ABSTRACT

The paper presents information of the project and the results of research on the problem of monitoring and management of information about occupancy of parking spaces in real time. The material draws attention the potential which, being properly used with adequate detection of the presence of selected technology and the desired transmission of information in graphic form for selected locations respectively in real time which will result in traffic that users will be more consciously decide on it's journey with the appropriate leads on the possibility of to reach the goal, as well as surrounding their existing infrastructure and the possibility of using public transport.

The present level of knowledge and experience is realized in the framework of research and development project in score of ITS applications in response to the lack of consistency between multiple transport streams and the lack of their interaction on each other.

KEYWORDS: E-parking, occupancy monitoring

1. Project goal

Conducting research aimed at the use of their results in the economic activities of companies, consisting in the development and creation of Platform software - hard-ware which will allow the participant access to a range of information communication through which most will be able to optimally plan your journey to a specific location in the city.

Optimizing navigate congested city streets requires the collection in an appropriate way, many real-time data from large urban area.

Factors that determine the way of traveling:

- Commuting time,
- The ability to reach a maximum close to
- The price of this trip
- Knowledge about how to communicate in case of change of transport

1.2 Selection of public transportation

Unfortunately, public transport is exceptionally taken into account by a participant in the communication (the person who have they own private transportation ) due to the unpredictability of travel time and lack of information about the possibility of getting up close to the target.

The result of work carried out in the project will be an innovative approach to information management in transport and prepare the base for the commercialization of possible solutions, so that potential participants will be able to consciously choose for themselves the best way to reach the goal.
1.2 Scope of project

This includes conducting research, as a result of which they are to be developed and tested devices, algorithms, developed the software responsible for implementing various functional purposes. Implemented research results in the form of technology demonstrator will be tested on the basis of load scenarios in real operation.

The problem described in the remainder of the paper is a problem that occurs in all major cities. It should be noted that this issue is often downplayed or ignored. Its scale may be exacerbated especially when coming to the agglomeration a large number of tourists (tourist season) or a supporter during big mass events such as EURO 2012.

The proposed technology can significantly affect the solution to this problem by providing the right information at the right time and place for travelers.

1.3 Presentation of the management problems of free parking spaces

The issue of having knowledge of the free space to park (moduls chain of city streets) still has not been resolved to the satisfaction of users, this issue occurs in all large cities, as well as places for travelers (MOP) on the newly developed and existing highways.

Crowded center problem (people seeking free parking spaces) is also the problem of local governments that do not have the appropriate solutions that can meet the needs of the local community and support tourist services.

The very center - the market (conservation protection zone)

There is a lack of accurate information in real time, which have to get a driver from multimedia in the right place and time.

1.4 Design Goals

1.4.1 Purpose and characteristics of the research phase

The aim of research is to design and test various solutions proposed software-hardware platform as a basis for the Integrated Information System of Communication.

In their assumptions Platform should lead to improving the efficiency of infrastructure and transport management - road in heavily urbanized areas, and consequently:

• integrate management activities so far apart the two functioning modes of transport in one area - individual and public transport
• increase the safety of travelers, especially during high mass events, where the chaotic traffic of vehicles and people can cause serious communication problems (eg difficulties in getting ambulances or fire brigades), @ raising the standard of environmental protection by reducing pollution.

1.4.2 The project aims at product level

• to produce facilities, which will form the foundation of hardware of the platform (SHP),
• to plan a secure communication between them, develop their problem-free installation policy under the existing road infrastructure
• to develop, implement and test algorithms allow the insert a function of identifying the most advantageous and determinate mode of travel for the passenger / driver, which in future could be implemented as part of the application of products available from a mobile phone or mobile device.
1.4.3 The project aims at the results

Is to increase passenger satisfaction with the functioning of public transport by providing them information about the current position of vehicles and scheduled bus services during their appearance at a specific location (visualization on the map), making it possible to plan and optimize routes in real time. The result will also be introducing the possibility to choose by the driver who is approaching the city a way to travel further based on current information collected online from the Platform.

1.4.4 The aim of the project at the level of impact

Is to reduce congestion in the city center (it is estimated that between 40% to 60% of the traffic inside the city is the driver who are looking for an individual vehicle parking space). At the same time will allow the commercialization of the results to produce applications for mobile devices, which allow to organize the traffic by transferring his weight in to the public transport.

On the one hand the number of individual vehicles is constantly increasing, urban agglomerations tend to continuous development, thereby increasing congestion in urban centers (down town). On the other hand, existing restrictions on the possible expansion of road infrastructure in the centers, forcing the search for new traffic control capabilities to allow a better use of existing infrastructure.

Currently managing the infrastructure in the cities are mainly focused on creating a fully functioning public transportation trying to provide to the users with “decent” time...
to reach their destinations. However, many elements that occur in the phase where we move to a destination, do not depend on the participant’s communication. This makes his displeasure, and in most cases comes down to choose an inefficient way of reaching the user planned destination.

2. E-parking / Architecture Solutions

Planned functionality and capabilities of the Platform presents the scenario described in the drawing. It shows part of the open road space controlled by the hub. Each parking space shall be supervised by hermetic sensor attached to the surface under the street.

Occupied parking spaces are detected by the hub, which connects to a payment system such as: parking meter and controls whether the fee was paid for the particular place. If no prompt is sent automatic to the appropriate services. A vehicle parked across the vehicle is identified as occupying two parking spaces and in compliance with the rules of the owner will be charged for two parking place.

The right of the oncoming vehicles, if only be equipped with satellite navigation systems (navigation system or navigation in the mobile phone) can be addressed by GPS to "approximate" parking space, allowing you to avoid driving through the surrounding streets "walking in a circle" searching free space for your car.

The driver of the vehicle waiting at the gate entrance to the reservation area can benefit from pay-option "guarded
parking place.” The system controls the amount of cars in the area and does not allow to occupy reserved seats. This means that in certain zones can be 100% to find a place, provided that a prior reservation.

The open system architecture based on the addressing used in the organization and building a LAN at any time will extend the scope of the system to areas not covered by the scheme. Modernity solution will consist, among others, for easy expansion of functions offered by the system, eg for loyalty programs.

2.1 Extensive research developed elements of the Platform

- constructions of sensors placed on the surface of the roadway and moving blocks of the road going along with the hubs are responsible for collecting information from sensors that are within their range,
- secure data transmission channels to prevent the introduction and removal of data from the system through mobile devices,
- prediction algorithms based on the current position of GPS data.

A characteristic feature of the Platform will be structure of linked planned measurement systems, visualization and audio to a computer system supervising and informing all participants of private and public transport. An important element will be the policy of attaching to the system of new types of devices scattered on the ground such as readers (cards), traffic sensors and other, which in future will be able to be used by applications which using the Platform.

2.2 The possibility of commercialization of the project

Group results of the project are the recipients of local government units, organizations, entrepreneurs who need information related to the state transportation system in a defined area (village, town, district ...) and institutions that are responsible for creating and overseeing the communication system.

With the introduction of the system will be possible to ongoing monitoring of free parking spaces designated in the streets and seats available for paid, unattended parking lots. Number of cars that are in daily use is increasing rapidly and the introduction of fees outside the 'congestion charge' or exclusion from the movement of inner cities has almost no ability to reduce car traffic.

The system could also find application in urban areas are preparing for EURO2012, where you will have quick and efficient deployment of vehicles, which will commute to games fans and tourists visiting the city.

3. Description of functionality and methods of data aggregation and presentation by the system

Unambiguous identification of a parking space will allow for rapid and remote configuration of paid parking zones, car park operator, depending on time of day, day of week or more circumstances, eg massive event.

All information about the changes and the current rates for parking will be available on the boards display and mobile devices. This allows the driver will be able to decide how far into the city wants to enter, which will lead to the level of fees or leave the car and use another kind of public transport.

Continuous monitoring of occupancy of individual sites by the system and the immediate transmission of such information to the appropriate services to a significant extent eliminate situations in which the offense occurs involving intentional avoidance of payment for parking by what will seal the toll collection system and increase return on urban parking spaces in paid parking zones. Possibilities to include measurements of movement or camera images creates opportunities for more specialized applications to enhance safety and convenience of road users.

In the basic variant, the system will be based on “quantitative approach”, which means analyzing, processing and correlation of information from sensors and payment collection systems. Number of occupied seats are in the "disposal" hub must match the amount of data derived from payment systems. In case of divergence relevant departments will be sent to the parking area (a specified quantity of sensor / parking areas), where the violations occurred.

In addition, an extended variant of the system infrastructure will be equipped with cameras, so that will be possible to record stickers / license plates of vehicles that defined parking spaces.

Correlating identified the registration number of the addresses of sensors will allow for precise indication of where the violations occurred.

4. Key system features

4.1 Functionality reservation in separate areas

Thanks to deployed on roads and parking sensors will be possible to create real-time maps of occupancy of individual sites. This will allow user quickly find free place
that are located in the vicinity of a moving car or at travel destination. Since each sensor will have a unique address, it will be possible correlation with the registration number of car parking space. This will include the introduction of a parking space reservation for a fee (separate areas).

It will be necessary for that purpose facilities such a parking space in a mobile blockade of leaving the ground, which at the time of booking a parking space for a specified period will be increased. This will allow the driver who made a reservation for a peaceful journey for him, waiting for a parking space. At a time when the vehicle will be located in front of the raised lock will need to send a message, eg SMS to the system, which associate with the current reservation request and leave the lock.

Reservations will be made at a predetermined time after which, in case of no person making the reservation, the place will be made available to other drivers.

The booking fee will be added to the mobile phone bill. Integrating the system of mobile services will provide customers with advance information about the need for aid in case of approaching the end of the paid time. The system will automatically generate an SMS message to be sent to the phone, which was registered fee.

With the accumulated will be possible for example: flexible tariffs, which will make the amount of aid since it was introduced (in the case of payment of an additional period of standstill on expiry of your current ticket price for the next hour will be higher than in the case of payment before the expiry date).

At any time user of the vehicle will be able to use the „debit” in which the counting will take over the payment system of registration based in the specific parking spot. In this case, you will not need to remember the introduction of additional fees.

Registered users will receive an invoice or direct debit payments will be recorded on the invoices contained the mobile operators.

At the time of leaving the car in a parking space equipped with a lift-lock will be possible to send information to the system of „payment guarded,” which will result in raising the blockade. Thanks to this theft of the vehicle will be difficult.

If the fee for a parking space shall be paid by mobile phone, it will be possible to inform the owner of the phone that a parking space, for which he paid was released. If the owner is outside the vehicle, it can mean only one thing - stealing a car.

### 4.2 Functionality „Pay for a place that you became”

In the case of a single vehicle occupied by more than one parking space levy system will wait for two parking spaces on the same vehicle (assumed to develop an algorithm to detect the simultaneous occupation of several sites by a vehicle on the basis of data from sensors and possibly cameras).

If not paid the relevant fee in accordance with the cost of free spaces in to the system will send a message to staff supervision.

### 4.3 Additional functionalities

- continuous monitoring and records of vehicles that use public and private parking spaces,
- service ordering, issuing and activating cards allow parking spaces,
- building loyalty programs based on historical information, control the operation of moving lock,
- cooperation with mobile devices used by city departments and law enforcement to immediately provide information about the exact location of the offense,
- records management vehicles whose drivers have paid ranks - based on historical information obtained from police and compare them with current data,
- cooperation with the police database of stolen cars,
- Internet access to the system, including the possibility of application for the parking card, and after confirmation of personal information, booking and purchase of “parking” in separate zones,
- Support of different ways to pay for parking site (transfer, credit card, online payment services offered by banks),
- choice of an algorithm using the best available space at a time or by pointing to a specific location.

### 5. Conclusion

Integrating these two streams of information - the amount of parking spaces and the level of mobility offered by public transport (at the moment these are separate subsystems managed separately) significantly changes the behavior of the user in traffic which significantly reduces the number of objects on their way to the district / city.

Paid parking zones created within the city of organisms are solutions of the individual and are not affiliated with other transport modes. Control and use of parking spaces located in the Motorway in Poland is mainly a problem solved organizationally but not technologically. Automation and process control parking is certainly needed for the organizers and those who are responsible for maintenance inside the city.

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