Technology shaping society

Engaging visual impairment, public transportation, and technology in emerging urban contexts

Gustavo Zepeda Independent design researcher based in Mexico
gustavzepeda@gmail.com

La tecnologia svolge un ruolo importante nel guidare una forte crescita interna delle città emergenti. È stato svolto a Monterrey, in Messico, uno studio su una comunità di utenti non vedenti. Gli ipovedenti sono visti, in Messico, come una minoranza e non hanno integrazione sociale. Un progetto pilota realizzato con tecnologia RFID, genera un ambiente interconnesso per facilitare l'accesso alla rete di trasporto locale. Il progetto si avvale della progettazione inclusiva per sviluppare proposte con il fine di integrazione con la tecnologia. Quindi, l'inclusione è un risultato del progetto che ha generato la coscienza e la lungimiranza di un trasporto pubblico per i non vedenti, in un contesto di città emergente.

Tecnologia RFID, Progettazione partecipativa, Città emergente, Trasposto pubblico, Disabilità visiva

Technology plays a major role in driving a strong internal growth for emerging urban contexts. A case study in a community of visually impaired users is researched in Monterrey, Mexico. Visually impaired people are seen as a minority in Mexico, lacking social integration. The case study unfolded into a pilot project reimagining current technology into an RFID-enabled bracelet to foster an interconnected environment to facilitate access to the local transportation network. The project employs inclusive design to develop proposals with technology bringing social inclusion as a result which generated consciousness and a foresight of how public transportation for the visually impaired, in an emerging urban context, can become.

RFID technology, Participatory design, Emerging cities, Public transportation, Visual impairment

G. Zepeda Orcid id 0000-0003-3985-2158

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Emerging urban contexts and transportation

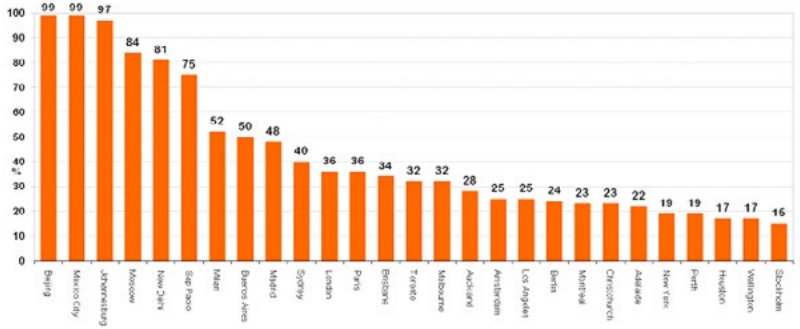
Apart from having a continuous growth, emerging urban context continuously modernize their infrastructure (Takushi, 2013, p. 6) due to the growing population demanding more efficiency in domains such as sustainability, housing, and transportation. In Latin America, examples of emerging urban contexts can be found around Mexico. While emerging urban contexts, or emerging cities, represent attractive markets, they also have evolving legal systems that tend to interrupt internal development. Nonetheless, emerging cities have begun to produce and confront these challenges (Cavusgil, et. al., 2007, p. 254) due to the growth they have to sustain in order to improve the living conditions of its citizens. For instance, infrastructure in industries like public transportation are key to maintain the health of the population. The Commuter Pain Index performed by IBM [fig. 01] ranks the emotional, economic and health toll of commuting in 20 emerging cities. The study detected the negative impacts of poor transportation infrastructure involving increased stress levels, damaged physical health, and loss of productivity (IBM, 2011).

Mexico City shares the top spot with Beijing for the most painful city to commute. A scenario replicated in other emerging cities in the country, like Guadalajara, Tijuana, and Monterrey. The latter being Mexico's third largest city, and driver of the per capita income growth with its fast-paced industrial culture and collective economic potential (Kepes, 2016). Statistics show that 91% of commuters in Monterrey use public transportation, and more than half do so using the local bus network which bus units are inaccessible for people with limited mobility. A case study was performed on the visually impaired community in Monterrey, who suffer discrimination on a daily basis (ONU- Habitat, 2015, p. 38) from the general public who do not understand their situation.

The aches of visually impaired users in public transportation

A major key to independence for the visually impaired is their capacity to be self-sustainable, productive, and active participants in society. Some of the problems they found in their daily bus commutes are the high rise of the bus units' steps, the lack of visibility of their desired route, the inability to operate both their white cane while making payments, or finding a seat on a moving vehicle. Adding to the issue, visually impaired people also fear being robbed or mugged while on the move. Avoiding such events by taking taxi cabs to their destination, adding up to their monthly bills on a low income. Hence, technology has

01 **IBM Commuter Pain Index**



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IBM's 2011 Commuter Pain Index. Credit: IBM

improved ways for the visually impaired to move more independently. For example, canes integrated with sensor technology have been developed to improve mobility but at expense of the high price range. Nevertheless, there is a bigger factor to consider, aiming at evolving the current network into an efficient and integrated mass transit service (ONU Habitat, 2015, p. 22) for the visually impaired.

Research question

Efficiency in integrated mass transit services offer the opportunity to integrate visually impaired users by improving the way they utilize said network, by way of easing transactions as ordinary as making a payment for a bus ticket. This benefits travelling in a cheaper way and perform their daily activities (American Foundation for the Blind, 2016). Notably, visually impaired people require to gather information about their physical surroundings by their heightened stimuli to touch (Rodríguez, 2006, p. 19). So how can innovation and technology work for an integrated transit system to improve accessibility for the visually impaired in public transportation without removing their hands to explore their environment?

Scenario in Monterrey, Mexico

An efficient public transportation network is non-existent in northeast Mexico where Monterrey was established 425 years ago. As an emerging city, legal disparities strand off control of infrastructure for public transportation to diverse stakeholders. The subway network is controlled by the Ministry of Highways and Transportation, a public organization, but there is a private concession program that triggers unbalanced and unreliable public transportation which is comprised mostly of buses [fig. 02], where

in 2015, 52% of daily commutes in Monterrey were performed, even in the precarious conditions bus units can have (ONU – Habitat, 2014, p. 43).
It is not surprising that 98% of commuters feel the situation needs an immediate solution even if they lack a standpoint (Dinamia: Investigación Social Estratégica, 2013, p. 15). Giving space for a second inquiry to stand out: if 'regular' people aren't being considered towards the development of a proper transportation infrastructure, how can minorities like those that present disabilities have a voice?
In order to remedy this situation, designers play a crucial role in redefining the way user experience. Designers have the tools to improve the life quality and conditions of marginalized groups in their research approach and solutions (INDEX: Design to Improve Life, 2016). Quoting the words of design critic Alice Rawsthorn, "design should always be in the service of a better life" (Heller, 2014).

Visually impaired users as a case study for innovation

A case study was developed in Monterrey focusing in the visual impaired users that have the necessity to commute large distances for daily activities. A case study works as at ethnographic research method that involves a process of inquiry characterized by the in-depth study of specific social entities (Bisquerra, 2009, p. 47). Visual impairment involves people who are blind and/or have low vision. In Monterrey, there are 15,222 visually impaired, of whom 68% use public transportation (INEGI, 2004, p. 24). The case study involved twelve visually impaired students of the Sightless Room inside The Fray Servando Teresa de Mier Public Library located in downtown Monterrey. A space dedicated to bring education, perform interactions, and assist in training to individuals with visual disability.

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Public transportation infrastructure in downtown Monterrey. Source: Laboratorio Urbano

Participatory design in joint academic activities

As a collaborative effort, participatory design was chosen as guidance to perform the case study to actively involve end users (visually impaired) in the design process to ensure that the designed product meets their needs (Spinuzzi, 2005, p. 163). Through this experience, the designer could develop a sense of security in the end user. Through participatory design, designers gained feedback directly from a non-visual perspective, since visually impaired people don't have the sight sense developed, they have a greater development of other senses (Equihua, 2007, p. 112); their hands are the means that connect them to the outside world and through touching they are able to "perceive" their surroundings as they have increased skin sensitivity (Córdoba, 2002), augmenting insight on their everyday lives. The sense of touch provided the pathway to understand the importance of a "hands free" device.

Prototyping various solutions following the principles of Universal Design (The Center for Universal Design, 1997), a bracelet with integrated RFID technology, that currently exists in smart cards to facilitate payment of public transportation accessible to all users; except the visually-impaired. Aiming at making the whole process more efficient for them avoiding using their hands. The bracelet functions as a regular "smart card", but allows the user to keep their hands off objects, essential for the visually impaired. When in use, the hand with the bracelet is simply placed at the verification module located at the entrance to the bus achieved by the simplicity and intuitiveness of use. It was decided to implement braille on the surface of the final prototype created to raise awareness of visually impaired users to the public [fig. 03]. An emotional link was generated between the bracelet and its users. Getting a sense of belongingness, inclusion, and most importantly, independence. It is noteworthy that the design of the bracelet is not limited to visually impaired users, it can be used by the entire population based on the universal design principles.

Implementation of pilot project

The pilot project was realized during the second semester of 2015. It involved the deployment of twelve bracelets for twelve visually impaired users that could be used in any bus route that forms part of the bus transportation network in Monterrey. The first pilot project was performed in downtown Monterrey, where the location of the public library is, known as the Macroplaza. The first user showed no skepticism and was "looking forward to participate" in his first solo bus trip. His encounter with the bus unit was

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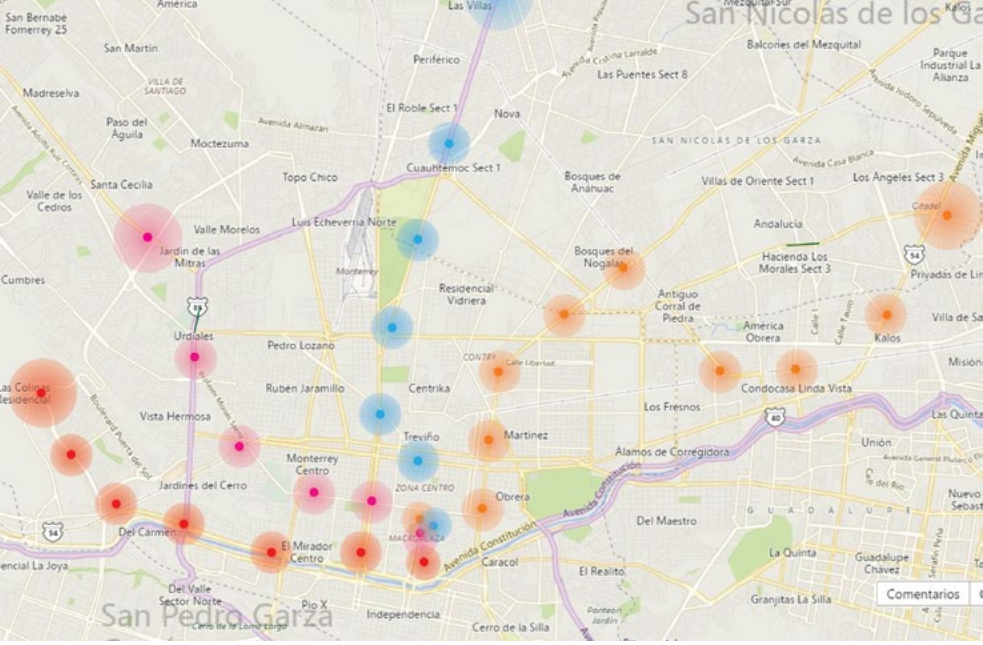
RFID technology enabled products. Credit: El Norte Newspaper

referred as positive, the process preceded as follows: the user raises his hand to 'call' the bus (a common practice in Mexico similar to New York City's hailing a cab culture), stepped inside the bus, in no time the payment transaction was made through the RFID-enabled bracelet placed on the verification module fostering an interconnected environment due to the use of already set RFID verification module at the entrance and commutes from the public library to their homes, as far as 52 km away from their destination downtown, pictured at the low center of [fig. 04].

Results of the pilot project

The commutes realized can be visualized throughout the colored circles in [fig. 04]. Distance recorded was between 5 km up to 52 km, an average of 21.5 km per commute. A time tracker showed savings in waiting time by 87% from up to 480 seconds waiting time in the most extreme of cases to just under 60 seconds average from eleven commutes. Therefore, the implementation of an efficient interconnected environment for the visually impaired permits the foundation for reshaping current infrastructure integrating this RFID interconnected environment to improve the overall system. Diminishing the known hassles due to the lack of infrastructure, as well as reducing visually impaired user's required physical effort accessing the unit that in the long term would affect the user's wellbeing, saving time and energy from daily commutes.



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Discussion of the results

As a conclusion, the pilot project assessed and materialized a universal solution for any public transportation user, thanks to the insight of the visually impaired users to become as dynamic and effective as "regular" users in the way they approach public transportation units, ceasing their detachment from society. A number of prototypes of the RFID-enabled bracelet have been manufactured and donated to visually-impaired users for them to manage and ease their daily commutes. In Monterrey, a query has been filed to government officials towards expanding and commercializing the use of the RFID-enabled bracelet, which visually-impaired users found most adequately fit to their needs. As well as introducing the implementation of the interconnected environment in bus stops and bus units to foster an integrated system through technology. Still, the project has yet to be extended nationwide. Sponsorship from local universities and government dependencies have enhance a smoother system. The project is to be replicated in other emerging urban centers throughout Mexico, particularly Mexico City and Guadalajara, to formalize the project and establish the standard of interconnected environments redefining the way participatory design through a case study can improve users'lives in emerging urban contexts.

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Geographic reach of commutes of visually impaired users fostering an interconnected environment. Source: Bing Maps

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