

Smart City: improving citizen security through the use of new technologies

Ciudad Inteligente: mejoramiento de la seguridad ciudadana a través del uso de nuevas tecnologías

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ABSTRACT

Keywords:

Cybersecurity, smart city, safe city, open data, internet of things, framework, physical security, public security.

Accelerated population growth in large cities is a major challenge for governments, as it brings with it an increase in social, economic and infrastructure problems that require these cities to implement new security systems using emerging technologies to provide their residents with a better quality of life, access to more services and more job opportunities. The purpose of this article is to emphasize the security aspects of a Smart City, to promote the implementation of the use of government technologies that make better use of resources to facilitate the performance of tasks that are easily accessible to citizens, turning them into Smart Citizens. The methodology used is the referencing of electronic databases, articles, and scientific research. It is essential to have an enhanced security infrastructure that meets needs and environmental standards, and is cost-effective and sustainable. It is concluded that the technologies offered by Smart Cities, in achieving the aforementioned benefits, achieve an evolution in their performance, making them more habitable and responsive. They make the Smart Citizen feel safe and confident when interacting with the intelligent technologies that surround them.

RESUMEN

Palabras clave:

Ciberseguridad, ciudad inteligente, ciudad segura, datos abiertos, internet de las cosas, marco, seguridad física, seguridad pública.

El crecimiento poblacional acelerado en las grandes ciudades supone un gran reto a los gobiernos, debido a que con dicho crecimiento aumentan las problemáticas sociales, económicas e infraestructurales y que para hacerles frente es necesario que dichas ciudades implementen nuevos sistemas de seguridad con las tecnologías emergentes y así garantizar a sus habitantes una mejor calidad de vida, acceso a más servicios y más oportunidades laborales. El propósito de este artículo es enfatizar los aspectos de una Smart City desde la seguridad, promover la implementación del uso de tecnologías gubernamentales que aprovechan mejor los recursos para facilitar la realización de labores que le sean de fácil acceso a los ciudadanos, convirtiéndolos en Smart Citizens. La metodología utilizada es la referenciación de bases de datos electrónicas, artículos e investigaciones científicas. Es vital contar con una mejora en la infraestructura de seguridad cumpliendo con demandas, estándares ambientales y que todo sea rentable y sostenible. Se concluye que las tecnologías ofrecidas por las Smart Cities al lograr las ventajas mencionadas consiguen una evolución en su desempeño que las vuelve más habitables y receptivas; hacen que el Smart Citizen se sienta seguro y confiado al interactuar con las tecnologías inteligentes que le rodean.

1. Introduction

The purpose of this article is to emphasize the security aspects of a Smart City and to detail the relevance of its aspects to differentiate them very well from other Smart City approaches. Cities are increasingly experiencing an accelerated population growth, and this is a problem for governments because it is coupled with other social issues, problems of obsolete infrastructure and limited budgets due to the economic crises faced by countries [1],[3]. Therefore, to face these situations, it is necessary that cities implement new technological systems that allow a significant development to improve the quality of life of their inhabitants

and that they have more job opportunities and better access to all the services offered by the state. to improve the quality of life of their inhabitants and to provide them with more job opportunities and better access to all the services offered by the government.

According to [2] Smart Cities initiatives around the world can be seen as a great revolution that solidifies urban development. Smart Cities provide many governmental frameworks that take better advantage of the use of resources, making tasks increasingly efficient and promoting the use of more user-friendly tools, which in this case are the citizens

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[3]. It is important to emphasize that it is not only the large physical infrastructure that is possessed that is taken into account, but also the availability and quality of knowledge in communications and social infrastructure, which has to do with human resources [4].

Data provided by the McKinsey Global Institute [9] states that by 2050 another 2.5 billion new residents will be added to cities, as they are currently home to more than half of the world's population. 2.5 billion new residents will be added to cities by 2050, as they are currently home to more than half of the world's population. These pose environmental and security pressures, along with an increasing need for infrastructure and growing demands from citizens that offer them a better quality of life and at a sustainable fee. "As cities become smarter, they become more livable and more responsive, and today we are only seeing a glimpse of what technology could eventually do in the urban environment." [9]

2. Definition

Many are the definitions of Smart City, [5] defines it as the use of all available technologies and resources in an intelligent and coordinated manner to develop urban centers that are integrated, livable and sustainable; all at the same time. While [7] and [8] state that there is no universal definition of Smart City, due to the widespread rise of this term in the last decade [8], the definition is used in many contexts and that the word Smart is often replaced by Digital or Intelligent. It is concluded that the definition is very open and that usually three directions are always included: technology, people, and community [7].

According to [10] the concept of Smart City is relatively recent and can be seen as the successor of Information City. Its use has been increasing considerably since 2013 where many citations were observed in articles of other terms such as Sustainable City. Although many authors have difficulty in defining Smart City, these definitions are not contradictory, but they do not entirely coincide either.

Thus, the definitions of Smart Cities tend to have something in common: they focus on social capital, on human investments, this together with transport and telecommunications infrastructures for the advancement towards a sustainable economy and development itself [6].

3. Smart City in Security

The main component of a Smart City is the citizen, and its most challenging challenge is security. This is why it is necessary to cover all areas that have to do with the security and privacy of a citizen, whether physical or virtual, and how this by interacting continuously with the environment of a smart city and feeling safe, can become a smart citizen (Smart Citizen).

3.1 Safe City

For this research, the topic of Smart City will be addressed in the aspect of security. In many countries social security is plagued by vandalism and criminality, that is why it is possible to make use of Safe City, which is focused on the security aspect. According to [11] a Smart City is also a Safe City if it meets the following characteristics:

- Health Care.
- Intelligent traffic and routing systems.
- Intelligent security systems for surveillance, search, detection, and identification.
- Intelligent crisis management systems to support decision making, early warning, monitoring, and forecasting, emergencies, and environmental situation.
- Centralized police units and Integrated Rescue System (IRS).
- Secure internet connection and data protection.
- Data processing centers.
- And others related to security.

According to urban planning experts, crime and fear of crime have long been recognized as a major challenge for sustainable cities. It also has a significant impact on the quality of life [12]. Safety is one of the most important aspects and is used as an indicator to measure a country's success as a developed country. The market value of smart city solutions (Market Solution) is expected to reach \$1.5 trillion by 2020. These huge figures create many opportunities for both smart city providers and local authorities in cities [13].

3.2 Physical Security and Cybersecurity (PSC) in Smart Cities

One of the most critical and risky points involving Smart City security is its infrastructure, the physical security in Smart City is constituted as factors such as the excessive growth of integrated computing and the inclusion of actuators such as sensors, adjustment, and control devices (such as valves, switches, filters, etc.) are involved [14].

"Cybersecurity is a critical issue due to the increasing potential for cyber-attacks and incidents against critical sectors in Smart City. Cybersecurity must address not only deliberate attacks, such as disgruntled employees, industrial espionage, and terrorists, but also unintentional compromises of information infrastructure due to user error, equipment failure, and natural disasters." [15]

According to [16] in his analysis of the challenges of Cybersecurity in Smart Cities, all legal and social concepts of privacy rights of citizens are hindered between these challenges and the benefits offered by a smart city, as this concept addresses confidential aspects of life, control of one's public profile and unwarranted interference. As for "cyber privacy", the legal regime is further defined by statutes

prohibiting unauthorized access to a computer, network and its data, illegal interception, interference, unauthorized data processing and analysis of a data collection [15,16].

3.3 IoT

Over time, many types of networks have evolved, and the Internet of Things (IoT) has not only become relevant but has also been one of the most important infrastructures in Smart Cities [17]. This IoT contribution is efficient with the needs of citizens because it provides solutions to the use of services offered by cities [17,18]. An IoT device with poor security increases the risk of privacy and data integrity [41].

Thus, the Internet of Things plays an essential role in the development of Smart Cities because it is the main collector of real-time data "While most IoT data is one-dimensional, its combination with geographic location and operational data will enable rich visualization and geo-analytics." [18] The overall aim of IoT in a Smart City is to collect all sensor information and convert that data into knowledge so that accurate decisions can be made by governments especially in the field of social security.

Sensors are the main component (after Citizens) of a Smart City, so they directly collect data from the city for example water, gas, and electricity consumptions. They also have the characteristic that they are small-scale mechanisms of a wide variety of types, which make their use cost-effective for a smart city [18,19]. This in turn poses several challenges: securing endpoint connections in sensors (considering the number of IPv6 addresses) and that security in technologies that enable sensing applications has several issues that need to be considered within the context of smart cities. These networks are exposed to cyber terrorism and cyber vandalism. It also involves security-related challenges such as data privacy, trust in the entities that manage services through the cloud, social issues (e.g., a Smart City that saves citizens from solving problems on their own), a centralized control scheme, and the costs of converting a normal city into a smart city [19]. counts), a centralized control scheme, and the fees involved in converting a normal city into a smart city [19].

3.4 Smart City and IoT Security Issues

All connected devices have their own vulnerabilities related to their various functions and, in addition, previously existing vulnerabilities must be considered.

According to [20] the new ones are caused by several reasons, among these the different operating systems used by the connected devices are not always well known, there are also no known security standards and many proprietary protocols, the architectures are very heterogeneous and physical security is usually breached. The integrity of software updates is not always guaranteed, and the security

of stored data is not always guaranteed either, and the limited resources of such devices prevent the use of classical cryptographic functions and security protocols.

3.5 Smart Citizen and Public Security

Building smart cities brings a better quality of life to people through digital interconnectivity, which in turn leads to greater efficiency and accessibility in cities. Smart cities must guarantee individual privacy and security to ensure that their citizens participate [21].

The inclusion of the term Smart Citizen is necessary since a city would not be smart if its citizens are not smart. Usually, governments focus on everything that has to do with the infrastructure of a Smart City and the citizens are relegated as "mere ICT consumers". That is why in a Smart City urban center should be created with the intention that citizens are digitally interconnected and exchange information and knowledge, thus generating a collective awareness and culture [22].

According to [23] the defining characteristics of a smart city in terms of citizen security and participation are the following:

- "To improve the quality of life of its citizens, offering them the best service with maximum speed and efficiency; taking advantage, for this purpose, of the latest technologies in communication." [23]
- "To offer multiple channels for the interaction, and participation, of citizens with/in the city; adapting, in real time, to their needs with efficiency in quality and fees." [23]
- "Providing citizen-oriented services, both from the public and private spheres, with the aim of solving the effects of the growth of cities; services that would favor an innovative integration of new or existing infrastructures with, also new, intelligent management systems." [23]

This is why strategies must be created to collect information regarding crime trends and thus be able to control criminal behavior. For this, it is necessary to implement Smart City Technologies and Services (SCTS) in places where they can or should be applied, to know what specific type of crime is to be dealt with, for example, smart lights and scent diffusers can be used in a particular area at a certain time [24]. The selection of location, time and type of technology can be based on crime statistics and criminology studies, as well as a variety of other data, (cell phone data, social network analysis, etc...) this implies that the "smart" technology is an element of situational prevention [24,25].

With respect to the area of public citizen security, in a Smart City, applications have been developed that help

institutions dedicated to the protection of life, health and property of citizens and national heritage in situations of harmful events that endanger the order and daily life of citizens. These applications facilitate decision making related to urban management and administration in real time, in addition, the city must also have alternative solutions that resort to the use of other advanced technologies to ensure security [26].

Over the years, organized crime has learned to subvert the surveillance systems of Smart Cities and use their information for their own convenience, as well as the struggle between different outlaw organizations for control of the networks they occupy, all which restructures, for example, illicit drug trafficking. At the virtual level, the birth of the Darknet on the Internet amplifies this criminality problem due to the access to confidential material and the purchase and sale of illegal goods and services [27].

4. Methodology

The methodology used to conduct this research is supported by bibliographic references in electronic databases such as: ACM, E-book, Google Academic, IEEE Explore, Science Direct, Scopus, Redalyc, Scielo, Dialnet and Resarch Gate, which include scientific articles and scientific research, conference papers, journals, and outlines. For Smart City, all aspects of its definition, evolution, and implementation from the security point of view are taken into account, as well as the majority of articles in English for its global environment and the articles that are Spanish for its study at the national level. References from universities specialized in Smart Cities studies that collect data from the beginnings of the term until today, to the realization of this article. The inclusion of search terms such as Cybersecurity, Open Data, IoT, Safe City, Physical and Public Security and of course: Smart City.

5. Background

In the Americas, technological investment to solve problems in cities has led to be considered in "smart growth", improving citizen security that reduces crime and emergency response time is one of the 4 guidelines that IBM proposes for governments to focus on in their Smart City development plan. In Colombia the government includes security services-crime fighting and public information services as axes of intervention to achieve the sustainability of a smart growing city [28].

6. Results

According to the consulting firm Machina Research, Bogota is included as one of the main Smart Cities in Latin America, this consulting firm specializes in IoT and smart application strategies that improve the quality of life of citizens, security focused on crime, accidents, pollution, and natural disasters. Medellin, like Bogota, has many advances in terms of Smart

City, as it appears in the list of the Instituto de Estudios Superiores de la Empresa de Navarra, Spain, as one of the most sustainable cities in Latin America [29].

6.1 Bogotá

"As of 2016, the Mayor's Office of Bogota has implemented the Information Security and Privacy Model (MSPI) strategy in the different district entities, with the aim of guaranteeing digital information security from a government responsibility perspective." [29] The district administration includes an MSPI implementation plan in the different entities. The Ministry of ICT welcomes this model by proposing the use of diagnostic tools for information security and privacy in order to improve in this field [29,30].

The following image (Figure 1) based on the University of Navarra [30] shows the ranking of the first 10 cities at the top of the list and the first 10 Latin American cities and the position of Bogota with respect to them, ranked 113th in the world.

return periods is determined through the probability and frequency analysis of rainfall data [4]. probability and frequency analysis of rainfall data [4], it should be noted that the use of statistical parameters is indispensable in this type of projects [5].

Rain gauges provide the rainfall records of a region, and with these data, frequency analysis can be performed, although it is necessary to try a number of models, such as normal, two-parameter log-normal, three-parameter

Ranking	Ciudad	Desempeño	ICIM
1	Nueva York - Estados Unidos	A	100
2	Londres - Reino Unido	A	98,71
3	Paris - Francia	A	91,97
4	Boston - Estados Unidos	RA	88,9
5	San Francisco - Estados Unidos	RA	88,46
6	Washington - Estados Unidos	RA	86,1
7	Seúl - Corea del sur	RA	84,91
8	Tokio - Japón	RA	84,85
9	Berlín - Alemania	RA	83,4
10	Ámsterdam - Países Bajos	RA	82,86
83	Buenos Aires - Argentina	RA	63,32
85	Santiago - Chile	RA	62,71
87	Ciudad de México - México	RA	62,22
96	Medellín - Colombia	M	59,91
99	Montevideo - Uruguay	M	59,09
101	São Paulo-Brasil	M	58,94
107	Córdoba-Argentina	M	56,7
111	Monterrey-México	M	55,74
112	San José-Costa Rica	M	55,74
113	Bogotá-Colombia	M	55,3

Figure 1. Ranking of the 10 best Smart Cities. Source. [30]

6.2 Medellín

Like Bogotá, Medellín has also gained national fame in the implementation of mobility technologies (Sistema Inteligente de Movilidad de Medellín SIMM) and in safety with Mi-Medellín. Mi-Medellín is a program and service developed to provide urban solutions that according to [31] features:

- "Learning community for entrepreneurship."
- "Information service on procedures."
- "Collaborative design of a digital public agenda of the city for the centralization of information on events of the different institutions."
- "And the creation of the website Medellín Ciudad Inteligente."

Mi-Medellín has not only allowed citizens to interconnect with each other to find practical solutions for access, security, and other issues, but also to interconnect directly with companies and public and private entities in different areas, in order to "promote initiatives with social impact in a more efficient way" [32,33].

Also, due to the MDE program, Medellín as a smart city has early warning systems, a noise and air quality monitoring network, an integrated emergency and metropolitan security system, and all kinds of initiatives aimed at citizens to improve their quality of life, especially solving problems that include security [33].

[34] states that Medellín has three modalities for the use of Smart City in terms of protection, citizen security and emergency response. The first is the urban security system and the single emergency number, where the Mayor's Office of Medellín, through the Urban Security Company (ESU) coordinates the Integrated System of Urban Security. Empresa de Seguridad Urbana (ESU) coordinates the Metropolitan Integrated Emergency and Security System (SIES-M). The second is that it has a citizen information system that includes: "virtual attention services in 18 decentralized headquarters, contact center, social networks, mobile attention unit, attention points in vehicle dealerships and mobility applications among other services." And the third is the website seguridad en línea.com which streamlines the complaint processes to make it more accessible and comfortable for the citizen, it is the first comprehensive digital complaint system in Colombia implemented by the Mayor's Office of Medellín since 2013 [33,34].

[35] cites that "The National Development Plan (2014-2018) establishes the technological advancement of cities as a medium-term aim, following a sectoral transformation and a process of education and training of human capital towards 2022. The Plan thus seeks to create technological clusters in Colombia, in addition to generating technological and innovation vocation in the cities.

This is why Bogotá and Medellín are the only cities in Colombia that are considered Smart Cities because they focus not only on solving mobility and environmental problems, but also give priority to the use of frameworks for citizen security, with the different programs and strategies

by the national government and their local mayors; that their citizens are smart [29].

7. Recommendations

According to what has been analyzed in this article, the following recommendations will be made for governments to have an optimal Smart City from the point of view of security (Safe City), and that its citizens feel as safe and confident as possible both in their daily lives and when using smart applications, especially with government transactions.

It is important to note that considering all these security measures will increase the resilience of a Smart City, for example, although many social measurement tools have been developed, it is necessary to gather all the data and create banks and sets of such data to establish measurement tools in particular urban contexts [37].

According to [38] recommends the development of service intelligence schemes for smart cities that have a People-Centric system, as it is easier to describe recurring patterns and behaviors to efficiently organize the obtained information and relate them to each other. "This type of schemes is decisive in computational learning systems especially in this era of Big Data."

If greater confidence and security in the Smart Citizen is to be achieved, the government must train the best possible specialized professionals in each of the areas of a secure Smart City; areas such as IoT, Big Data, ICTs, or Programming, this generates in such workers optimal professional profiles [39].

It is highly recommended to take into account all types of existing Smart Cities, such as Safe Cities, Sustainable Cities, Digital Cities, Innovation Cities, etc... since it is possible to make comparisons that rather than discerning advantages or disadvantages between one Smart City or another, serve to analyze more clearly security failures and how such systems can be improved when compared with other security systems developed by another Smart City [40].

According to Gade and Ahtal [42] Smart Cities are also affected by epidemics and pandemics (such as Covid 19), although they cannot directly end the virus, due to their Smart status it is recommended to develop initiatives to reduce the economic impact, avoid infrastructure damage and save more human lives at risk. The use of teleworking is indispensable for citizens working at home and encourage the use of digital platforms offered by a Smart City [43].

Some examples can be cited in this line of security application in Smart Cities such as cloud based IoT applications that according to [45] quote: "They receive, analyze and manage data in real time to help municipalities,

businesses and citizens to make better decisions, instantly, that improve the quality of life." There are also IoT sensors that trigger alarms upon detecting explosive particles in the air of a building, or the maximum capacity of people at an event, this to ensure physical security.

Finally, it is recommended the inclusion of definitions such as "Smart University" which "allows the implementation of a large number of components that involve the adaptation of the traditional educational model using smart information technologies." [44]

8. Conclusions

Throughout the document, emphasis was placed on the issue of security in a Smart City, which differentiated a particular scheme with respect to other articles that address issues such as mobility or environment in a smart city. This scheme establishes the citizen as its main component, carrying out all the interactions that the citizen performs with its smart environment, to generate trust and satisfaction.

When this is done positively, the ordinary citizen becomes a Smart Citizen, and the smart city is given the characteristic of Safe City.

These situations lead governments to instances in which they must do everything possible to provide metropolitan coverage that includes improvements in terms of physical infrastructure and logical security systems, so that in situations of civil disorder such as terrorism and vandalism in a city, are placated by the use of these smart technologies and that citizens do not resort to particular solutions that endanger their integrity, but it is the Smart City itself who does it.

To conclude, it is of vital importance to be clear that there are many smart cities around the world and that each one has characteristics that define them in the different Smart City contexts.

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