed by SDD ITG.

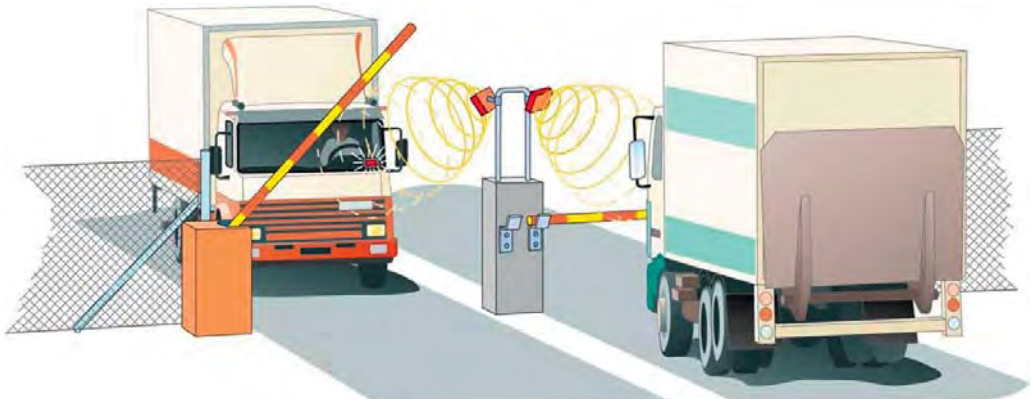

Fig. 1 Principle of automatic identification of vehicles

The basic elements of the hardware are:

- The control station that consists of:
  - vehicle identifier (active RFID transponder)
  - mounting accessories
  - power supply
  - signalization equipment
- Vehicle identifier (active RFID transponder)
- Supervisory system that consists of:
  - PC computer in the supervision center
  - equipment for transponder personalization
  - application software – ITG Bus tracking
  - elements of connecting the reader with a PC computer.

The **reader** establishes communication with a vehicle identifier and reads its characteristic number when finds it in the reading area. If more identifiers are in the reading area at the same time, the reader has the ability of identifying all of them. Every transponder is visible only once when it gets in reading area. The information about the actual date and time, joined by the ID number and those data are transferred to the computer system in the supervision center.

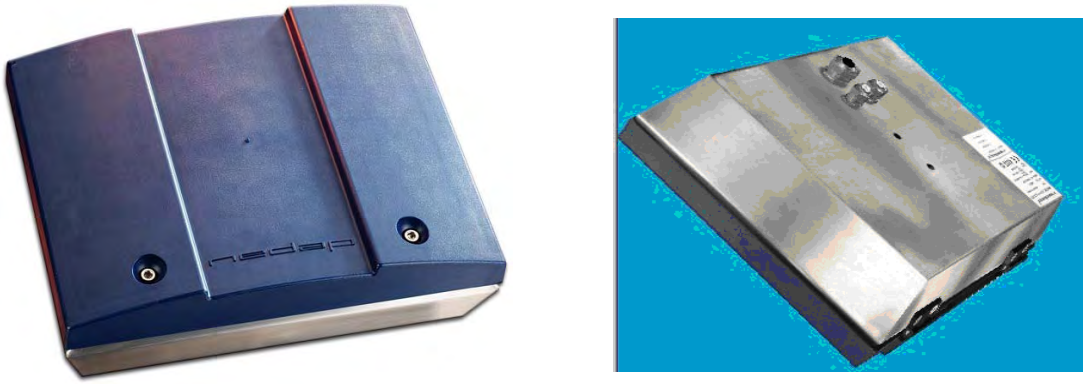

Fig. 2 Front and rear view of the reader

The **identifier** is being installed inside a vehicle on the windshield or lateral window gluing or attaching with a vacuum sink. There is no need of its electric or

similar connections to the units of the vehicle. The dimensions of the identifier are Ø 70 mm; thickness 3 mm. Its structure is compact, resistive to extreme environmental conditions. It has built in a lithium battery, which secures him a working life of 6 years.

Fig. 3 Side and front view of the transponder

There is no need for maintenance because it has its own unique eight digital numbers. Communication with the reader establishes on frequency of 2.45 GHz and on the distance that is not bigger than 10 meters.

After the identification of the transponder, the following data are sent to supervision computer:

- the gate where the identification was made,
- serial number of the identifier,
- date of the identification,
- exact time of the identification.

In addition, some other actions could be initiated after the transponder identification, such as:

- turn on green light (entry allowed), or red light (entry forbidden);
- open mechanical barrier (if entry allowed);
- activating video surveillance system.

Application software for ITG-Bus Tracking

The application software package ITG-Bus Tracking provides basic data for vehicles entry to and exit from depot. It can be customized according to user's requirements.

The following data are sent to the supervision computer:

- the gate where the identification was made
- identifier serial number
- date of identification
- the exact time when the identification was made
- operation that was initiated:
  - green light on (entry allowed) or red light on (entry forbidden)
  - barrier was open (entry was allowed)
  - video surveillance system was activated

This package was developed with standard software tools, under Windows environment.

Coverage area

The system operates in the 2.4 to 2.45 GHz ISM band. The tags used with the system are all equipped with lithium batteries to power the internal logic. The tags do not contain a transmitter but are using the received power from the reader, after modification, for re-transmission to the reader. This principle is called modulated backscatter. The tags are so called field modifying devices. The received RF power from the reader is modulated with the data from the chip containing the ID-number. To read a tag there has to be a line of sight to the tag from the reader. Most synthetic materials are transparent for RF energy with little attenuation and are forming no obstruction. Snow and ice are no problem as long as it is in crystal form. Closed water films are a problem for the detection range. Heavy rain shall be no problem as long as there is no closed water film on the reader front cover or on the tag. To reduce the influence of unwanted reflections circular polarization is used, this brings also rotation freedom for the tag. Placing the tags on metal surface is not influencing the read range.

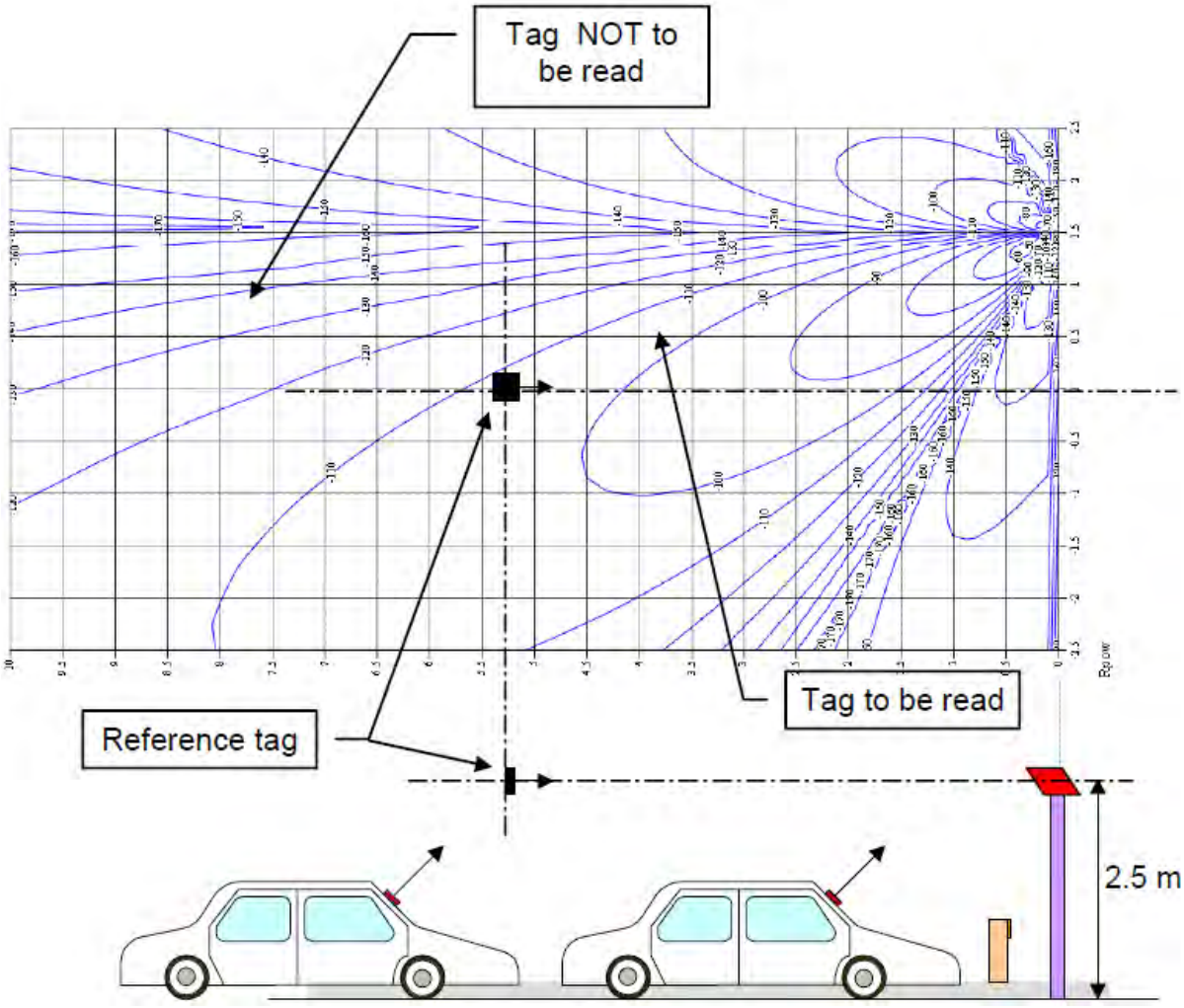

Fig. 4 Use of a reference tag to limit the reading zone

The antenna diagram of the reader has a vertical beam width of 40° and a horizontal beam width of 80°. The tags are having a symmetrical diagram, 80° in the horizontal and vertical plane. The coverage area is based on the combination of the two diagrams. When defining the reading range between reader and tag one should take in account the misalignment between reader and

tag. Good practice is to reduce the read range by a factor of two when the tag is on the –3 dB points of the reader antenna and the normal on the tag still parallel to the main axes of the reader. *[6]*

By means of so called reference tags, read range can be controlled in a practical manor. This can be necessary when no cross readings between adjacent lanes is allowed. Reference tags are normal tags which are programmed with a customer code that is different from the customer code used in the application. By placing the reference tag in the reading zone of the reader it sets certain received signal level. A tag that is to be detected has to have a received signal level above the level set by the reference tag. The example on Fig 4 shows how a reference tag is located to limit the reading zone

Conclusion

AVI systems rely on vehicles and enable real-time traffic data collecting to monitor traffic flow, detect incidents, collect data and/or inform the public. In this paper presented practical solution for identifying vehicles and receiving information about vehicles passing by the entrance or exit gate is RFID wireless technology based so do not need to stop the vehicle or to open window during the identification process. Depending on the configuration of the system, it is possible to control of vehicle movement on departure as well as on arrival platforms. By mounting of the readers on appropriate position it is possible to achieve optimal results in identifying vehicles. Basic advantage of the system is fast control completing on entrance or exit gate including data keeping. It is possible to record date, time of passing through, number of barrier, vehicle ID, etc. This solution is a good concept for economic business.

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