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BUILDING A CENTRALIZED SMART CITY SYSTEM FOR URBAN MOBILITY MANAGEMENT AND SOLVING PROBLEMS RELATED TO PARKING AREAS, PUBLIC TRANSPORT AND ECO-TRANSPORT PART 2 - SMART CITY INTELLIGENT SYSTEM IN PUBLIC TRANSPORT[27]

Eng. Ivan Kolev, PhD
Department of Telecommunications,
University of Ruse "Angel Kanchev", Bulgaria
Tel.: +359 899 075 092
E-mail: ikolev@uni-ruse.bg

Assoc. Prof. Georgi Hristov, PhD
Department of Telecommunications,
University of Ruse "Angel Kanchev", Bulgaria
Tel.: +359 82 888 353
E-mail: ghristov@uni-ruse.bg

Assoc. Prof. Plamen Zahariev, PhD
Department of Telecommunications,
University of Ruse "Angel Kanchev", Bulgaria
Tel.: +359 82 888 353
E-mail: pzahariev@uni-ruse.bg

Abstract: *The focus of the article is to consider the principles and ideas for building a unified centralized system for urban mobility management and finding intelligent solutions to solve well-known problems in a highly urban environment and in particular problems in public urban transport, finding innovative intelligent solutions for modernization and improving its efficiency. The basis of this article is the need to create such a centralized system, which consists of many different software applications that communicate with each other via API (Application Programming Interface), collecting data in a central database, performing the necessary computational actions on central servers. , such as fees, tariffs, subscriptions, fines, generation of QR codes for identification or validation, etc.*

Keywords: *Smart City, intelligent parking solutions, public parking lots, blue and green areas, public transport, eco transport, LoraWan network, API and central database, smartphone app, Android, iOS, Centralized system, Web applications, Servers, efficiency , GPS*

INTRODUCTION

The term "intelligent transport" summarizes the results of the integration of information and communication technologies in transport infrastructure, urban planning, land and underground transport and transport control and management systems in order to create innovative solutions for more efficient movement of people and goods and to provide more convenient transit services for the benefit of citizens and businesses. Telecommunications and information technology have always been a vital part of the transport system of any society in the context of globalization.

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Technological innovation is the most important catalyst for the creation of a new generation of transport services (Aeron-Thomas, A., Downing, A. J., Jacobs, G. D., Fletcher, J. P., Selby, T., & Silcock, D. T. (2002)). Technological advances in the Internet of Things, cloud technology, machine learning and artificial intelligence, wireless communication (Wi-Fi, RFID, 4G) have the potential to make conventional transport safer, more environmentally friendly, and more flexible, and to create innovative business models for the transformation of passengers and cargo. For us, the wider use of technology in conventional transport is one of the keys to tackling the emerging problems due to urbanization and concentration of large groups of people in small urban areas, rising fuel and energy resources, the increasingly common aspiration problems for residents. of big cities and the deep environmental footprint that transport leaves on a global scale (Allsop, R. E. (2003)).

Public transport has existed all over the world for more than 100 years and although our society is becoming more individual in every aspect, including its mode of movement, such as the constant trend of increasing the number of private cars worldwide and any other type of vehicle (Road Vehicles) for personal use. Despite these global trends, public transport will always exist and will be widely used by even more people, for many new reasons in modern social society. Public transport is also undergoing its development and change, as well as modernization and the introduction of new technologies in its use. Its development consists not only in the emergence of more and more modern and comfortable vehicles, but also those that meet the ever higher environmental requirements and standards, the increasingly intensive transition to electric vehicles with zero emissions.

Public transport is also naturally evolving in terms of offering more and more comfort and convenience to its passengers, as well as all possible methods to make it easier for the passenger to pay for the services he uses.

The increasing use of modern SMART devices, such as mobile phones and tablets, find a huge application in every sphere of modern public life. Naturally, they are the most popular among the youngest part of society, but not only that, according to recent studies, the age limits for Smartphone users vary between 8 and 90 years of age.

In general, the age limits of public transport users also vary widely, ranging from pupils, students and the employed to retirees. For these reasons, the application of the basic ideas and concept of the SMART CITY system could find its place and application for the convenience and convenience of all users of public transport services (Pratt, R. H., Turnbull, K. F., Evans IV, J. E., McCollom, B. E., Spielberg, F., Vaca, E., & Kuzmyak, J. R. (2000)).

THESIS

As the most common means of transporting people and goods, public transport continues to be the source of the most serious social, environmental and economic problems in the transport sector. That is why it is the sector leader in the implementation of intelligent systems to successfully achieve a higher level of safety, environmental friendliness and efficiency of transport.

The widespread use of intelligent transport systems in the public sector will inevitably lead to the collection and processing of large flows of personal data. Due to their deliberately "invisible" design and their purpose to perform continuous real-time monitoring, technological solutions - part of intelligent transport systems, must comply with the legal and ethical features and protection requirements at the earliest stage of their design. of personal data and the privacy of citizens. A small part of the mandatory measures to be taken into account under the General Data Protection Regulation and Directive 2010/40 / EU on the deployment of Intelligent Transport Systems in the field of road transport are the principle of minimizing the collection and processing of personal data, anonymization, the use of cryptographic mechanisms, etc.

On the other hand, the large arrays of information on the basis of which these systems operate require the construction of back-office data processing centers, which must introduce technological and organizational measures with a sufficiently high level of protection against internal abuse, malicious actions of third parties, loss or leakage of information, as to a large extent the level of

information security depends not only on the basic rights of citizens in relation to the protection of their personal data, but also their physical safety when driving on the roads.

The concept of a single centralized urban mobility management system is also applicable in the public transport system. The same SMART CITY client application (Android / Iphone), which registers / pays for parking, via QR code identification in the Blue and Green Zone, could also be used to register / pay for public transport trips (buses / trolleybuses / trams / metro).
This is quite possible and feasible, as each vehicle (road vehicle) of public transport has a unique identification QR code, which is static and posted as stickers in many convenient places in the now for passengers.

In this unique for the respective vehicle is encoded information respectively for Account ID - unique identifier of the instance in the centralized system for the respective Municipality, Department ID - unique identifier of the public transport unit for this Municipality, for example bus transport department, dep. trolleybuses, dep. trams, dep. subway…
Information about the vehicle itself is also coded, such as the ID of the vehicle itself in the centralized system, the vehicle registration number and possibly the line / route on which it is moving. The latter information may not be coded in these static barcodes, as it may be common practice to change the line / route served by the particular vehicle.

The travel scenarios for a client / user of the SMART CITY application in public transport are the following:

1. The customer / user gets on a vehicle from the public transport on a route for which there is a valid prepaid subscription for this specific line of the public transport. It scans some of the static QR codes located throughout the passenger compartment, through its smartphone with the pre-installed SMART CITY application. The system compares the parameters obtained when scanning the static QR code with the information in the centralized system for this particular Customer / user, finding that there is a valid prepaid subscription for this line of public transport and validates his trip by returning a response to his smartphone with the validity parameters. on his current subscription. A QR code for verification is generated, which is displayed on the screen of the user's smartphone. This verification QR code can be scanned by control officers with another mobile application in the SMART CITY system, and information on the validity of the current use of the service is returned accordingly.

2. The customer / user gets on a vehicle from the public transport by route, having a valid prepaid subscription for a certain number of trips, without restrictions for a specific line of public transport. It scans some of the static QR codes located throughout the passenger compartment, through its smartphone with the pre-installed SMART CITY application. The system compares the parameters obtained during the scanning of the static QR - code with the information in the centralized system for this specific Client / user, establishing that there is a valid prepaid subscription for a certain number of trips from the public transport. It then validates the trip, reduces the number of prepaid trips by 1 and returns a response to the user's smartphone with the validity parameters for the current trip. A QR code for verification is generated, which is displayed on the screen of the user's smartphone. This verification QR code can be scanned by control officers with another mobile application in the SMART CITY system, and information on the validity of the current use of the service is returned accordingly.

3. The client / user of the service does not have a prepaid monthly subscription but has indicated through the application that he wishes to be on a tariff plan with deferred payment. It is necessary to scan some of the static QR codes located throughout the passenger compartment, with the pre-installed SMART CITY application. The system compares the parameters obtained during the scanning of the static QR - code with the information in the centralized system for this specific Client / user. Finding that for this client in the database is a tariff plan with deferred payment, the

system validates payment and issues an electronic ticket. The parameters of this electronic ticket, such as validity hour from / to, valid for line XXX, registration number XXXXXX. A QR code for verification is generated, which is displayed on the screen of the user's smartphone. This verification QR code can be scanned by control officers with another mobile application in the SMART CITY system, and information on the validity of the current use of the service is returned accordingly.

4. The client / user gets on a vehicle from the public transport on a route for which there is no valid subscription. It scans some of the static QR codes located throughout the passenger compartment, through its smartphone with the pre-installed SMART CITY application and if there is a valid associated credit / debit card, the system validates payment and issues an electronic ticket. The parameters of this electronic ticket, such as validity hour from / to, valid for line XXX, registration number XXXXXX. A QR code for verification is also generated, which is visualized on the screen of the Client / user's smartphone. A QR code for verification is generated, which is displayed on the screen of the user's smartphone. This verification QR code can be scanned by control officers with another mobile application in the SMART CITY system, and information on the validity of the current use of the service is returned accordingly.

The decision on which of these scenarios to validate the trip of the client / user of the service is made automatically by the system, according to the individual information in the database. The algorithm of action always starts in this order: First, a check is made for the availability of a prepaid subscription for the specific line / route. If there is a valid subscription for this line / route, the trip is validated, and a response is returned to the smartphone. If there is no valid subscription for the specific line / route, it continues with a check for a prepaid subscription for a certain number of trips. If there is one and the number of remaining trips is greater than 0, their number is decremented by 1 and the trip is validated by returning a response to the smartphone. If there is no subscription for a prepaid number of trips, but the user has chosen to be on a tariff plan with deferred payment, then the system adds to the total virtual account an amount according to the tariff plan.

If there is no subscription for a prepaid number of trips or an option for a tariff plan with deferred payment, then the system decides that the user will be charged with an electronic ticket. It is checked whether this client has a previously associated valid credit / debit card with the MyPOS payment system, as this is established by the availability of a Token issued by MyPOS and stored in the database of the SMART CITY system. If a valid Token is available, then the system performs a payment transaction to MyPOS, based on that Token. If the payment is successful, then the trip is validated and the issued electronic ticket is returned to the smartphone. If the payment is not successful, then the trip is not validated, an electronic ticket is not issued and a response for unsuccessful validation is returned to the smartphone.

So far, we have considered the algorithm of response of the SMART CITY system to the user in terms of payment methods for the service. The user may have chosen to be on a prepaid subscription plan, and in the case of subscription plans the variations can be very different, for example unlimited in number of trips and in number of lines for which his subscription is valid, as well as a combination of restrictions on these same parameters. Accordingly, the price of the different subscription plans would be different according to the restrictions on the use of the service. The user can pay for a subscription plan at the designated places, in which case the employee of the respective cash register uses the centralized software of the SMART CITY system to reflect the payment of a selected subscription plan for the specific customer already in the system with his smartphone. If the customer has an associated credit / debit card through the SMART CITY application or could from the application itself make a choice of a subscription plan and pay it directly online through the MyPOS system, without the need to visit the cash register. While for subscriptions the customer does not have to associate his credit / debit card with the SMART CITY application, as he can prepay at the checkout, in case the customer has chosen to use the service

without a prepaid subscription, but on a one-time basis, then the customer or must be on a deferred payment tariff plan, which again allows him to pay the amount charged to him at the box office at the end of the reporting period or must have an associated credit / debit card to make an instant payment at the start of his trip. When choosing a tariff with deferred payment, the customer can pay the invoice issued to him at the end of the reporting period and through the SMART CITY application, where a complete history of invoices and payments will be displayed.

CONCLUSION

The practical and financial benefits for the municipalities that will use the SMART CITY system in public transport for the respective settlements will undoubtedly improve the efficiency and will be proven to solve some of the known problems. First of all, such a system will greatly facilitate the users of public transport services as it provides them with several alternative options by using their personal smartphone as a virtual subscription card or as a virtual wallet. Second, the collection and reduction of free passengers would be drastically reduced, as the reasons given by such passengers are often quite trivial. Sales of public transport subscriptions will also increase as through the application of their smartphone, users have the convenience to choose their own subscription plan and adjust it to their own needs, as well as to pay for it directly through their phone without having to go to the designated places at physical cash registers. Effectiveness in identifying violators would also be improved, as the system itself would facilitate the relevant control officers.

Our commitment to the development of the sector is driven by the firm understanding that intelligent transport systems will significantly reduce the costs of building transport networks and managing transport and thus make transport services more accessible to all citizens. This will lead to balancing the unequal economic opportunities for the movement of the inhabitants of developed and still developing regions both within a country and at the interstate level.

Intelligent transport systems should be recognized as an important national priority not only because of the significant social and economic potential they possess, but also because they underpin the European Union's targeted policy of building a multimodal and more efficient European transport.

In the long run, the development of intelligent transport will require the development of integrated policies, the introduction of interoperable technological standards and sustainable decisions, consistent with the rights and interests of citizens and, above all, with their safety.

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