A Smart City Initiative for Participatory Urban Accessibility Planning and Management

Raquel Pérez-delHoyo, María Dolores Andújar-Montoya, Higinio Mora, Virgilio Gilart-Iglesias, and Rafael Mollá-Sirvent

Abstract Social awareness towards maintaining urban accessibility is a growing concern in modern societies. This consciousness opens up necessary research fields in regard to the possibilities of new technologies to provide innovative methods for monitoring and preserving the accessibility of urban areas. Because of that, the present research focuses on the synergy of the use of new technologies and the information provided by citizen themselves that allows to meet the real needs of people with movement disabilities in a dynamic manner. The methodology proposed in this work allows the deployment of information and communication technology for the analysis of the urban user's experience and accessibility to movement, allowing accurate information on urban barriers to be obtained directly from citizens. In addition, it not only provides information on accessibility issues, but also allows the monitoring of their effectiveness over time. In this respect several case studies have been carried out in different urban environments to validate the proposed methodology. First, the system was tested in the environment of the University of Alicante in Spain, detecting existing accessibility issues in different scenarios of the University Campus. The evaluation was focused on the analysis of students and lecturers' daily paths across the campus (outdoors) and their movements inside of the buildings (indoors). Afterwards, the sample was expanded to the identification of the degree of inclusion in one of the city's neighbourhoods. As a result, the authors determined that Technology

R. Pérez-delHoyo (✉) · M. D. Andújar-Montoya
Department of Building Sciences and Urbanism, University of Alicante, Alicante, Spain
e-mail: perezdelhoyo@ua.es

M. D. Andújar-Montoya
e-mail: lola.andujar@ua.es

H. Mora · V. Gilart-Iglesias · R. Mollá-Sirvent
Department of Computer Science Technology and Computation, University of Alicante, Alicante, Spain
e-mail: hmora@ua.es

V. Gilart-Iglesias
e-mail: vgilart@ua.es

R. Mollá-Sirvent
e-mail: rafael.molla@ua.es

A. Visvizi and O. Troisi (eds.), *Managing Smart Cities*,
https://doi.org/10.1007/978-3-030-93585-6_2

today is a great ally to promote citizen participation actions, becoming an effective channel for communication between citizens and Administration, and involving the citizens as the core of all the processes concerning the city from planning and design to management and maintenance.

Keywords Inclusive city · Citizen participation · Sensing technologies · Smart city · Social inclusion · Technology-aided urban design · Urban accessibility

1 Introduction: Citizen's Knowledge as a Support to ICT in the Smart City

The adoption of Information and Communication Technologies (ICT) in the daily life of today's society is already a reality. This fact opens new possibilities for collaboration between citizens, public services and the administrations that manage them. In this sense, citizen participation is especially relevant in the field of the Smart city where the convergence of administrations-citizens-and city brings reciprocity, and therefore meaning and humanization, to the Smart city concept. This fact is becoming increasingly important in political agendas and public services, through the promotion of initiatives within the Smart City framework (European Commission, n.d.; Neirotti et al., 2014). The increasing complexity of the management of cities and their public services as a consequence of population growth, makes it necessary to develop these initiatives to face the challenge in an efficient way (Chourabi et al., 2012; Lytras & Visvizi, 2020; Lytras et al., 2020; Rathore et al., 2017; Rudnick, 1980). The challenges arising from demographic changes bring new difficulties such as urban gentrification or social exclusion, as well as new challenges in terms of resource sustainability, health services, or urban security (Glasmeier & Christopherson, 2015). One of the most important aspects that a city can offer to avoid social exclusion, and which directly influences the quality of life of its citizens, is the capacity of that city to be inclusive (Colantonio & Dixon, 2011). The participation of citizens in urban planning implies the democratization of planning, which acts as a mechanism against exclusion (Pearce, 2010). In light of that situation, the contribution of technology through ICT and citizen participation facilitate the design of both public accessibility and sustainable resource management policies (Lytras & Visvizi, 2020; Uribe-Pérez et al., 2016; Visvizi et al., 2017; Yigitcanlar & Han, 2010). The contribution of knowledge is taking a stance as a fundamental pillar that reinforces the potential of ICT in the Smart city as citizen-centred services, turning them into participatory systems where citizens can interact and collaborate with authorities (Del Hoyo & Lees, 2018). An essential aspect where feedback can be produced from administrations-the citizen-and the Smart city is in terms of urban accessibility, understanding accessibility as a universal and elemental factor in the quality of life of citizens (United Nations, 2006).

The premise behind this chapter is to explore how the synergy of citizen participation and ICT can improve people's quality of life, facilitating greater flexibility and greater inclusion in both urban planning and its maintenance. This will ensure that the whole process meets both the real needs of the citizen and the initial expectations of the administration in a dynamic and prolonged way, avoiding isolated and static actions.

Therefore, the present work focuses on the real, updated and reliable information on the city related to urban barriers that users can provide to public administrations, for its management and monitoring over time, through the development and implementation of the UA Accessibility App. Regarding this reciprocal relationship between 'citizens-public administrations-cities' based on ICT, this chapter develops the following sections. The following section describes the model developed to enable the connection between society—Smart cities—and city governance as interdependent elements. Subsequently, various case studies developed in different scenarios in the city are presented and finally, in the last section, the conclusions are presented.

2 Accessibility Evaluation Model of Smart Cities Integrating 'Citizens-Public Administrations-Cities'

Citizen participation in urban planning and city management allows meeting the real needs of people with disabilities continuously over time, avoiding isolated and non-operational improvement actions. As a consequence, our contribution is focused on pedestrian mobility through the study and analysis of urban accessibility within the Smart city scope. The contribution integrates the capture of urban accessibility diagnoses and the ICT framework to strengthen the transversal nature of urban accessibility from different perspectives. To this end, the design of an ICT-based model has been developed to evaluate the effectiveness of urban accessibility through citizen participation (Mora et al., 2017; Pérez-Delhoyo et al., 2017; Pérez-delHoyo et al., 2018). This evaluation is carried out through the capture of diagnoses that generate accurate, real and updated knowledge about the level of accessibility of the existing public space. The integration of technology and citizen contribution will facilitate the implementation of improvement actions in the maintenance management of cities over time. In addition, it will also facilitate the planning and design of cities that usually do not consider the needs of people with mobility difficulties and other physical or sensory limitations (European Commission, 2010). The contribution of citizen knowledge as active user brings veracity and pragmatism to urban planning and city design. The relationship between the three interdependent variables 'citizens-public administrations-cities' allows identifying needs, habits and preferences that improve the quality of life of citizens. This veracity lies in the positioning of citizens as the main source of information on the real conditions of the city they live in. Therefore, it is necessary to provide a communication channel that allows the flow of information between citizens and public administrations (Fig. 1), generating accurate, real-time knowledge about citizens' experience in the city (Dameri, 2017), to continuously move towards all-inclusive cities.

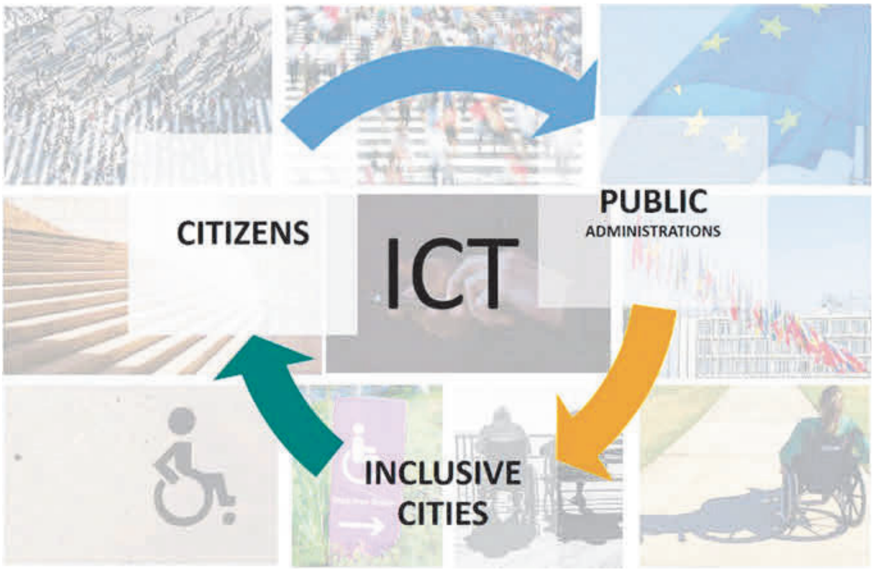

Fig. 1 Methodology proposed for obtaining information about accessibility problems and improving accessibility of cities. *Source* The authors applying Creative Commons License

This direct communication facilitates the decision making process of the administrations, as well as enabling interaction with the citizen beyond the periods of public exhibition of the urban development projects established by the law (Alfaro Navarro et al., 2017). Additionally, the introduction of citizens in the maintenance phase as active agents in the process, allows overcoming the current barrier of the degradation of cities. This occurs through the identification of accessibility deficiencies or simply loss of effectiveness due to deterioration or breaks or as a result of subsequent actions, such as the later placement of urban furniture that may produce a loss of accessibility on a route that was initially accessible.

Currently, there are no mechanisms that allow a continuous analysis over time to identify whether maintenance is guaranteed in terms of accessibility of the public existing environment or if, on the contrary, there is a degradation or loss of effectiveness of previously planned and designed accessible routes. The mechanisms widely used to obtain this information are focused on specific evaluation actions in specific environments. As a consequence, our research is focused on the automatic and continuous collection of information in any area without geographical limitations. The main objective of our research has been the design of a model to evaluate the effectiveness of urban accessibility in public space of the city, and the public buildings it contains. This assessment is done through automatic monitoring tools supported by technology to discover, evaluate, and dynamically classify urban accessibility issues. The methodology proposed by the authors allows obtaining real knowledge about the state of cities in terms of accessibility directly from citizens, based on their own experience, through an active process of global participation that materializes the transition towards a truly inclusive and accessible city. The model includes the joint application of technologies that effectively integrate the advantages of ubiquitous sensor-based computing, the characteristics of wireless communication technologies and the cloud computing paradigm in Smart City environments.

The computational model architecture consists of three main layers, the first Layer is the Citizen Location Acquisition Infrastructure, the second refers to Cloud Support Infrastructure and the last layer includes Information Services of urban accessibility. These three layers of the system contain the components of the infrastructure and provide the services as it is developed in Mora et al. (2016). The Citizen Location Acquisition Infrastructure layer allows obtaining and processing citizen locations both in the public space of the city (outside) and inside public buildings through position systems. The Citizens' Location Acquisition Infrastructure layer allows obtaining and processing the positions of citizens both in the public space of the city (outside) and inside public buildings through Radio Frequency Identification (hereinafter RFID) communication technology and Global Positioning System (hereinafter GPS). Furthermore, it makes it possible to generate the flow of movements and the patterns or experiences of such displacements by allowing the distinction between users with reduced mobility and users without reduced mobility. Subsequently, the cloud support infrastructure layer allows the collection and centralisation of locations from GPS devices and/or the smart sensor network and citizen-generated accessibility incidents. In addition, this infrastructure allows the creation of Key Accessibility Indicators (hereinafter KAI), classifying different types of urban accessibility problems as shown below. This layer developed by the authors in Mora et al. (2017) ensures system scalability and availability, reliable data delivery and interoperability with different types of sensors and technologies. It also includes a Structuring Information Component that calculates the possible routes followed by citizens. Finally, a component for urban accessibility problem detection is included through an automatic method, using the acquisition system defined in the previous paragraph, together with a second method of citizen collaboration through a smartphone application—UA Accessibility App—and internet of things (hereinafter IoT) solutions. The automatic method makes it possible to compare and analyse the differences between routes followed by citizens with reduced mobility and routes followed by citizens without reduced mobility, helping along to identify the causes that generate accessibility problems on that route. The automatic method enables the comparison and analysis of differences between the routes followed by citizens with reduced mobility and the routes of citizens without reduced mobility, allowing the identification of the causes that generate accessibility problems on said route.

The installation of the UA Accessibility App in citizens' mobile devices allows obtaining the accessibility experience of the end user, while moving around the urban environment anywhere and anytime. The UA Accessibility App offers the possibility of logging in by entering personal data such as email, date of birth, gender and type of disability, but also choosing the option of logging in without registering (Fig. 2).

Once inside, it opens up the possibility of anonymously uploading photos and comments on incidents regarding accessibility, reporting the claim along with the real location as shown in the image below. Figure 2 also shows a claim detected by a citizen

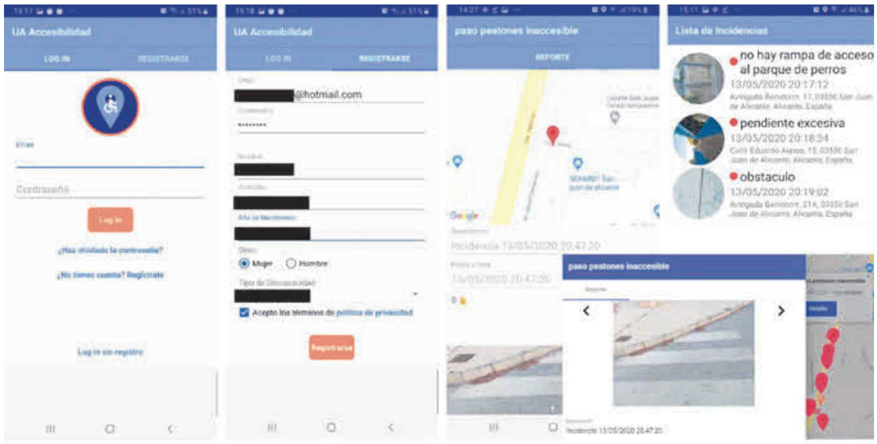

Fig. 2 UA Accessibility App for citizens' mobile devices. *Source* The authors

in which a pedestrian crossing ends at a curb without a ramp, thus preventing to go on that route. All the information collected provides real and updated information on accessibility to public administrations, allowing to know if accessibility is maintained over time or if, on the contrary, it is impeded by daily actions such as construction sites that invade sidewalks with provisional fences, stockage areas or construction sheds, or even due to definitive actions such as the placement of street furniture.

Information transfer is carried out through the last layer of the model, urban accessibility information services, that provide accessibility services to all the agents involved, i.e. citizens and administrations and public companies developed in (Mora et al., 2017). In addition, as specified in previous paragraphs, this infrastructure allows the generation of KAI according to the type of accessibility problems detected, ordering and classifying different types of urban accessibility claims according to the classification of accessible points; inefficient accessibility points; automatic inaccessible points; self-reported points; self-reported inaccessible points; y self-reported inefficient points (Fig. 3).

Accessible points are those locations where accessibility policies have already been applied. These points are graphed in white bordered in blue. Inefficient accessibility points are those urban locations where applied accessibility policies are not working properly, these points are graphed in orange. Automatic inaccessible points are those urban locations not suitable for people with mobility problems, these points are graphed in red. Self-reported points are those locations reported by users, these claims are graphed in yellow. Self-reported inaccessible points are those urban locations not suitable for people with mobility problems reported by users, these points are graphed in white bordered in orange. Self-reported inefficient points are those urban locations where accessibility policies have already been applied but are not working properly and are detected by citizens. These points are graphed in white, bordered in red.

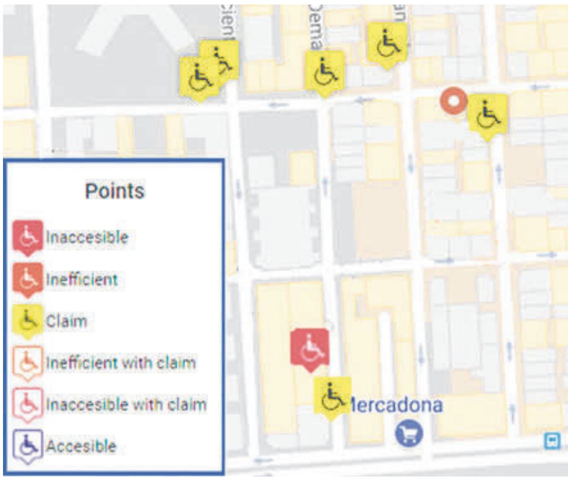

Fig. 3 Sample of KAI obtained. *Source* The authors

3 Sampling, Data Collection and Analysis of Case Studies Developed

After the development of the method, several validations have been carried out through different case studies that allow us to show a real diagnosis of urban accessibility including both the city itself and the public buildings integrated in the city. The research team started from a small stage limited to the campus of the University of Alicante (Alicante, Spain). The campus has a large area of 505,324 m^2 where three different case studies were carried out. Subsequently, the experiment was extended by extrapolating the study to the city of Alicante, specifically to the Benalúa neighbourhood.

All the areas where the four study cases were carried out are highlighted below (Fig. 4). On the left hand side are shown the case studies developed in the University of Alicante campus while on the right hand side it is highlighted the area where the case study 4 in Benalúa neighbourhood was carried out.

All the experiences developed in the campus of the University of Alicante (case studies 1, 2 and 3) allowed us to involve different groups of people with and without disabilities, from different groups that make use of the university in different ways. These collectives included administrative staff, teachers, and students. This diversity enriches the sample by bringing different perspectives to the research since behaviour patterns commonly diverge between university staff and students. It has provided different information not only about some buildings of the campus but also about their most common connections with other buildings and services that are part of the daily life of all participating groups, such as leisure areas, libraries and study rooms, sports areas, vehicle parking areas and public transport services.

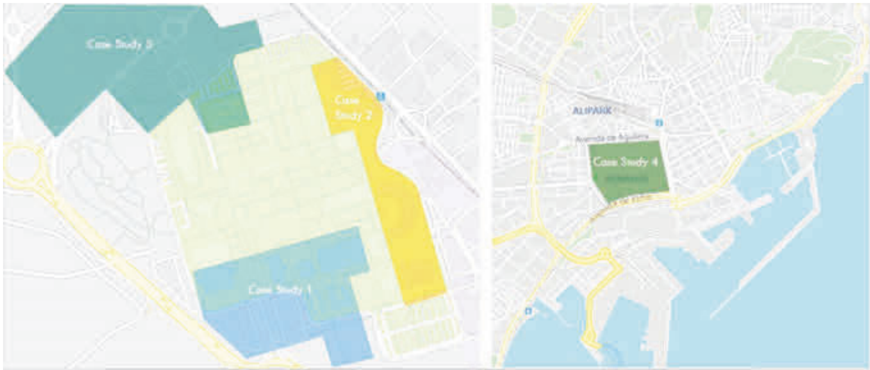

Fig. 4 Areas where the different case studies were carried out. *Source* The authors

4 Results and Discussion

The case studies development has allowed to map the points that prevent a complete social inclusion of students, teaching and research staff and administration and services staff of the University of Alicante. This information enables studying the relationship of people's movement patterns according to their degree of disability, determining, for example, if people with reduced mobility follow the same routes as people without disabilities, or if on the contrary they follow different routes when encountering obstacles such as stairs, ramps with excessive slopes, or any other obstacle that forces them to follow another route. All monitored routes on campus are shown below in Fig. 5.

The first experimentation (case study 1) (Pérez-Delhoyo et al., 2017) was carried out in the southwest area of the campus, and was carried out in both indoors and outdoors contexts. Specifically, the building identified as 0036 in the geographic information system of the University of Alicante (Figs. 5 and 6) was analysed. The Building 0036 is destined to classrooms and offices for campus management services, so it is usually used by all the diverse groups included in the study cases. The study was also extended to the immediate surroundings of the building, analysing the route from building 0036 to the UA Museum (hereinafter MUA) with code 0040, since it represents a relevant cultural area integrated into university social life. In addition, the route from Building 0040 to the leisure areas frequently enjoyed by both students, teachers and other university workers was analysed. These leisure areas identified as Building 0035 include restaurants, stationery store, bookshop, food store, post office and bank services. Finally, the analysis of the route to the nearest parking area was included. The last analysis of case study 1 started from the parking area following the user's route to the general library Building 0033. Both the interior scenes of Building 0036 and the exterior routes shown in the previous figure were validated through the UA Accessibility App, which allowed participants to report incidents and locate this claims via GPS using smartphones. The experience

Fig. 5 Routes followed in the case studies developed in the University of Alicante campus. *Source* The authors

Fig. 6 Sample of case study 1. *Source* The authors

identified claims inside Building 0036 related to lack of maintenance; barriers due to the placement of furniture; irregular flooring uncomfortable for wheelchair users; excess weight on several access doors that also have a manual opening systems; inaccessible information point due to the height of the counter or the absence of an adapted toilet on the ground floor. Experimentation from building 0036 to other relevant areas in university social life also showed other claims reported by the participants. These claims were related to insurmountable curbs, lack of sidewalks from the crosswalk to the space reserved for handicapped in parking, excess slope on various ramps, and sand shortcuts.

Fig. 7 Sample of case study 2. *Source* The authors

Some of these barriers require a process of construction work but others simply require the displacement and relocation of furniture, so the accessibility barrier could be solved immediately. From the point of view of city administrators, our proposal allows the implementation of a more participatory and inclusive accessibility management, in addition to a more effective and visible management offering fast solutions to specific problems that come quickly to society.

The second experimentation (case study 2) (Mora et al., 2017) was developed in the eastern area of the campus, specifically it started inside the Building 0039 shown in Figs. 5 and 7, and it was extended to the analysis of the most common exterior routes of students, teachers and university services staff. To carry out the evaluation in the indoor scenario, two RFID-based acquisition components were installed on the first floor of the building. This indoor experimentation enabled to detect deficiencies derived from the use of the building, specifically the use of the adapted toilet located in first floor. In addition, the experience developed in Building 0039 identified non-inclusive routes to access the basement where half of the building's classrooms are located. Most students follow the ramp to go down to basement level, but the ramp is too steep and all the participants with reduced mobility chose an alternative elevator route to avoid the ramp. The development of the experience allowed to give voice to all the users who live daily with this accessibility problem and the non-inclusive feeling. Once the accessibility claims inside the building were noticed, routes commonly used by all university groups on a normal day to other buildings continued. The UA Accessibility App was used along with RFID acquisition components that were placed at the entrances to the buildings. Some of the reported problems were inaccessible curb at the entrance of the Building 0014 and Building 0015, heavy door preventing access to Building 0030, a road with stones that prevents the use of wheelchairs, or sand shortcut to administrative services building that also prevents the use of wheelchairs. Likewise, different routes followed by people with and without reduced mobility were detected to reach an identical destination. These differences that impede social inclusion are materialize in a complete list of problems that will serve as a source of information to identify and prioritize actions. These detections allow the administration to become aware of routes that are comfortable for citizens that were not initially planned, and to transform those routes into both accessible and inclusive. Therefore, the identification of new user habits makes it easier for the Administration to adapt new routes and new uses that were not originally planned in the urban plans. In short, these solutions that are possible through the ICT allow to equip the urban planning of a greater flexibility incorporating the participation and the inclusion of all the citizens in the decision making. Therefore, the proposal supports one of the main current challenges of urban planning processes that require greater flexibility and greater inclusion of all citizens in their planning.

Finally, this case study also helped us to verify that the combination of GPS and RFID technologies allows the detection of situations in heterogeneous areas where not all acquisition alternatives are available.

Similarly, the third experience (case study 3) was developed in the north area of the university campus (Figs. 5 and 9). One of the main novelties was the identification of unforeseen citizens' behaviours, which allows to detect other unexpected consequences related to the conception of accessibility of the urban environment as a whole, beyond the individual components (buildings, facilities, parks) (Pérez-delHoyo et al., 2019). The case study developed allowed us to evaluate the operability of the Alicante University urban environment regarding the integration of recently constructed buildings in the new university expansion areas. Specifically, we analysed the new Building 0702 located outside the closed perimeter of the campus, separated from it by a public main road. Building 0702 was built in 2013, with an investment of approximately 20 million euros and an area of 20,000 square meters. The building interior presents a fully accessible design with ample spaces for manoeuvring, close and inclusive interior itineraries, comfortable elements such as motion detectors for automatic light, "push to open" doors systems in adapted toilets, as well as furniture fully adapted to the needs of the people with reduced mobility. It is undoubtedly one of the most accessible buildings on the University of Alicante campus. However, despite the large investment made, we detected after carrying out the case study 3 that the environment in which it operates minimizes the accessible nature of the building design. The uncomfortable and inaccessible outdoor environment reduces the degree of real social inclusion of the building, causing unexpected users behaviour at certain points and routes. Several inaccessible points were detected. These inaccessible points prevent students with mobility disabilities from having a full integration in university social life. Some of these claims have their origin in the use phase of the building. A clear example of this is the direct access to parking spaces exclusively for people with reduced mobility in Building 0702 (Fig. 8). This parking is located at the back of the building in a design intended as the shorter itinerary, but in the use phase of the building this access has been established as a fire exit so doors are blocked and therefore not accessible from the outside. As a consequence, the access to the building from that point translates into a much longer and different route than the one from the general parking of the building. Moreover, this alternative route is further uncomfortable considering the absence of shadows in a Mediterranean climate.

With this Integrated Accessibility Management System, it is also possible to detect unexpected functioning with respect to the expectations that were held when they were planned. Once these unexpected consequences are detected, the administration can improve and readjust the planning with a dynamic and real adaptation. The system allows making decisions based on the information provided by citizens and acting in two different moments of time, with the initial planning but also when the space is already in operation to reverse situations that have not met the initial expectations that had been marked with initial planning. It allows administrations to

Fig. 8 Unexpected barriers in the use phase of the building and its surroundings. *Source* The authors

Fig. 9 Sample of case study 3. *Source* The authors

warn if the planned expectations have been met and consequently vary or introduce elements so that those initial expectations can actually be met.

In addition, the building's connections with the usual university facilities have several inaccessible and uncomfortable points that prevent the full integration of students with reduced mobility. Some of them are long routes that end in inaccessible curbs with no access, which require a return to the starting point and a search for a different itinerary. The absence of information for people with reduced mobility was also observed on the information panels. The summary figure of case study 3 is shown above.

Finally, the experiment was transferred to the city of Alicante (Spain) (Pérez-delHoyo et al., 2018), specifically to the Benalúa neighbourhood (Figs. 2 and 11), with the aim of determining the degree of social inclusion in the neighbourhood. The Benalúa neighbourhood is a residential area located one kilometre from the Alicante town centre. In relation to the facilities, the neighbourhood hosts many public services and facilities that serve the entire city of Alicante as the national police, courts or water service. As Fig. 10 shows, the case study focused on the path to all these public services and other routes from its most significant square to carry out daily activities in a normal day in the neighbourhood, such as go out for a drink, go shopping, or withdrawing money from banks.

The case study began in the central square which was crossed over to the nearest bank branch, and then continued to the Alicante courts. Then, a second route continued from that point to the supermarket with the largest influx of people in the area. Finally, the itinerary continued to some municipal services, specifically the water service and the municipal police building. During the route, inaccessible points were identified among the different connections in the neighbourhood, all the information was saved by the Urban Accessibility Information Service and KAIs were categorized.

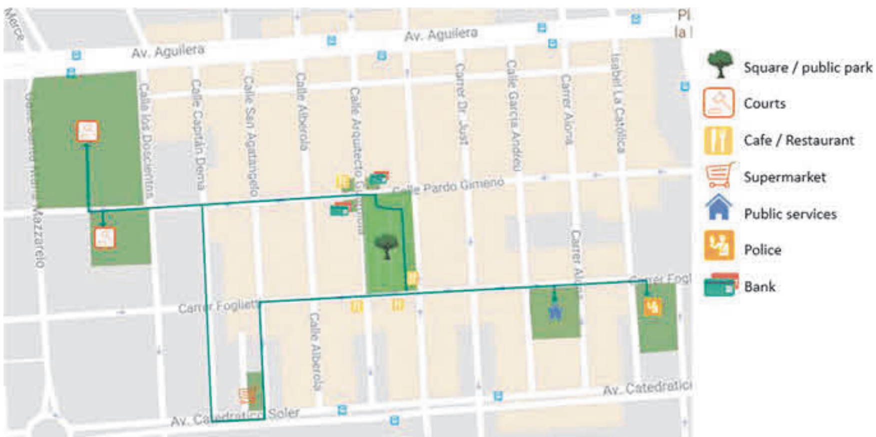

Fig. 10 Routes followed in case study 4 developed in Benalúa neighbourhood. *Source* The authors

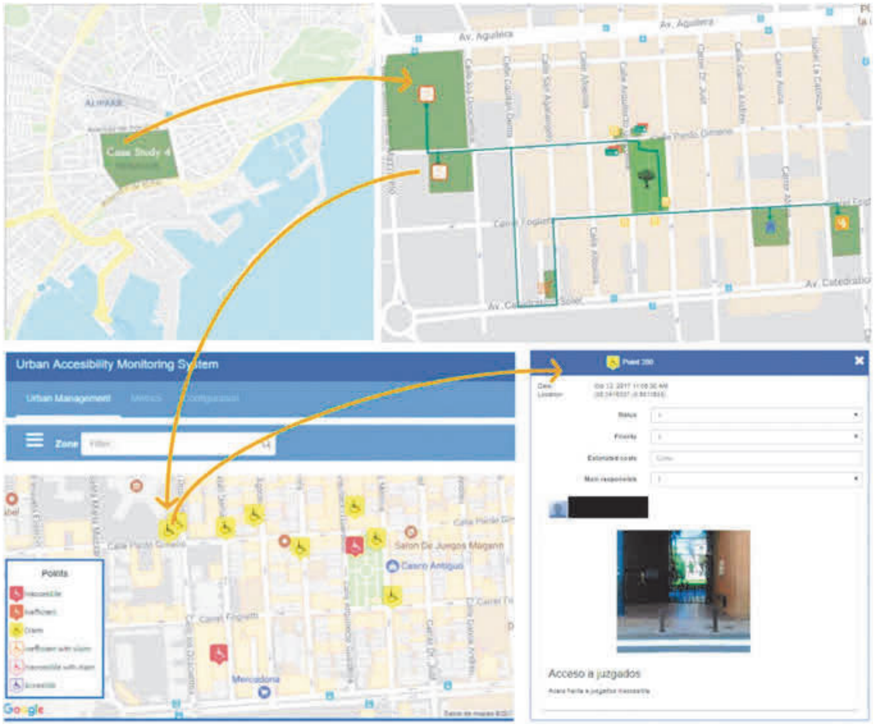

Fig. 11 Sample of case study 4. *Source* The authors

5 Implication

The current development and maintenance of cities requires urban policy makers and planners with an understanding of social implications to created inclusive urban environments. In terms of city management and policy-making, strategic solutions are needed to integrate the humanization of cities and efficient decision-making. Managing the challenges of urban growth and planning in today’s society requires new approaches capable of detecting the needs of citizens, to obtain an updated knowledge of problems and priorities. The present proposal will allow the managers involved to deal with real life issues, allowing to approach tangible objectives that will have a direct visibility in the society. This rapid detection-action requires integration of citizen participation that facilitates real data collection and ICT deployment not only for the analysis of the urban user’s experience but also to ensure a fast and reliable communication channel between citizens and city administrators. Furthermore, the proposal supports one of the main current challenges of urban planning processes in terms of flexibility for the dynamic re-adaptation of urban planning in changing situations throughout its use and greater citizen inclusion.

6 Conclusions

This research has allowed us to validate the benefits of the synergy of the use of new technologies and the information provided by citizens themselves, which allows to meet the real needs of people with movement disabilities in a dynamic way. The experimentation carried out to validate the proposed methodology included four case studies in different locations, three of them were carried out in different backgrounds at the University of Alicante, and the last sample was extended to a fourth case study to identify the degree of inclusion in one of the neighbourhoods of the city of Alicante.

The experiments carried out on the university campus analysed the daily journeys of the students, teachers and university services staff through the campus (outdoor routes) and their movements inside the buildings (indoor). Numerous inaccessible points were detected both inside the buildings and on the exterior routes to other buildings and areas of the campus, which are relevant for integration into university social life. In addition to the Accessibility App, some on-campus case studies incorporated RFID-based acquisition components located inside buildings. In this sense, experimentation has allowed obtaining information on the needs, habits and preferences of students, teachers and university services staff. It has also facilitated the identification of non-inclusive routes, verifying user integration as a fundamental active element and positioning the urban accessibility monitoring system as an effective channel for giving voice to people with and without disabilities.

The extrapolation of the experimentation to the urban environment of the Benalúa neighbourhood in the city of Alicante has allowed us to identify the degree of inclusion of the area. Furthermore, it has allowed us to ensure the effectiveness of citizen participation and to verify how, through technology, the citizen is positioned as a starting point in the cyclical process to achieve Smart cities, with the capacity to respond to the needs of their community. This direct information of the citizen carried out through the ICT deployment allows us both to know the information related to existing incidents in terms of accessibility, and its monitoring over time. Therefore, this research contributes to the creation of a continuous communication channel between citizens and public administrations, promoting not only social inclusion but also a sense of identity and belonging to the neighbourhood. This feeling generates a greater interest of citizens in the problems of their city that will improve both social cohesion and the quality of life of the citizen in general.

References

Alfaro Navarro, J. L., López Ruiz, V. R., & Nevado Peña, D. (2017). The effect of ICT use and capability on knowledge-based cities. *Cities*, *60,* 272–280. https://doi.org/10.1016/j.cities.2016.09.010

Chourabi, H., Nam, T., Walker, S., Gil-Garcia, J. R., Mellouli, S., Nahon, K., Pardo, T. A., & Scholl, H. J. (2012). Understanding smart cities: An integrative framework. In *45th Hawaii International Conference on System Sciences, Maui, HI* (pp. 2289–2297).

Colantonio, A., & Dixon, T. (2011). *Urban regeneration and social sustainability: Best practice from European cities*. Wiley.

Dameri, R. P. (2017). *Smart city implementation: Creating economic and public value in innovative urban systems*. Springer.

Del Hoyo, R. P., & Lees, M. (2018). Redefining the smart city concept: the importance of humanizing 'intelligent' cities. In E. U. P. de València (Ed.), *24th ISUF International Conference Book of Papers* (pp. 865–872). https://doi.org/10.4995/isuf2017.2017.5982

European Commission. (n.d.). *Market place of the European innovation partnership on smart cities and communities*. Retrieved June 10, 2017, from https://eu-smartcities.eu/

European Commission. (2010). *Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions. European Disability Strategy 2010–2020: A Renewed Commitment to a Barrier-Free Europe*. Retrieved June 11, 2017, from http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52010DC0636&from=ES

Glasmeier, A., & Christopherson, S. (2015). Thinking about smart cities. *Cambridge Journal of Regions, Economy and Society*, *8*(1), 3–12. https://doi.org/10.1093/cjres/rsu034

Lytras, M. D., & Visvizi, A. (2020). Information management as a dual-purpose process in the smart city: Collecting, managing and utilizing information. *International Journal of Information Management*. https://doi.org/10.1016/j.ijinfomgt.2020.102224

Lytras, M. D., Visvizi, A., Chopdar, P. K., Sarirete, A., & Alhalabi, W. (2020). Information management in smart cities: Turning end users' views into multi-item scale development, validation, and policy-making recommendations. *International Journal of Information Management*. https://doi.org/10.1016/j.ijinfomgt.2020.102146

Mora, H., Gilart-Iglesias, V., Pérez-Del Hoyo, R., & Andújar-Montoya, M. D. (2017). A comprehensive system for monitoring urban accessibility in smart cities. *Sensors (Switzerland)*, *17*(8). https://doi.org/10.3390/s17081834

Mora, H., Gilart-Iglesias, V., Pérez-Delhoyo, R., Andujar-Montoya, M. D., & Compañ Gabucio, H. J. (2016). Interactive cloud system for the analysis of accessibility in smart cities. *International Journal of Design and Nature and Ecodynamics*, *11*(3). https://doi.org/10.2495/DNE-V11-N3-447-458

Neirotti, P., De Marco, A., Cagliano, A. C., Mangano, G., & Scorrano, F. (2014). Current trends in smart city initiatives: Some stylised facts. *Cities*, *38*, 25–36. https://doi.org/10.1016/j.cities.2013.12.010

Pearce, J. (2010). *Participation and democracy in the twenty-first century city*. Springer.

Pérez-Delhoyo, R., Andújar-Montoya, M. D., Mora, H., & Gilart-Iglesias, V. (2017). Urban and building accessibility diagnosis using 'accessibility app' in smart cities a case study. In *SMARTGREENS 2017—Proceedings of the 6th International Conference on Smart Cities and Green ICT Systems*.

Pérez-delHoyo, R., Andújar-Montoya, M. D., Mora, H., & Gilart-Iglesias, V. (2018). Citizen participation in urban planning-management processes assessing urban accessibility in smart cities. In *SMARTGREENS 2018—Proceedings of the 7th International Conference on Smart Cities and Green ICT Systems* (Vol. 2018-March).

Pérez-delHoyo, R., Andújar-Montoya, M. D., Mora, H., & Gilart-Iglesias, V. (2019). Unexpected consequences in the operation of urban environments. *Kybernetes*, *48*(2). https://doi.org/10.1108/K-02-2018-0096

Rathore, M. M., Paul, A., Ahmad, A., & Jeon, G. (2017). IoT-based big data: From smart city towards next generation super city planning. *International Journal on Semantic Web and Information Systems (IJSWIS)*, *13*(1), 28–47. https://doi.org/10.4018/IJSWIS.2017010103

Rudnick, S. K. K. (1980). *Problem solving in school mathematics. MEPS Technical Report 84.01* (National c). Year Book.

United Nations. (2006). *Convention on the rights of persons with disabilities*. Resolution 61/106.

Uribe-Pérez, N., Hernández, L., de la Vega, D., & Angulo, I. (2016). State of the art and trends review of smart metering in electricity grids. *Applied Sciences*, *6*(3), 1–24. https://doi.org/10.3390/app6030068

Visvizi, A., Mazzucelli, C. G., & Lytras, M. (2017). Irregular migratory flows: Towards an ICTs' enabled integrated framework for resilient urban systems. *Journal of Science and Technology Policy Management*, *8*(2), 227–242. https://doi.org/10.1108/JSTPM-05-2017-0020

Yigitcanlar, T., & Han, J. H. (2010). Ubiquitous eco cities: Telecommunication infrastructure, technology convergence and urban management. *International Journal of Advanced Pervasive and Ubiquitous Computing 2*, 1–17.

Raquel Pérez-delHoyo, Ph.D., Associate Professor, University of Alicante, Alicante, Spain. Her research interest include urban planning, smart cities, and inclusive cities.

María Dolores Andújar-Montoya, Ph.D., Associate Professor, University of Alicante, Alicante, Spain. Her research interests include the built environment in connection to design and accessibility.

Higinio Mora, Ph.D., Professor, University of Alicante, Alicante, Spain. His research interests include blockchain, smart contracts, smart cities, internet of things and cloud computing architectures.

Virgilio Gilart-Iglesias, Ph.D., Associate Professor, University of Alicante, Alicante, Spain. His research interest include process automation, distributed systems, smart cities, internet of things and cloud computing architectures.

Rafael Mollá-Sirvent, Adjunct Professor, University of Alicante, Alicante, Spain. His research interests include mobile applications, cloud computing and internet of things.