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# Introducing Intelligent Ticket's Dual Role in Degraded Areas: Electronic Monitoring of Crime and Transmedia Content Presentation to Users

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**KEYWORDS**

*Intelligent ticket, RFID, NFC, Crime monitoring, Transmedia, Gentrification*

**ABSTRACT**

Smart cities may be considered a contemporary developing research field, principally as new technologies are made presented to the research community. Despite technological advancement and gentrification, smart cities continue to experience many challenges regarding crime and people's indifference towards important city issues. This work aims at the synchronization and cooperation of the city's authorities and user experiences through a conceptual framework of an intelligent ticket with the incorporation of RFID - NFC technology which constitutes the amalgam of coexistence and organized design. The proposed ticket's duality supports a tool for crime mapping-monitoring and the user's information through transmedia narratives. While it is widely accepted that transmedia has been used extensively to create fictional worlds, this work seeks to inspire real-world participation in criminality city problems. This paper describes the ticket's conceptual working process framework as an admittance point for crime monitor scenarios and the transmedia approach of multimedia users, presenting a use case on the Piazza Giuseppe Verdi in Bologna that allows its use.

## 1 Introduction

Recently, the demand for RFID (Radio Frequency Identification) technology has increased in many applications that are quite related to tracking traffic, improving inventory management, tracking equipment, and ensuring the identity of objects or living things.[1] In addition, RFID systems are set to play an important role in the IoT (Internet of Things), paving the way for IoT's main goal, the interconnection of physical objects.[2] One of the most popular RFID applications is human identification or where a tag is located external or internal on the human body,[3] as well as the "EM" (Electronic Monitoring) which concerns the electronic tracking of criminal offenders.[4]

The technology today is connected to the IoT, and with individual personalized human tags, the Internet can evolve into the "IoP" (Internet of Persons or People), networking digitally and socially people, contributing to the Big Data.[5] In this regard, the AmI (Ambient Intelligence) resulting from the use of RFID and different combined technologies, such as IoT, Internet of Everything, the 5G (fifth-generation mobile network),[6] thus giving a greater meaning in the commercial industry of smart tourism and smart cities in general.

Many cities around the world have begun adopting smart city programs to improve urban life, due to the expected population increase of 70%, envisioning smart cities and communities, as stated

1    Rodríguez, Marcela D., Alain Diaz-Montes, Carlos G. Verdin, Carlos A. Puga, José M. Ramírez, and Ángel G. Andrade, "An RFID-Based Digital Bracelet for the Timely Assistance of Indigents," *Proceedings* 2 (19) (2018): 1259.

2    Ahmed Khattab, Zahra Zahra, Esmaeil Amini and Magdy Bayoumi, "RBS RFID Security and the Internet of Things," *Analog Circuits and Signal Processing* (2016): 150.

3    Tajchai Pumpoung, Pitchanun Wongsiritorn, Chuwong Phongcharoenpanich and Sompol Kosulvit, "UHF-RFID Tag Antenna Using T-Matching and Double-Ended Rectangular Loop Techniques for Wristband Applications," in *Theory and Applications of Applied Electromagnetics* Vol 379, ed. by Soh P., Sulaiman H., Othman M., Abd. Aziz M., and Abd Malek M. (Springer, Cham, 2016), 98.

4    Robert S. Gable and Ralph Kirkland Gable, "Remaking the Electronic Tracking of Offenders into a "Persuasive Technology"," *Journal of Technology in Human Services* 34 (1) (2016): 13-31.

5    Demetrius Klitou, "Human-Implantable Microchips: Location-Awareness and the Dawn of an "Internet of Persons"," in *Information Technology and Law Series* (The Hague: Asser Press, 2014), 175.

6    Dimitrios Buhalis, "Technology in Tourism-From Information Communication Technologies to Etourism and Smart Tourism Towards Ambient Intelligence Tourism: A Perspective Article," *Tourism Review* 75 (1) (2019): 267-272.

in European Commission Decision C (2015) 6776 on 13th October 2015.[7] The term "smart cities" is commonly used in academic literature to designate a type of city with heavy investment in advanced ICT's (Information and Communication Technologies)[8], with urban infrastructures and home appliances to be automated by sensors.[9] Despite the technological evolution, smart cities continue to experience crime with an increasing focus on worsened social inequalities speared by the gentrification of affluent neighborhoods.[10] Under this context, it is particularly important today, to track a city's crime.  he process of recognizing and monitoring lawbreaking is systematically and deliberately divided. Mapping areas that show high criminal mobility, is a technique that has already been used on a large scale, and serves not only the reduction of criminal incidents but also in the prevention, by identifying specific patterns, based on the area and time of requested zones, which have been affected. This recognition process personalizes the respective areas that are automatically converted into crime hotspots. For this reason, various technological methods for crime mapping and crime data analysis data have been proposed, based in a variety of research in which GIS system with spatial patterns is applied, helping to locate the criminals in specific areas in collaboration with local authorities.[11] Jointly with the conceptualized GIS system, there have been attempts to use RFID technology to assist police work[12] through bracelets and wristbands integrated with RFID chips monitoring lawbreakings and providing security to communities in real-time.[13]

However, smart cities focus not only on technology but also on culture which may include urban cultural heritage or urban creative

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7    Eleni Tracada, "Foreword IV: European Smart Cities: Current and Future Enterprises and Research Activities," *Smart Economy in Smart Cities* (2017): xiii-xiv.

8    Allam and Newman, "Redefining the Smart City: Culture, Metabolism and Governance," 15.

9    Elmo Gonzaga, "Precarious Nostalgia in the Tropical Smart City: Transmedia Memory, Urban Informatics, and the Singapore Golden Jubilee," *Cultural Studies* 33, no 1 (2018): 149.

10    Bernard Cathelat, *Smart Cities: Shaping the Society of 2030* (Paris: UNESCO, Netexplo, 2019), 7.

11    Zhou, Guiyun, Jiayuan Lin, and Xiujun Ma, "A Web-Based GIS for Crime Mapping and Decision Support," *Forensic GIS* (214): 222-223.

12    V. Daniel Hunt, Albert Puglia and Mike Puglia, "RFID Technology in Homeland Security, Law Enforcement, and Corrections," in *RFID-A Guide to Radio Frequency Identification* (New Jersey: Wiley-Interscience, 2007), 74.

13    Mirko Akrap, "RFID Implementation: Testing in Prisons and Parolees for the Greater Good," *The John Marshall Journal of Information Technology & Privacy Law* 33 (1) (2016): 26-27.

industries. The latter is being addressed by the notion of "smart culture", which indicates the significant contribution of cultural heritage to the economic development of a city. It is exactly within these smart cities' environments that multimedia interaction can be utilized in many applications, such as with the "SmaCH" (Smart City Cultural Heritage).[14] Multimedia claims that users learn more from pictures and words and that meaningful learning should be supported with the use of multiple mediums.[15] This tendency is called "smart learning", which constitutes the smart city's exemplary learning concept and is characterized by autonomous adaptive learning environments.[16] More concretely, the users, both individually and collectively, are driven by different devices and platforms, disseminating collective action instead of passively receiving inormation from only one channel.[17]

In this context, TS (Transmedia Storytelling) appears as a tool that fully adapts the media's content related to time and space - sparking the idea of the global village that Marshall McLuhan envisioned in the '60s.[18] Thus providing new learning opportunities, where different channels and texts allow for different ways of meaning. Due to its interactive nature, TS is not just a modality of smart learning but also shows the game-based character of smart learning that connects to Gamification[19] and Edutainment[20].[21]

The proposed framework takes RFID and NFC technology into account by incorporating them into the conceptual ticket process design. It should be clarified that the term "intelligent ticket" is used to refer to the two technologies that are thought to give access to the TM content through an app. The technologies provide an approach

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14    Zois Koukopoulos, Dimitrios Koukopoulos, and Jason J. Jung, "A Trustworthy Multimedia Participatory Platform for Cultural Heritage Management in Smart City Environments," *Multimedia Tools and Applications* 76, no. 24 (2017): 25947.

15    Richard E. Mayer, "Cognitive Theory of Multimedia Learning," Psychology of Learning and Motivation 41 (2002): 85.

16    Dejian Liu, Huang Ronghuai and Marek Wosinski, "Contexts of Smart Learning Environments," *Lecture Notes in Educational Technology* (2017): 16.

17    Renira Rampazzo Gambarato, "Transmedia Project Design: Theoretical and Analytical Considerations," *Baltic Screen Media Review* 1, no. 1 (2013): 84.

18    André Jansson and Karin Fast, *Transmedia Work: Privilege and Precariousness in Digital Modernity.* (New York: Routledge, 2019).

19    Gamification is the principle of designing games in traditional non-game environments in order to improve user engagement, flow and learning.

20    Edutainment (Education + entertainment).

21    Ekaterina Tour, "Transmedia Storytelling in Education," *Encyclopedia of Educational Innovation* (2019): 4.

to the ticket's application process, increasing the flexibility in co-operation between the city's authorities and users. However, the framework focuses on understanding the ticket's duality, which can be understood as translating to crime monitoring, by spatial patterns that use identification through RFID technology to map law offend-ers providing statistics on degraded areas and probably a crime.  n addition, the ability of RFID and NFC technology to store and pro-cess data offer the ability to integrate TS narratives, and users can be reached by common social problems. In this way, local authorities can create TM interactivity strategies in areas that are considered to be degraded and bring cultural gentrification on the areas (Fig. 1). This will be discussed later in a conceptual case study on Piazza Giuseppe Verdi in Bologna surrounding the ticket's dual role.
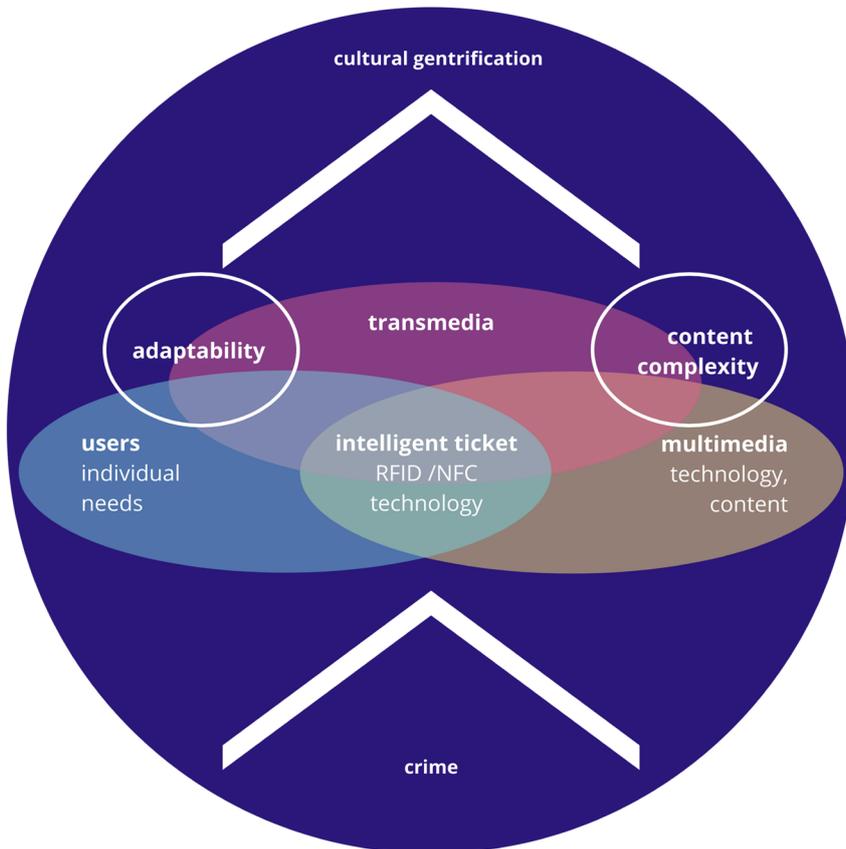
FIG. 1    Presentation of key research axes.

## 2 Background

### 2.1 Intelligent Ticket: RFID and NFC Use

When comparing levels of "smartness" and "intelligence" in operating systems, it becomes apparent that they share many similarities. Both terms refer to material-sensitivity, as well as the technical application for digital applications.[22] In other words, intelligence focuses on the ability to store and process data to exchange information as a system capable of performing intelligent functions. To elaborate further on this, the intelligence may be cataloged under the detection, recording, tracking, and communication for decision making.[23]

RFID systems have conquered the market with a great example of public transport tickets.[24] Large scale public transport systems were utilized RFID-based credit-card-sized reusable tickets[25] or paper made tickets, combining or replacing them with different technologies, such as SMS, Wi-Fi, QR Codes[26], or even solely digital - online tickets through ticket booking apps, proposed mainly by the airline industries.[27] The known "smart card" applications are also related to RFID systems, where data is stored on an electronic data transfer device - the transmitter and data transfer is achieved using magnetic or electromagnetic fields.[28] In particular, the development of smart cards is related to secure data transfer, large memory capacity, and high reliability, resulting from the use of two communication technologies RFID and NFC.[29] Smart cards or even bracelets with RFID

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22    Σπυρίδων Ι. Νομικός, *Νέες Τεχνολογίες Εκτύπωσης - Τυπωμένα Ηλεκτρονικά* (Αθήνα: Εκδόσεις Τσότρας, 2008), 163.

23    Kit L. Yam, Paul T. Takhistov and Joseph Miltz, "Intelligent Packaging: Concepts and Applications," *Journal of Food Science* 70, no. 1 (2005): 2.

24    Klaus Finkenzeller, *RFID Handbook: Fundamentals and Applications in Contactless Smart Cards, Radio Frequency Identification and Near-Field Communication*, trans. Dörte Müller, Third Edition, (John Wiley & Sons Ltd, 2010).

25    Roussos, George and Vassilis Kostakos, "Rfid in Pervasive Computing: State-of-the-Art and Outlook," *Pervasive and Mobile Computing* 5 (1) (2009): 112.

26    Campos Ferreira, M., Dias, T. G., and Falcão e Cunha, J. "Is Bluetooth Low Energy Feasible for Mobile Ticketing in Urban Passenger Transport?," *Transportation Research Interdisciplinary Perspectives* 5 (2020): 100120.

27    Norazah Mohd Suki and Norbayah Mohd Suki, "Flight Ticket Booking App on Mobile Devices: Examining the Determinants of Individual Intention to Use," *Journal of Air Transport Management* 62 (2017): 146.

28    Finkenzeller, *RFID Handbook: Fundamentals and Applications in Contactless Smart Cards, Radio Frequency Identification and Near-Field Communication*, .

29    Campos Ferreira, M., Dias, T. G., and Falcão e Cunha, J., "Is Bluetooth Low Energy Feasible for Mobile Ticketing in Urban Passenger Transport?," 100120.

or NFC tags are used in many museums to control the number of viewers, as well as to analyze user behavior and interaction.[30]

Usually, RFID refers to a long-range wireless communication, while RFID's subject, NFC, allows communication within a few centimeters.[31] The RFID's operating frequency, coupling method, and the range of the system are some of the most important criteria.[32] RFID frequencies ranging from 135KHz, 13.56MHz, 2.45GHz, 5.8GHz, 860 - 960MHz, 433MHz[33] to 5.8 GHz long wave in the microwave range.[34] Certainly, the referred frequencies are classified into four basic RF (Radio Frequency) signals, the LF (Low Frequency, 125kHz~134kHz ), the HF (High Frequency, typically 13.56MHz), the UHF (Ultra-High Frequency, 860-960 MHz) and the MW (Microwave Frequency, > 1 GHz).[35] RFID technology uses RFID tags (not visible or at a perfect angle) for the identification and storage of data.[36] RFID reader sends continuous CW (continuous waves) to identify the RFID tags[37], which can be considered "active" when a transmitter and a battery are used, as "passive" when they need the power source by the reader, "semi-passive" tags when tag's electronics need a battery.[38]

NFC technology allows a better information rate, ease of use, low consumption of power, tag invisibility through the objects, and a unique tag ID number verified by a server. This means that the two devices (reader/starter - tag/listener/label/target) can be near to each other (3-8 cm) with a frequency range between 13.56 MHz, while

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30    Ulyana V. Aristova, Alexey Y. Rolich, Alexandra D. Staruseva-Persheeva and Anastasia O. Zaitseva, "The Use of Internet of Things Technologies within the Frames of the Cultural Industry: Opportunities, Restrictions, Prospects," *Communications in Computer and Information Science* (2018): 151.

31    Dimitrios Panagiotakopoulos and Konstantina Dimitrantzou, "Intelligent Ticket with Augmented Reality Application for Archaeological Sites," in *Strategic Innovative Marketing and Tourism* 8, Springer Proceedings in Business and Economics, ed. Kavoura A., Kefallonitis E., Theodoridis P. (Springer, Cham, 2020), 43.

32    Finkenzeller, RFID Handbook: *Fundamentals and Applications in Contactless Smart Cards, Radio Frequency Identification and Near-Field Communication*, 21.

33    Stephen Statler, "Barcodes, QR Codes, NFC, and RFID," in *Beacon Technologies: The Hitchhiker's Guide to the Beacosystem* (Berkeley, CA: Apress, 2016): 326.

34    Finkenzeller, *RFID Handbook: Fundamentals and Applications in Contactless Smart Cards, Radio Frequency Identification and Near-Field Communication*, 21.

35    M Ayoub Khan, Manoj Sharma, and Brahmanandha R Prabhu, "A Survey of RFID Tags," *International Journal of Recent Trends in Engineering* 1 (4) (2009): 68.

36    Mirko Akrap, "RFID Implementation: Testing in Prisons and Parolees for the Greater Good," *The John Marshall Journal of Information Technology & Privacy Law* 33 (1) (2016): 22.

37    Khan, Sharma, and Prabhu, "A Survey of RFID Tags," 68.

38    Stephen Statler, "Barcodes, QR Codes, NFC, and RFID," 326.

the information exchange is up to 424 Kbps.[39] In some cases, NFC communication can take place between two active devices, such as mobile phones, designated as active or even between an NFC device and a label designated as passive. On the active mode, both the reader and the target produce the RF signal (Radio Frequency) where data are transmitted. On the passive mode, the RF signal is generated only by the starter and the target communicates it back.[40] The information's exchange between two NFC devices, while the target uses more power than the reader due to the use of its supply, is referred to as peer-to-peer mode.[41] The characteristics of both technologies are summarized and compared in Table 1.

| | RFID | NFC |
|---|---|---|
| Technology | RF (Radio Frequency) | RF (Radio Frequency) |
| Set up time | <0.1ms | <0.1ms |
| Operating frequency | 125 or 134kHz | 13.56MHz |
| Range | With a handheld UHF reader ~10 feet (3 meters) for passive tags. Active tags can be read from 100-1,500 feet (30-457 meters). Many variables | Up to 8 inches (20 cm) |
| Data exchange range | Up to 640Kbps | 422Kbps |
| Active/passive | Active/passive/ semi-active | Active/passive/ semi-active |
| Communication modes | Read/write | Read/write/ Peer to Peer emulation |
| Line of sight | Not required | Not required |
| Data storage | Generally 2KB | Varies by tag, on average 64, 128 |
| Technology native to data mobile | No, requires an RFID reader | Yes |

TAB. 1    RFID and NFC comparison. Adapted from Trivedi[40] , and Statler[41].

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39    Dimitrios Panagiotakopoulos and Konstantina Dimitrantzou, "Intelligent Ticket with Augmented Reality Application for Archaeological Sites," 43.

40    Garima Jain and Sanjeet Dahiya, "NFC: Advantages, Limits and Future Scope," *International Journal on Cybernetics & Informatics* 4 (4) (2016): 2-3.

41    Rohde and Schwarz, "*Near Field Communication (NFC) Technology and Measurements,*" White paper, Roland Minihold (2011): 10.

## 2.2 Electronic Monitoring

EM tracking systems monitor violators 24 hours a day from satellite or terrestrial location tracking systems as they are moving around in the community. There are various technologies used, such as GPS (Global Positioning System) devices, in which the signal is often lost, CDMA mobile phone towers, location technology using wireless WiFi signals and others.[42] RFID is also applied to criminal cases and this is an interesting aspect introduced first by Motorola[43], integrating RFID with different technologies. GPS and biometric identification and its use as a police crime-fighting tool being an example. The company decided that RFID could be adapted to prisons for tracking and monitoring prisoners due to the high rates of violence between the staff and the prisoners.[44] RFID labels are used with a unique ID number for each offender, transmitting a signal up to 100 meters (300 feet) in the case of active tags, and up to 10 meters (3 feet) if passive tags are used.[45] Similar projects, use RFID to allow authorities to locate the criminal's car by collecting their information on tolls.[46] Electronic bracelets or labels are used in everyday social situations, such as the new pilot actions of the Dutch Ministry of Justice to monitor alcoholics, helping offenders to show that they have changed their ways.[47] All of the above uses are important technological aspects of EM's external use.

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42    Stuart S. Yeh, "Cost-Benefit Analysis of Reducing Crime Through Electronic Monitoring of Parolees and Probationers," *Journal of Criminal Justice* 38 (5) (2010): 1090-1096.

43    Motorola, Inc. is a telecommunication company.

44    V. Daniel Hunt, Albert Puglia, and Mike Puglia, "RFID Technology in Homeland Security, Law Enforcement, and Corrections," 76-77.

45    Robert S. Gable and Ralph Kirkland Gable, "Remaking the Electronic Tracking of Offenders into a "Persuasive Technology"," Journal of Technology in Human Services 34 (1) (2016): 13-31.

46    Kwangho Jung and Sabinne Lee, "A Systematic Review of RFID Applications and Diffusion: Key Areas and Public Policy Issues," Journal of Open Innovation: Technology, Market, and Complexity 1 (1) (2015): 8.

47    Esther Verkaik, "Dutch Drink Offenders to Get Teetotal Tag to Keep them Dry," Reuters (2020).

## 2.3 Media Convergence: Multimedia, Cross-media, Transmedia

In the last decades, new technologies, services, and capabilities on user interaction modes, content types, formats, semantics, metadata editing, and management, have emerged.[48] Currently, the media environment is constantly changing with digital audiovisual software, enabling more and more people to participate in the content production process.[49] The media's convergence has evolved with the IS (Information Society) and the opposing technologies trying to gain market share. Most theories examine new possibilities that arise from the audience's needs for complementary multimedia channels: changing from a single product to multimedia content. However, the content must be adapted to each channel, with different bitrate and coding ranges. For instance, the use of different communication networks for data transmission is due to the conversion of analog to digital communication, typically referring to Internet access.[50] On the other hand, in the field of Communication, Jenkins defined convergence as contents flow across multiple media platforms, with the audience "migrating" on many different media forms.[51]

The multimedia field is characterized by a wide range of subcategories. Various researches examine the fact that multimedia combines interactive media by dividing them into two categories. The first is related to the inability to change content, while in the second, dynamic content can be explored and create new navigation paths.[52] The "multi-" suffix means 'many'; combining text, graphic art, audio, animation, and video provided by a computer. This combination implies an imaginative representation of words and images that can be expressed with any audiovisual format.[53] The multimedia, as described, is based on a traditional communication model, while

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48    Andreas Veglis, Charalampos Dimoulas and George Kalliris, "Towards Intelligent Cross-Media Publishing: Media Practices and Technology Convergence Perspectives, "*Media Convergence Handbook* 1 (2016): 132.

49    Chiras Christodoulos, Andreas Veglis, Charalampos Dimoulas and Georgios Kalliris, "Audiovisual Information Management Training Demands in the New Media Environment: The AVIMAN Learning Portal Case," (2012): 1.

50    Ioannis Deliyannis, "Converging Multimedia Content Presentation Requirements for Interactive Television," *Media Convergence Handbook* 1 (2016): 231.

51    Sabiha Ghellal, Annika Wiklund-Engblom, Ann Morrison and Damjan Obal, "Transmedia Perspectives," Media Convergence Handbook 2 (2016): 310.

52    Γιάννης Δεληγιάννης, *Η Κοινωνία της Πληροφορίας και ο Ρόλος των Διαδραστικών Πολυμέσων* (Fagotto books, 2nd ed., 2010): 145-146.

53    Stephen D. Sorden, "The Cognitive Theory of Multimedia Learning," (2012): 1.

their use has more dynamic communication processes that are relevant to the paper's framework and will be discussed below.

Many have already stated that multimedia technologies and IDN (Interactive Digital Narrative) are somewhat different from the non-digital interactive narrative, from the perspective of a post-classical narrative, African oral traditions, French transcendence, transmediality, and new media-specific views, generating new definitions.[54] These definitions are studied concerning the semantic chaos, increasing the digital's communication complexity with neighboring concepts such as "cross-media", "multimodality", "multiplatform", "enhanced storytelling" and more.[55] Certainly, cross-media has been created by the convergence of computing and HCI (Human-Computer Interaction), supporting multiple media to deliver a story, directing the receiver from one media to another, while supporting a specific goal through functions distributed across all media.[56] According to Bolter and Grusin, new media do not replace existing ones but complement them by increasing the exposure time of information.[57] The basic design of cross-media applications is the layout of various media, for example, after using Media A the user must go to Media B.[58]

A different term may be used similarly, indicating a new media aesthetic, dependent on the active involvement of users. As Henry Jenkins, the creator of the term "TS", points out, this is the art of creating the world, with users collecting pieces of stories to have richer entertainment.[59] TS was officially created in 2003, while it first appeared in the 1990s, and it refers to the integrated experience

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54    Hartmut Koenitz, Mads Haahr, Gabriele Ferri, Tonguc Ibrahim Seze, and Diğdem Sezen, "Towards Mapping the Evolving Space of Interactive Digital Narrative," LNCS 8230 (2013): 285–286.

55    Carlos Alberto Scolari, Transmedia Storytelling: Implicit Consumers, "Narrative Worlds, and Branding in Contemporary Media Production," *International Journal of Communication* 3 (2009): 585.

56    Katarin Segerståhl, "Crossmedia Systems Constructed Around Human Activities: A Field Study and Implications for Design," *International Federation for Information Processing* (2009): 354.

57    Jay David Bolter and Richard Grusin. *Remediation: Understanding New Media* (MIT Press, Cambridge, Mass, 1999).

58    Katarin Segerståhl, "Crossmedia Systems Constructed Around Human Activities: A Field Study and Implications for Design," 354.

59    Henry Jenkins, *Convergence Culture* (New York: New York University Press, 2006): 21.

of media communication, engaging the public to interact.[60] Both cross-media and TS concepts refer to productions taking place through different media and platforms, while TS pays attention to UGC (User-Generated Content), finding a narrative dimension that cross-media does not include as much.[61] In particular, the TS consists of the main story, transmitted through a particular channel, while external narratives enrich the story through various channels, contributing to the whole world of the story.[62]

According to Jenkins, most TM examples are based on a fictional scenario, as opposed to non-fiction stories. In fact, many alternative TS definitions have been presented and explain social change by spreading social messages across multiple media platforms, as Sasha Costanza-Chock proposes.[63] In other words, the main TS task is to recognize the right environment and experiences, which may lead to social change and personal development. More contemporary researchers have used this concept, and they have proposed the TS umbrella term of "T4C" (Transmedia for Change).[64] This results in the utilization of TS in different fields whether the subject is society or culture. A more functional definition is certainly possible, like "Transmedia in Tourism", a recognized prime tool, particularly suitable for promoting sites and cultural heritage. owever, in addition to the industrial part of tourism and culture, the use of TM may have more social dimensions.

When developing TS applications that focus on society, it is important first to investigate how the community is structured and which strategies are best at bringing different people together. Major TS projects are briefly summarized below while the basic strategies are being extracted and outlined to help as a guideline for the case study section. Certainly, in the case of political change in Colombia, transmediality generated social campaigns to inform people about

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60    Davidson Drew, *Cross-Media Communications: An Introduction to the Art of Creating Integrated Media Experiences* (Pittsburgh, PA: Carnegie Mellon University: ETC Press, 2010): 6.

61    Renira Rampazzo Gambarato, "Transmedia Project Design: Theoretical and Analytical Considerations," 83.

62    Emet Gürel and Öykü Tığlı, "New World Created by Social Media: Transmedia Storytelling," *Journal of Media Critiques* 1, no. 1 (2014): 47-48.

63    Tanya Notley and Alexandra Crosby. "Transmedia Activism: Exploring the Possibilities in West Papua." *Transmedia Practice* (2014): 79.

64    Mara Dionisio, Valentina Nisi, Nuno Nunes, and Paulo Bala, "Transmedia Storytelling for Exposing Natural Capital and Promoting Ecotourism," *Interactive Storytelling* (2016): 351.

the city's social problems.[65] Also, TS has been used in North America's tourism, with stories based on locations; introducing visitors to the site's history with interactive multiple social narratives, and cultivating an emotional experience. The paper's framework conceptually integrates the use of alternative TS terms through the ticket's content adaptability in order to raise awareness on the city's social issues.

## 3 Ticket as a Method – Use case

It is generally agreed that today RFID and NFC technology are used in daily public and private life. We build on this analysis to identify possible two-level RFID ticketing possibilities, on crime tracking, and the presentation of digital content for the cultural gentrification of infamous areas. The intelligent ticket is a research area with a connection between cultural information[66], which allows the ticket to be used as an access point for the adaptation of multimedia content.

The use case of this section is the square of Piazza Giuseppe Verdi in Bologna in Italy, analyzing particularly the dual role of the ticket's intelligence. A key objective is to understand the traceability of crime and at the same time TS strategies processes within social contexts and how these practices affect the area's cultural gentrification. Bologna is a city in northern Italy and the capital of Emilia Romagna. Today, the city has a population of 380,000 inhabitants, while the metropolitan area has about one million inhabitants. The city is renowned for its University[67], attracting many students. The city has a formal vision of becoming a smart city, providing opportunities for citizens, making Bologna the second Italian smart city after Milan.[68] During the '70s and '80s, around Piazza Giuseppe Verdi, political clashes took place between students and the police,

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65    Camilo Andres Tamayo Gomez and Omar Mauricio Velásquez, "Transmedia Projects in Contexts of Armed Conflict and Political Change," *Global Convergence Cultures: Transmedia Earth* (2018): 140-156.

66    Dimitrios Panagiotakopoulos and Konstantina Dimitrantzou, "Intelligent Ticket with Augmented Reality Application for Archaeological Sites."

67    University of Bologna, the first in the Western world (founded in 1088 AD - Alma Mater Studiorum).

68    Antonio Caperna, Guglielmo Minervino and Stefano Serafini, "Smart Cities, Local Community and Socioeconomic Development: The Case of Bologna," *Smart Economy in Smart Cities. Advances in 21st Century Human Settlements* (2017): 602.

linking the square to the concept of political participation rather than entertainment. Today, the area is at the heart of the debate on security, fear of crime, injustice in the city, and public image.[69]

The evolution of smart cities affects many societies stricken with crime due to social inequalities. The ticket's bracelet integration with RFID technology and TS narratives provides new means of city control against crime with the mapping - monitoring of criminal users, and the parallel TM approach of all users. A conceptual scenario involves the case where the city's authorities use the RFID system in contexts of crime mapping - monitoring in Piazza Giuseppe Verdi in Bologna. As shown in Figure 3, the system consists of four categories; users 1 (law offenders), users 2 (legal users), the city, and the police authorities. Specifically, for users 1, RFID bracelets are used to monitor the users, while for users 2, NFC cards are preferred. For both users, an app is required to bring both users together through a gameplay mode and the UGC around the square.

## 3.1 Users 1 and Users 2

Considering the case of illegal citizens, there are several important reasons for preferring RFID bracelets as it may be waterproof and dust resistant. In terms of technology, it does not require visual contact and human intervention to work with readers, while RFID reader systems can recognize hundreds of tags per second from any location up to 30 meters (100 feet) apart, while the direction of the bracelet-tag considering the reader does not always play a significant role.[70] For this scenario, active RFID tags are selected as they have a built-in battery that communicates with the reader, transmitting its identity once every few seconds from several tens of meters to several hundred meters.[71] Some other advantages lie in the battery life of about a year, the security is secure, and the cost is around ten

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69    Amadeu Recasens and Eric Marlière, *Violence Between Young People in Night-Time Leisure Zones* (Brussels: VUBPress, 2007): 99.

70    Stephen Statler, "Barcodes, QR Codes, NFC, and RFID," 327.

71    Shingo Kinoshita, Miyako Ohkubo, Fumitaka Hoshino, Gembu Morohashi, Osamu Shionoiri and Atsushi Kanai, "Privacy Enhanced Active RFID Tag," in *International Workshop on Exploiting Context Histories in Smart Environments* (2005): 1.

dollars.[72] The operating frequency bands of UHF-RFID systems can be divided into the frequency bands of 433/860/960 MHz which depend on the standard of each country. The universal UHF-RFID frequency band is between 860 and 960 MHz.[73] According to GS1 Global[74], in Europe and therefore in Italy, the UHF band (865.6-867.6 MHz), and the ETSI[75] EN 302 208 prototypes are used.[76]

RFID readers placed around areas where already observed to experience high rates of crime will be able to process user's recognition by transferring the bracelet's ID number on a server, where the authorities receive information about the time spent and possible gathering with other lawbreakers. Furthermore, the process of recognizing the increasing delinquency would be accomplished in two ways. Initially through the user interaction with the app. In case a user is attacked then he will be able to update the app and a notification will be automatically transferred to the authorities and the police units that are located near the scene of the incident so that at the first level there is a quick response so that the criminal cannot fend off the area and secondly to automatically record the incident in the police database to facilitate the investigation procedures.

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Correspondingly, on the occasion that a carrier of the singular bracelet is around the delinquent action, the system will be automatically updated again to proceed with the necessary investigative actions. This, of course, is not the cornerstone of resolving the attack, but a first assumption that will be put forward under specific examination and scrutiny. At the same time, all other nearby stakeholders of the system will be automatically informed so that there can be a social undertaking so that possible witnesses can be activated and constitute the turning point for the consolidation of the event and the administration of justice.

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72    Isamu Yamada, Shinichi Shiotsu, Akira Itasaki, Satoshi Inano, Kouichi Yasaki and Masahiko Takenaka, "Secure Active RFID Tag System," in *Ubicomp*, (2005): 2.

73    Tajchai Pumpoung, Pitchanun Wongsiritorn, Chuwong Phongcharoenpanich, and Sompol Kosulvit, "UHF-RFID Tag Antenna Using T-Matching and Double-Ended Rectangular Loop Techniques for Wristband Applications," 2.

74    https://www.gs1.org/

75    ETSI (European Telecommunications Standards Institute) is a European Standards Organization (ESO). https://www.etsi.org/

76    *Regulatory Status for Using RFID in the UHF Spectrum*. 2010. PDF. GS1 EPC Global. http://www.veryfields.net/wp-content/uploads/2011/10/UHF-RFID-Tag-Regulations.pdf.

The pre-trial and arrest procedure is carried out as already mentioned with the creation of patterns. This method is done by default by monitoring the attacks through the app. The process of mapping the incidents and scrutinizing them through a scheme could lead to important terminations about the location and time of most of them. The result of these findings is the greater preservation of these areas and the increase in police surveillance. However, the purpose of this proposal is not to create an institutionalization (which may raise the sharp dissatisfaction of the citizens) innermost these zones that will be strengthened by only the precaution of the police force, but the establishment of a safe city that could operate effectively at all levels as a full and secure organization.

On the other hand, the monitoring of users 2 for the export of statistics will be done with NFC cards with passive tags, and with the use of an app to connect the data of the users' geographical location to the same GIS pattern of users 1 in order authorities to receive an image for city's mobility. It is important to mention that users 1 will also be able to get the NFC card, as the community does not want to choose different media for its members and on the other hand wants to integrate them with users 2. In addition, a second identification of their geographical location for extra security is added (Fig.2)
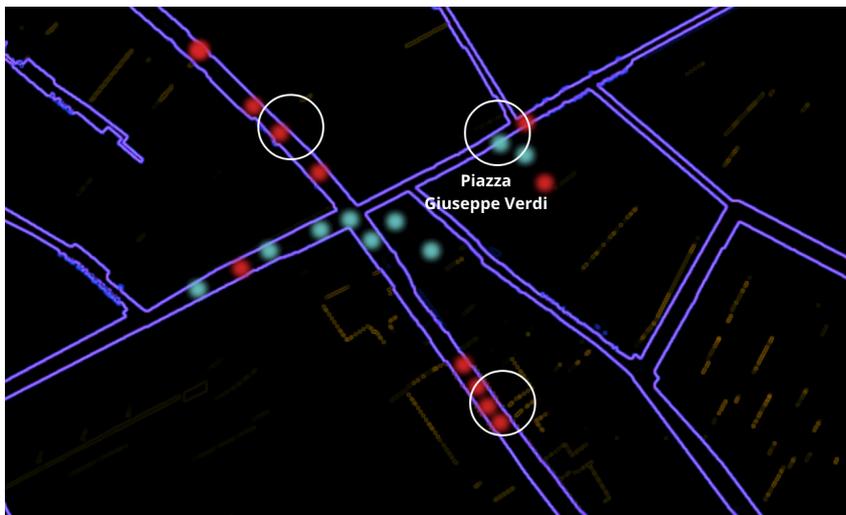
FIG. 2    Visual conceptual representation of the mapping and monitoring of illegal acts in Piazza Giuseppe Verdi in Bologna with the use of RFID technology. The red dots represent people who have already been identified by the authorities for criminal acts, while the blue ones do not. The white circles represent the RFID readers[77].

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77    Map source: Google maps. 2019. Piazza Giuseppe Verdi Bologna. Online map. Accessed November 11, 2019. https://www.google.com/maps/place/Piazza+Giuseppe+Verdi,+40126+Bologna+BO,+Italy/@44.4962824,11.3498762,18.43z/data=!4m5!3m4!1s0x477fd4bb8de1ba0d:0x7a39a7224d40275f!8m2!3d44.4962584!4d11.3506682.

With the purchase of the card, the registration of the user's data is completed with the parallel entry of the data in a database. Then, with one tap of the NFC card on the mobile device, the user's data is transferred to the app. The user is required to accept GPS authentication settings so that he can receive information from the area in which he is located, as well as its position will be transferred to the base for the export of traffic statistics. In no case will their geopolitical position be shared with third parties, unless this is deemed necessary and the whole of society is threatened. Having completed this step, the app is ready for full navigation, offering a wide range of personalized information. Figure 3 summarizes the operation of the system.
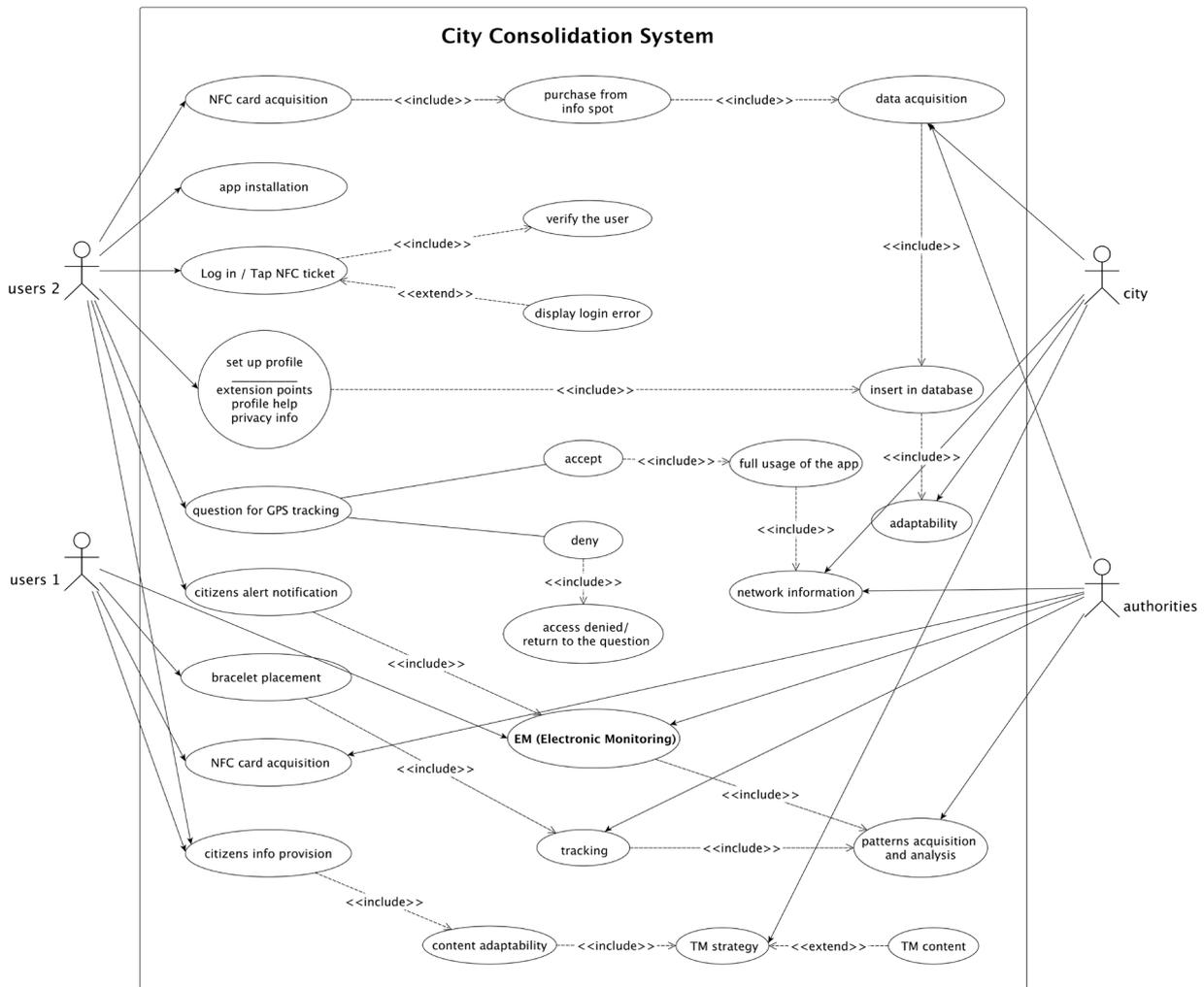
FIG. 3　City consolidation system; all four parts that contribute to the system are presented. Users 1, 2, the city and the authorities.

## 3.2 The case of TS

The above crime scenario shortly describes the process by which the city could be informed in real-time for crime areas, while at this point, the aim to create social awareness through TS should be considered. A variety of scenarios and approach models can be proposed to implement the alteration of the public's idea on critical social issues. Harkening back to earlier, most TS projects are based on a fictional scenario. Instead, the conceptual methodology focuses on alternative TS definitions for social change. The main characteristic of T4C is to approach the local community on social issues through campaigns. The evidence from these studies suggests a variety of factors related to the dimensions of user experience. Thus, following this reasoning, it is hypothesized that the user's experience lies in various media content.

At this point, TS's main task is to create and present an environment where the users need to collect pieces of information through different media to contribute to their own story. The underlying TS strategies can approach the square's historical importance for the city, highlighting crime issues. This results in the crime issue destroying the square's importance. Thus, it is clear that the square's public image needs to be recovered to its importance. By developing TS strategies, the main aim is users to be educated around the square about the problem of crime and enable them to recognize it in the context of the square's degradation.

Persuasive TM narrative is proposed to inform and change people's attitudes and behaviors on social issues in the real world, while a gameplay mode is reminiscent of ideological messages.[78] TM social campaigns trying to bring the community into public debate, communicating with all users (residents, students, shopkeepers, law offenders, etc.). For this purpose, the creation of a narrative of changing the square's public image is needed. Introducing and discovering through the app the square's history can be the first step into changing people's ideas regarding the area's public image. Specifically, the narrative can be presented through different media channels, such as a game supporting also AR and VR utilities, while participants

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78    Mizuki Sakamoto and Tatsuo Nakajima, "Augmenting Yu-Gi-Oh! Trading Card Game As Persuasive Transmedia Storytelling," *Design, User Experience, and Usability. Health, Learning, Playing, Cultural, and Cross-Cultural User Experience* (2013): 587.

have the opportunity to create their own stories for collective memory and finally to notice their digital and personal impact in the public space.

The TMG (Transmedia Gaming) campaign is considered ideal, as it promotes a narrative system for bridging gaps in media types through a central platform, that is, a coherent interface for both users.[79] In our case, the platform is related to the app that users already need to have installed on their mobile devices to contribute to the content. The created gaps would allow viewers to act as protagonists to the game narrative, such as the online interactive weekly film "Beauty Inside[80]" by Intel and Toshiba.[81] Users themselves become the main characters where they are free to create an identity and personal history.[82]

Besides that, users will experience a learning method that combines information (content) and emotional immersion (user experience), creating an information process concerning conditions (Edutainment) and way of implementation (interaction, UGC, Gamification). It is a popular belief that multimedia interaction leads to the positive user experience through the four dimensions of experience: practical, cognitive, emotional and sensual involvement.[83]

The media content may come from representative projects selected to serve the strategy of the scenario, while the content will be designed to adapt to the individual needs of each user (age, physical disabilities, educational background and preferences), a factor that was introduced by storing personal information on the NFC card. In particular, as shown in Figure 4, the strategies are to be adapted from the data collected by users' mobility 1 and 2. That is if a street is observed to attract more users 1 than users 2 and at specific times, it

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79    Herlander Elias, "The Bridge – A Transmedia Dialogue Between TV, Film And Gaming," *Design, User Experience, and Usability. Theories, Methods, and Tools for Designing the User Experience* (2014): 548-559.

80    Doremus, Drake. 2012. *The Beauty Inside*. Film. United States: B-Reel Films.

81    Zuhal Akbayır, "Transmedia Storytelling as a Corporate Communication Strategy and its Effect on Corporate Culture," in *Handbook of Research on Transmedia Storytelling and Narrative Strategies*, ed. Recep Yılmaz, M. Nur Erdem, and Filiz Resuloğlu, (Hershey, PA: IGI Global, 2019): 408.

82    Ademir Pasalic, Nikolaj Hollænder Andersen, Christopher Schinkel Carlsen, Emil Åberg Karlsson, Markus Berthold, and Thomas Bjørner, "How to Increase Boys' Engagement in Reading Mandatory Poems in The Gymnasium: Homer'S "The Odyssey" As Transmedia Storytelling with the Cyclopeia Narrative as a Computer Game," *Smart Objects and Technologies for Social Good* (2018): 218.

83    Sabiha Ghellal, Annika Wiklund-Engblom, Ann Morrison and Damjan Obal, "Transmedia Perspectives," 320.

may mean that there is a reduced reputation and fear for that street. Thus, interactivity through the app, that is, by discovering a certain piece of story, may increase street popularity.
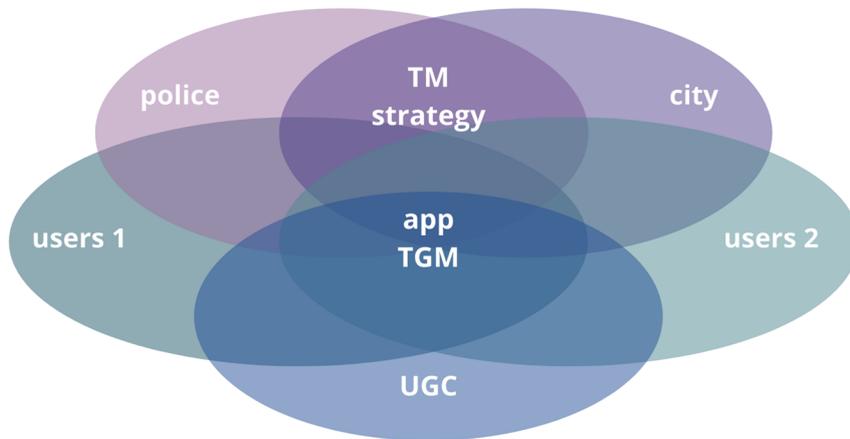


FIG. 4 Visual representation of how the content TM strategy and UGC are produced.

## 4 Discussion and Conclusion

Ticket's intelligence provides new means of crime mapping - monitoring and TM narratives, guiding users efficiently through social issues. The conceptual methodology approaches the ticket's dual intelligence through the development of a process capable to monitor criminality in degraded areas and to contribute TS narratives, actualizing a media message arranged to approach people's social interest. The system's procedure is heterogeneous and continuous. It must deliberate differently but at the same time simultaneous functions so that the ultimate goal of ensuring the security of society as a whole can be carried out with the greatest efficiency. Towards this aim, the proposed framework combines a conceptual methodology of RFID - NFC. By using RFID-NFC technology, it will be possible to extract statistics on crime and the concentration and interaction of users in degraded areas. As such, several issues need addressing. To demonstrate the framework, a method using the ticket (RFID bracelet for users 1 and NFC card for both users connected through an app) was selected, showing that the ticket's intelligence can process user experience.

The framework can be applied in the context of AmI, as RFID and NFC technology are used, while the actual creation of this project would require the use of IoT, while considering that the personal transfer

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of an RFID bracelet of a personalized card can also be considered IoP, connecting people with a gamified content. At the same time, the concept of the smart city is being adapted to the framework, as the city and the police work together. This is particularly important today, as the city user's experience requires the cooperation of many fields and institutions (city planners, managing organizations, etc.) and individuals (population - users). This certainly indicates that city administrators and authorities should develop projects and social campaigns, while the campaign's speed by which the information is approached, presented and adopted by the to the user should be well considered. This, in real-life scenarios, involves various fields and institutions being integrated, such as computer science - engineering, city administration, police authorities, and legal assistance, in the design and implementation of proposed application and testing.

The RFID technology has not been expanded, with major obstacles being the lack of standardization and privacy concerns. Additional questions are related to the offenders' bracelet and safety monitoring. While RFID technology has many potential benefits for the scenario developed, ensuring the privacy of both categories analyzed, is vital to information systems. All technologies are faced with the possibility of being abused by criminals and for this reason, technological developments must be dealt with by a legal framework so that users have reliable security, while the technology itself must ensure security and protection mechanisms to prevent criminal activity, which will help in the widespread acceptance of users.[84] Therefore, more work needs to be done to standardize and address privacy/security issues to increase the application of RFID as well as NFC technology. To give a future aspect as well, as the external use of RFID bracelets raise several questions about safety and its ability to be publicly transported by the lawbreaker. In this direction, according to Steve Aninye, the American justice system has shown interest in human microchip implants.[85] The human implants - paving the way for boundless future applications. This is not uncommon in real-life scenarios, as the FDA (Food and Drug Administration) has

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84     Gerald Quirchmayr and Christopher C. Wills, "Data Protection and Privacy Laws in the Light of RFID and Emerging Technologies," *Trust, Privacy and Security in Digital Business* (2020), 155-164.

85     Klitou, Demetrius. 2014. "Human-Implantable Microchips: Location-Awareness and the Dawn of An "Internet of Persons"", 157-249.

already approved VeriChip[86], two decades ago as a human implantable device that can be used for medical records. That being said, financial and personal identification applications are still under discussion.[87]

However, personalization and adaptation tools offered by RFID - NFC technology approach each TM medium to contribute to a story's narrative and approach transport channels with a story that remains appropriately sized and appropriately placed, while highlighting measurable behavioral changes. Through the TMG function and gamification will consolidate these areas as there will be a continuous live flow of social mobility. The result would be the suppression of criminality in the recorded zones, the abolition of any deplorable ghetto, and the accession of these districts to the safe social and commercial city mobility. The participation of both categories of users is going to unravel the social barriers between them, while it is also possible to re-approach the lawbreakers in society. It will essentially be a digital link with which both categories of users will interact with a game around the area. The ability to change the content allows the stories of both categories to be heard and to create a digital collective memory for the area. For these reasons and if it turns out that such a system can have these effects, then the term "cultural gentrification" can be used, while, at the same time, it will be able a new role for multimedia, transmedia and RFID-NFC technology to be identified in the functional context of the smart city.

## Acknowledgements

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86    The VeriChip is the first microchip implant for humans. It contains a 16 digit number and is described as a passive chip.

87    V. Daniel Hunt, Albert Puglia, and Mike Puglia, "RFID Technology in Homeland Security, Law Enforcement, and Corrections."

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