Individual and Collective User Needs in Public Transport Systems with Internet Access

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***Abstract*—In recent years the interest of smart cities has increased. A smart city promises to improve the living conditions of the persons who live in. The transport is a key element in the cities. The transport has been catalogued as the principal element of degradation and negative impact for the nature. Intelligent transportation systems use Information and Communications Technologies enabling better urban space use, taking better advantage of energy, promote more conviviality, reduce pollution and saturation of routes and offer safety. The access to Internet in public transport systems can enable intelligence in such systems. The applications of these transportation systems have been designed from many assumptions. To improve this, it is necessary to know the individual and collective user needs. In previous work we presented traffic analysis and user statistics. This work extends previous works by focusing in collective user needs in systems of public transport that offer access to Internet and especially the case of the Qronectate project. Furthermore it is presented the first approximation to the design of an application based on the user needs identified. To the knowledge of the authors, this it is the first work on the topic.**

Keywords—Smart City, User Needs Identification, Internet in Transport Systems, Applications in Buses, Intelligent Transportation Systems.

I. INTRODUCTION

In the last years the interest for the concept of smart cities has increased. A smart city promises to assure sustainability and to increase the quality of life. In general, it promises to improve the living conditions of the persons who live in these [1]. The first urban ideas considered the city as machines of living. But the results of this conception have been disastrous; the persons have given priority to the functional problems, without considering the cultural, economic, social aspects and of sustainability [2]. Now we face the need to construct integral cities, smart cities that allow the interaction of the people with buildings, infrastructure and natural environments. The smart cities emerge as the key element in the search of sense of community, belonging, identification and commitment with the natural, urban and social environment. The smart cities have the support of Information and Communications Technology (ICT), with hyperconneted objects to promote and transform the interaction and integration of the society; the goal of the smart city is to design strategies to improve economic efficiency, services and sustainability. Current solutions must have creativity, excellence and speed [3]. Around the world there are many solutions based in the smart city concepts[1] [4][5]. According to the study, the concept of smart city is in a developmental stage under an integral dimensionality. The techno-anthropology has been proposed to design the smart cities. The techno-anthropology relates an effort to identify a number of global and local parameters that can be adopted to manage the smart city [6]. In Mexico there are two smart city initiatives, the first initiative is the Ciudad Inteligente de Queretaro[2]. The second initiative is the Ciudad Creativa Digital de Guadalajara [7].

The transport is a key element in the cities. The transport has been considered as the principal element of degradation and negative impact for the nature [1]. Sustainable urban transport preserves and eventually takes the best decisions on mobility in cities [2]. Intelligent Transportation Systems (ITS) are expected to make better use of urban space, harness energy, promote coexistence, fight pollution and saturation roads and provide security. All this in an environment where all components are interconnected for easy sharing of information in real time, easy navigation, autonomous driving, etc. Technology and standards of intelligent transportation systems has been developed since the last century in the early 90's [15]. At present and in the new context of smart cities there are two lines of effort in ITS. The first is to provide services using the ITS standards, the second is to extend Internet services to transport systems. Because the first approach is in development and is not commonly known, most current initiatives correspond to the second category. Also, the applications of these transport systems have been designed with many assumptions without taking into account user needs. User needs identification has been recognized a very important activity in the design of ITS[3]. To improve it is necessary to know the individual and collective user needs. This paper presents results of a field study of individual and collective needs of users of public transport systems that offer Internet access. This work is the extension of a previous work presented in [8], where only usage statistics and analysis of Internet traffic were presented. This work is an extension of the research work of main author of this paper, and is presented in [9]. From the authors' knowledge, this paper presents the first work on identifying individual and

[1] http://www.fastcoexist.com/1679127/the-top-10-smart-cities-on-the-planet
[2] http://eleconomista.com.mx/estados/2012/05/21/marcha-primera-smart-city-queretaro
[3] http://www.pcb.its.dot.gov/stds_training.aspx

collective user needs in public transport system with Internet access. It also presents a first approach to the design of an application based on identified needs.

The paper is organized as follows: in the second section is described a state of the art of public transportation systems with Internet access; in the third section the Qronectate project is presented. In the fourth section we presented a study of individual and collective user needs as well as the design of applications that promote greater use of the infrastructure in the Qronectate project. The fifth section presents the conclusions and future work.

II. Internet Access in Public Transport Systems

The I-Commute Bus Project in Adelaide, Australia; started in 2010 with Internet connection on the bus; the Project provides information and security services to passengers in real time. The offer of the service is based in free connection to Internet, free games and programs for passengers. The bus contains an advanced system based on GPS information in real time. This information is valuable and useful for passengers which is displayed on two LCD screens; you can see the bus stop times and information about the community [10]. *Netbus Project* is promoted by the bus service provider in San Francisco East Bay which has introduced free connectivity to Internet in all buses (Transbay). The service permits to the passengers the use of computers enabled with Wi-Fi connection, PDAs, and mobile phones to access entertainment and information, email, monitoring the activities of travel work. Netbus architecture is based on a 3G mobile modem, which connects to the mobile infrastructure of a mobile operator and share the connection between users via Wi-Fi (802.11b WLAN) [11]. *Buswifi – EMT Madrid*, offers Wi-Fi connection that allows access by Smartphones, anywhere, the users can consult information related to the service. Among other features of the service is: using GPS location option to have knowledge of the streets and stops around the time of arrival of buses. Complete dynamic information network Madrid bus lines, with interactive route maps, incident information, interesting facts, suggestion box, etc. [12]. *Wi-Fi a Bordo – Ciudad de México y Estado de México Mex.*, consists of 20 buses belonging to Integradora de Transportes del Eje Central, Grupo ITEC. Buses have a modem type Option Globe Surfer II for Internet access. The Wi-Fi service provides students, lectures, and scholar workers who move through a path toward an important university in Mexico.[4] *Sonora Bus* is a project from the Sonora government in Mexico. It has implemented a number of measures to improve public transport service. From 2012, 15 buses have Internet connection. This is part of a big strategy coordinated by the government called "Sonora Bus". It is a complete system change including decent, safe and efficient service; control, monitoring and surveillance; origin-destination time and form. *CICEMovil* is an intra-campus transportation service, used to move people in the installations [13]. The authors of CICEMovil paper present the design and development of a mobile augmented reality system using opportunistic and participatory sensing to allow users to track, share location and status of CICEMovil via smartphones.

III. Qronectate Project

The public transport has vital importance in Querétaro City, 69% of the population use it with high frequency, an average of half million people. The Qronectate project consist on the adaptation of mobile Internet in public buses in the city of Querétaro (see Figure 1 – in left side we show the connection process; the network, the devices and available applications). In its first stage on February 2013, 100 units were equipped with network infrastructure and Internet service, about 7.5% of all units; they belong to 32 different routes; 3 to 4 each route buses [14]. The connection has a content filter that prevents misuse of the system. In each bus, a wireless network was installed via 3G/4G modem and a WiFi router. The 100 buses have a username and password, which are clearly indicated in the bus. The connection is accomplished with the use of Wi-Fi-enabled electronic devices: smartphones, laptops, tablets, palms, etc. According to the first results, reported online at buses have good quality access [14]:

- The daily average use is 80 users in July 2013. This percentage decreases to 61 user in October 2013.
- The mobile Internet in buses was used by 447,719 users in its three first months.
- The most visited sites were: Twitter, Facebook, Youtube and Google.

IV. Methodology

Different variables of the users have been previously studied. But little has been done to know the type of technology assimilation and solutions needed. To acquire this knowledge we executed a second study, which is presented in this paper.

General aim: To know the value of the service, as well as improvements, innovations and forms of collaborative work that might arise across the Internet project in the buses.

Methodology:

- Surveys accomplished between October and November, 2013.
- Forms of application:
  - In the stops of buses of avenues with users' high abundance of the service of public urban transport. (60 surveys)
  - On-line (100 surveys)
- Size and type of the sample: representative, random.

4 http://sinergiaradio.mx/portal/index.php?option=com_k2&view=item&id=3052:wifi-gratis-en-autobuses-del-df-y-estado-de-mexico&Itemid=620

V. RESULTS

A. *Design of applications*

The applications are tools that allow users to use their devices with a specific purpose: web browsing Internet, check emails, edit text, play, etc. Apps can display text interfaces, graphical or both. All previous applications for public transport systems with Internet access were designed without considering the individual and collective needs of the users. As previously said, user needs are important for ITS design. So far, the Qronectate project has a single application for the development of the Internet network in buses. The administration of the municipality is responsible and is identified in Google Play as Android Apps Qronectate. In this application you can find WiFi coverage in the municipality of Queretaro with public Internet access. The information of fixed WiFi access points is also available in the website of the Mexico Conectado Project[5].

B. *Participatory design for the identification of individual and group applications*

Few efforts have been made to know what type of assimilation and solutions the people may suggest from grassroots projects such as the implementation of mobile Internet in the urban transport system. To acquire this knowledge we realized a field study named Qronectitos (which means little users of Qronectate). The overall goal was to determine the value of service, proposals of improvements, innovations and forms of individual and collaborative works that could arise through the Internet project on the buses. The methodology was based on surveys. Application forms were in the bus stops avenues with high influx of users of urban public transport and through Internet (online surveys). The sample size was enough to be representative. The sample type was random selection. The results are presented in the following.

The people identify positive and negative aspects about Qronectate Project. It is important to know that only 30% of the users in the sample have used the free service of Internet in buses. People interviews were conducted in the high influx stops and bus arrivals. 70% of respondents did not connect. The perception of the service goes high percentages in bad, poor, fair, good and excellent in few cases. The qualitative questions reflect the kinds of responses that are indicated; these are the most repeated.

The type of individual activities most mentioned users would like to make are: schedule appointments, view social networks updates, application to find alternative bus routes and location of the bus at the time, music, review email, edit documents online, view jobs, make a bank operation, occupancy in emergencies and check online newspaper.

The type of collective (or collaborative) activities most mentioned users would like to make while they travel are: participate in discussion forums and participate in thematic blogs, training in the use of Internet, research a topic of common interest, access social networks to provide ideas and moods, see how to live in Queretaro, recreational activities, adding questions and disagreements in group chats, access to shared applications, citizen complaint, have video conference with teams and make theirs opinion in the music setting.

C. *Definition of applications*

Based on the principal component analysis in multi-exploratory method we can see the separation of factors for user needs, i.e. according to the parameters evaluated in the studies reviewed for the purposes of raising valid proposals for representative population should be considered according to the group graphics. No shared quadrant is required to consider all factors [17]. The experiment was enriched by adding components (variables) and discriminated sometimes because they are already represented by another similar variable. We noted to be in the same quadrant with a similar significance. Figure 1 (left), shows the graphic of to the principal component analysis with the multi-exploratory method; it is possible to observe that all components have vital importance to take decisions.

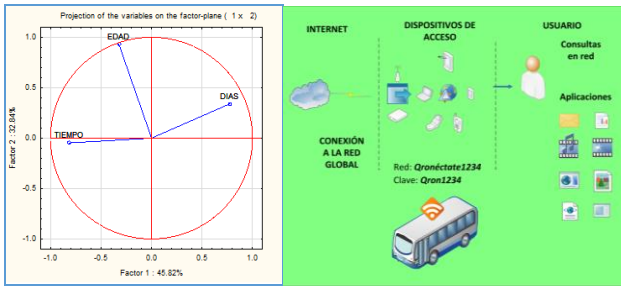

Figure 1. (left) Multivariable Analysis – main components analysis (right) Internet connection.

In order to detect general user needs, in Table 1 we present specific topics, which are organized by involving various segments of the population studied.

Table 1. Identification of General User Needs

Technological education/Interactive Guide (feedback)
Incident report (traffic, accidents, denunciations)
Access to the agenda of government agencies
Access to health agencies agenda
Access forums of common interest
Perform actions recreation
Tool to edit documents online.
Virtual Promotion of culture and sports

Retrieving the principles of ideal technology [16] and reflecting on the search for a comprehensive solution involving as many stakeholders, technology education / interactive guide and reporting of incidence (traffic, accidents, complaints): the two most necessary actions to implement were identified. The first is a plan of action to disseminate the implementation stages of the Internet on public transport, and the scope of dissemination of technology and how this desire and the need for teammates.

[5] http://www.mexicoconectado.gob.mx/

The second is an application where people can contribute and consult the incident report that lets you know the status of conditions in between (some evolution of Twitter). Incident report regarding road traffic accidents, blockades and events within the city.

According to the findings, the platform for development must be based on Android. Knowing public transport incidents of the city reveals the actual pulse of the inhabitants; also define alternate routes, analyze on issues of public safety, failure to report and denounce the authorities, risks to the community; in short, it's the road to participatory city. Figure 3 shows the workflow of our proposal application; it shows the main elements of the wireframes. The implementation of the report consists of an event (two menu buttons), which are used for the configuration and registry. We can choose to view or report; report or query is done through the corresponding button on a menu item: Query / report incidents of transport, public spaces, clean services, health, housing, public safety, culture (activities mentioned during interviews with users).

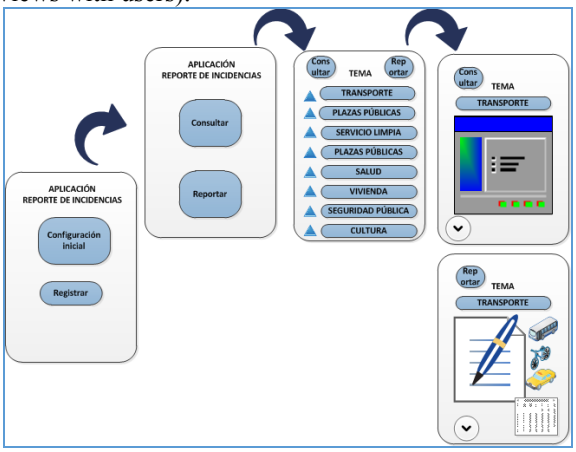

Figure 3. Application- Incidence Report.

VI. CONCLUSIONS AND PERSPECTIVES

The experience indicates that most efficient and sustainable transportation systems are those with a group of alternatives for the users. The applications for this kind of systems (e.g. ITS) must be designed with the participation of the society. Through this work we have achieved to have a better understanding of individual and collective public transport user needs with Internet access. The Qronectate project allows observing the phenomenology of cities and the social Internet adoption seen in a real environment, with people and their specific problems. The Qronectate project should follow a comprehensive development strategy, strengthened by the timely interaction of technologists - sociologists, politicians, businessmen, citizens; all collaborating for better the city; adapting technology to the person; in a community; participatory, proactive, and objective society. In this research, individual and collective user needs of public transport systems with Internet access were identified. We also presented a first approach to application design which was based on the individual and collective needs identified. Future work is to develop and deploy the application submitted. The Qronectate project should provide momentum to the implementation of Internet in public transport. It is necessary to define, develop and validate more applications based on user needs (citizens). Qronectate project needs to be promoted; also the authorities should educate people on the uses and scope as well as provide the means for global access; to empower members to review and propose enhanced uses.

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