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IoT Technologies and Applications in Tourism and Travel Industries

M. Dolores Ordóñez[1], Andrea Gómez[2], Maurici Ruiz[3],
Juan Manuel Ortells[1], Hanna Niemi-Hugaerts[4], Carlos Juiz[3],
Antonio Jara[2] and Tayrne Alexandra Butler[1]

[1]AnySolution, Spain
[2]HOPU, Spain
[3]University of the Balearic Islands, Spain
[4]Forum Virium, Finland

Abstract

Tourism is one of the most dynamic industries in the world, but it has also an industry to be greatly and directly affected by the 4th revolution, as can be evidenced by the impact of the internet in the evolution of this industry. Disruptive technologies, including IoT play a crucial role in the way of understanding and managing this industry and especially in how the offer and demand are linked. The great diversity of IoT applications in the tourism industry defines the competitiveness not only of the private companies involved but also of the destinations which are being transformed into Smart Destinations as a natural evolution from Smart Cities, which are influenced by the tourism sector. Smart Cities are characterised by smartly managing different areas. Smart Destinations require this smart management as well as the integration of the stakeholders' value-chain throughout the entire process. In this process, IoT has a crucial role in enhancing the experiences of tourists, to more efficiently manage the destination, and to offer a channel of information exchange. As a result, a more efficient destination, with better and more personalised experiences will improve the competitiveness of the tourism destination and of the quality of life of its citizens.

8.1 Introduction

Europe is one of the world's leaders when it comes to tourism, welcoming 713 million tourists in 2018 [1]. Europe's top position in worldwide tourism can be maintained and enhanced by using new technologies such as IoT and artificial intelligence to automate different processes in the industry according to the needs of a new kind of visitor. The visitor's profile needs to include capabilities that manage tourist experiences by use of Smartphones, including transport, tour guides, bookings and information in real-time. Companies in the tourism sector also need to use this technology to better understand the needs of the visitor, as a channel to discover and recover data to build future smart strategies for the tourism industry's entire value chain. A consequence of the industry's globalisation is the emergence of new tourism destinations, and an extraordinarily high level of development in tourism activity, especially in urban environments, a clear example being European capitals. This rise in the number of people visiting different tourism destinations and cities, together with the increasing importance of sustainability in the management of tourism destinations and urban areas, has generated the pressing need for new technological developments that can help to make destination and city management more efficient and productive.

New disruptive technologies, such as IoT, artificial intelligence, and distributed ledger technologies (DLTs), are crucial to achieving more efficiency and productivity in Tourism and Travel Industries. The ability to collect data from different types of sources and transport it to platforms, where it is then analysed and used to improve decision-making processes thanks to Big Data, is the first step to highlighting the importance of IoT in Smart Cities. To a high extent, this has been automatically transferred to tourism destinations, therefore generating what we call Smart Destinations. Here it is essential to point out that Smart Destinations are no more than Smart Cities but with an extra layer of complexity when it comes to management, which is simply tourism activity. So, all Smart City applications using IoT and other technologies are directly applicable in Smart Destinations. Beyond this, the fact that tourism activities are carried out in Smart Cities increases the need for disruptive technologies and places people even more at the centre. And, if Smart Cities intend to improve the quality of life of its citizens, Smart Destinations aim to improve the quality of life of every single person living or spending time in a tourism destination.

This entire process would not be complete without mentioning the importance of transforming tourists themselves into digital tourists. These tourists have changed their travel habits, and now stay in places for shorter periods, but travel more frequently and use mobile devices, especially Smartphones

during almost every stage of their trip (before/preparation – during/stay over – after/memories). These tourists who are and want to be permanently connected, generate and consume data during the entire life cycle of their trip, and they also require a whole range of different digital services to help make their experience better.

The personalisation of experiences is another issue where IoT has a key role, and this also has a direct consequence on the competitiveness level of the different destinations.

The changes generated by the tourism industry's new trends, together with the tourists' new needs and requirements and the demand for tourism destinations to continue being competitive, have been the basis for the concept of 'Smart Tourism Destinations' emerging in Spain [2].

This concept is supported by the Smart Tourism Destinations (STD) UNE 178501 standard that promotes standardisation by establishing governance, accessibility, sustainability, innovation, and technology as the fundamental pillars for a destination to be considered *Smart*. Therefore, a STD or Smart Destination is not a tourism destination that only sets up digital infrastructures capable of improving interaction with digital tourists, but a destination where the final goal is to make the territory itself Smart by promoting sustainable and efficient management together with economic development to therefore improve the quality of life of every person living/staying/visiting the tourism destination.

In the EU and without having regulations in this sense, the European Commission has launched the European Capital of Smart Tourism initiative [3] that recognises the achievements of cities as tourism destinations in 4 areas: sustainability, accessibility, digitalisation, and cultural heritage and creativity.

Some of the most relevant definitions of *Smart Destination* are:

- UNE 178501 Standard for STDs "An innovative area for tourism, accessible to everybody, consolidated on the basis of cutting-edge technological infrastructure that guarantees the sustainable development of a specific territory, facilitates the interaction and integration of visitors with their surroundings and increases the quality of their experience while in the tourism destination, as well as the quality of life of the people living in the area.
- Organisations such as SEGITTUR defined the concept of Smart Tourism Destination as [4]: "A Smart Tourism Destination is an innovative tourism destination, consolidated and based on cutting-edge technological infrastructure and the tourism territory itself. An area highly committed to environmental sustainability, culture and socio-economic

progress, provided with a smart system that collects information in a procedural way, analyses, and understands events in real-time, making it easier for visitors to interact with their surroundings and for managers to make decisions, increasing their efficiency and substantially improving the quality of the experience".

8.2 IoT Technologies and the Tourism Sector

The tourism industry consists of multiple stakeholders and impacts global economy. Customer experience and personalised travel in the tourism industry are at the top of the list when it comes to IoT improvements for the industry. This is only possible if local infrastructure allows for the deployment of devices that provide information and the necessary data to make decisions in real-time, as well as information that helps to carry out simulations for the prediction of future scenarios. It is therefore essential for tourism destinations to implement comprehensive information collection, analysis, and distribution systems among all of the actors included in the tourism destination's value chain, thereby facilitating the decision-making process for each of them, in real-time.

According to Antonio López de Ávila, former president of SEGITTUR: "Intending to become a Smart Destination means that the tourism destination will need to implement a strategy that will increase its value by using innovation and technology. This process will help to increase competitiveness, not only because tourism resources will be used better but also because other resources will be identified and created; improving efficiency in marketing and production processes; and using renewable energy sources. Everything
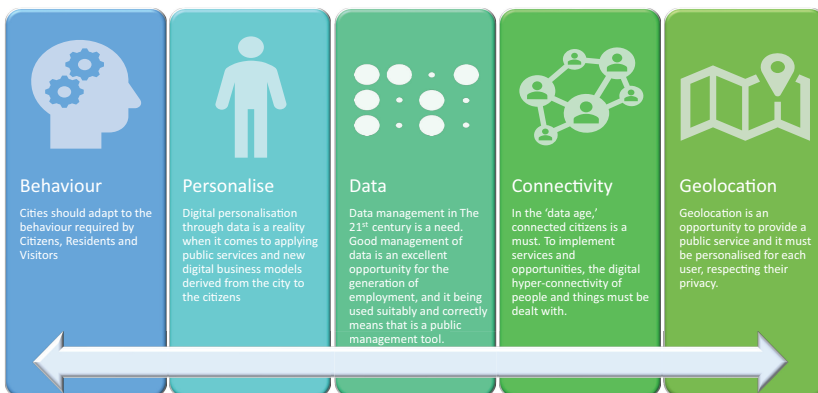

Figure 8.1 Personalisation of services in Smart Tourism Destinations.

must be focused on boosting sustainable development in tourism destina-tions based on three aspects (environmental, economic, and socio-cultural elements), and subsequently, by improving the quality of the visitors' stay and the quality of life of its residents. In this way and in the short-term, the marketing and production processes will improve and be more effi-cient, employment and tax revenues will rise, and most importantly, overall satisfaction levels will also see a clear improvement" [4].

One of the most critical aspects of using IoT in tourism is the ability to personalise what's on offer based on the information collected and obtained from the tourists' connectivity itself.

The fact of knowing what tourists like and don't like will help to person-alise what is offered to them, by sending them 'custom-made' information and therefore fulfiling their expectations, and subsequently making them loyal customers. If we know one of our clients likes vegan food, we can send them information about culinary workshops they can go to or restaurants specialised in this kind of food. In fact, if he/she were walking near to one of these restaurants and we knew they liked eating at a particular time, we could send them an alarm telling them what restaurants are in the area, help them to book a table and tell them how to get there; and all of this without realising it, but thanks to IoT.

The range of applications of IoT technologies in SDs is extensive, and every day it is enriched with new devices and functionalities. Table 8.1 shows the primary sensors that would be applicable.

Table 8.1   Types of sensors and applications in the frame of IoT and tourism

Type of Sensor	Objectives	Applications
Temperature	Measure the amount of thermic energy	Cooling system control. Applications: manufacturing processes, production of agricultural systems
Proximity	Identify the presence or absence of nearby objects. They can also identify the object's properties	Presence control. Applications: Movement of people, the presence of tourists, alarm system, and safety. Online information on offers for tourists. Available parking spaces
Pressure	Identify pressure and changes.	Maintenance of water and heating systems
Water quality	Identify water quality and monitor ions (chlorine, organic carbon, pH, etc.)	Controls water distribution systems Quality of water for swimming

(*Continued*)

Table 8.1   Continued

Type of Sensor	Objectives	Applications
Chemical/Gas	Identify changes in chemical composition in liquids and in the air	Environmental monitoring, contamination control (CO_2, CO, O_3, O_2, NO_2, NO_3, particles, etc. Safety and security systems
Smoke	Smoke detectors	Safety and security systems from fires
IR	Infrared sensor that identifies environmental characteristics	Health care (blood flow and arterial pressure, etc.)
Level sensors	Determine the level of the amount of fluid, liquid flowing in an open or closed system	Water deposit, fuel levels
Image sensors	Take pictures and videos	Safety. Car, medical . . . images
Movement sensors	Detect physical movement in a certain area	Safety. Intruders, tolls, manual driers, lights, Air conditioning, parking, fans
Accelerometer sensors	Measure the physical acceleration of objects. They detect vibrations, inclination, and acceleration	Anti-theft systems. Sports monitoring
Gyroscope sensors	Measure the angular speed Velocity around an axis	Car, drones . . . navigation
Humidity sensors	Very similar to temperature sensors	Air conditioning control. Hospitals and pharmaceutical industries
Optic sensors	Number of rays of light and electromagnetic energy	Electric energy control. Environmental and energy control
Positioning sensors	Provide geographical coordinates to position objects	

8.2.1 IoT Applications in the Tourism Sector

Some of the most important IoT examples in the travel industry are the following:

Personal Control

One of the most widespread uses of IoT technology within the travel industry so far, has been the possibility of enabling a higher degree of personalisation in hotels, and on flights, and this is primarily achieved by allowing customers to control more appliances or services through a centralised device, such as a tablet or even their own Smartphone.

By implementing internet-enabled heating, lighting, and television, customers can turn these appliances on or off from wherever they are. They may

even be able to choose a specific temperature and light level and have the devices maintain those levels automatically. Similar technology can also be used on flights, regulating seat temperatures and air conditioning.

Seamless Travel

Another excellent use for IoT involves streamlining customers' experiences as much as possible, across all areas of the travel industry. In airports, this may mean using sensors and sending information to passengers' Smartphones, warning them when their luggage is nearby, and allowing them to locate it faster.

In hotels, the check-in process can be made seamless, with hotels sending electronic key cards to guests' phones, which, when used, automatically check them in without them even having to stop at the front desk. Sensors may also be used to warn restaurant staff when guests arrive, and automatically send them the right table number.

Smart Energy Saving

While IoT can enable personalisation, it can also offer businesses financial benefits through automated or smart energy saving. In a hotel, for instance, internet-enabled devices and sensors can allow for the room temperature to be adjusted continually, meaning heating is only used when it is really needed.

A similar principle can also apply to lighting. Some hotels already use IoT technology to control when lights are turned on and off. Sensors automatically detect the levels of natural light in the room, reducing the power of light bulbs in the process, meaning less energy is wasted, and high-powered lighting is only used when natural light is not enough.

Location Information

Companies working in the travel industry can also use the Internet of Things to send location-specific information to customers and to also gather other valuable data. By combining Smartphone capabilities with beacon technology or other sensors, messages can be sent to tourists when most relevant and based on where they are.

For instance, messages about local attractions could be sent with information on the times when they are least busy, or messages pointing out nearby public transport services could also be sent, as well as messages and alarms depending on when people are using specific hotel facilities at different times so that the amount of staff needed is adjusted.

Maintenance and Repairs

Finally, the Internet of Things can also be used to directly benefit IoT devices by providing valuable, real-time information about their current status and working order. This can be vital for many of those working in the travel and tourism industry, allowing for essential devices to be repaired or replaced before they stop functioning.

For example, hotel staff can be warned if a radiator or light bulb starts to deteriorate. As well as in hotels, the Internet of Things can also be deployed to allow airlines to fuel airplanes more efficiently or replace parts at the right time, striking the ideal balance between gaining maximum value and maintaining safety.

Ultimately, IoT involves adding internet connectivity to everyday devices and appliances, allowing them to communicate with one another, and this offers numerous benefits for those working in the travel industry, including the ability to deliver a greater customer experience and to optimise internal procedures.

8.2.2 User/Tourist Experience

As a context of Smart Tourism Destination, it is essential to understand the role of Smart Cities as a domain where cities seek to build sustainable and smart strategies for city growth, taking into consideration its people, institutions, and finally, the technology. Because of the relevance of the tourism economic activity, the sector also needs to use smart strategies and the technological infrastructures of Smart Cities, having given rise to the Smart Tourism Destination as a new domain of research, solutions, and tools [5].

In the domain of Smart Tourism Destinations, technology could be used in different sectors depending on the aspects it covers. Smart Tourism brings together all of the tools and deployments to interact with the physical environment as tourist guides, Virtual Reality (VR) and Augmented Reality (AR), among others. On the other hand, the e-tourism cluster joins technological enablers that can be used prior to, during, and after a visit/trip as a planning tool (booking of hotels, restaurants, etc.) [6].

The impact that Smartphones have on people's lives, being a device used for everything to do with our daily lives, has led to the emergence of what is called mobile tourism. This concept summarises the current situation of tourism, where visitors do everything with their Smartphones, for example making reservations and getting information on places related to the heritage sites visited [7].

Under this new approach in the tourism sector, which places ICTs as a critical element, the use of Smartphones has become the main point of analysis in companies, it is the point of contact between visitors and the Smart Tourism Destination. Hence, the needs and preferences of users who visit a certain area can be known, and therefore supply can be adapted to demand [8–10].

As another important aspect in the new visitor profile, in addition to the use of technology, it should be noted that with the active incorporation of the Millennial, Z and hashtag generation to the tourism sector as clients, destinations must start to offer personalised and exclusive experiences, forgetting about "tourist packages" as such that are currently marketed by travel agencies. This generation, that have the need to visit new places, want to go to places where they feel like they are at home (short time citizens) and where they will be able to live once-in-a-lifetime experiences [10].

8.2.3 Disruptive Technologies in Smart Tourism Destinations

ICTs have opened up a multitude of markets in all sectors. Cities and tourism destinations, as already mentioned, have also been affected, and currently, managers and institutions require technological solutions that generate the sustainable strategies that cities need.

Although ICTs are one of the great stars of this new market (Smart Cities & Smart Tourism Destinations), the authors in [11] stress that all deployments and technological infrastructures used must be based on the needs of people and institutions.

The technological pillar of Smart Cities and Smart Tourism Destinations could be summarised into three types of technologies: IoT that refers to the connection between objects and humans, Big Data, as structured and non- structured data, generated by IoT infrastructure and other processes and Smart Cities Platforms that manage the Big Data and IoT in cities [12, 13].

The IoT concept was born in 1999 in the Technological Institute of Massachusetts (MIT) by the hand of Kevin Ashton and referred to the situation that was beginning to be seen with respect to the number of objects and people that were already connected to the network [12].

The work of Pathak defines, in this concept, four points to understand it: a device that connects objects to the Internet, wireless networks, data collected in the cloud and capacity for analysis of this data, also seen as a key feature: The bi-directionality of the information, that is to say, the possibility of establishing communication with an object that is connected and
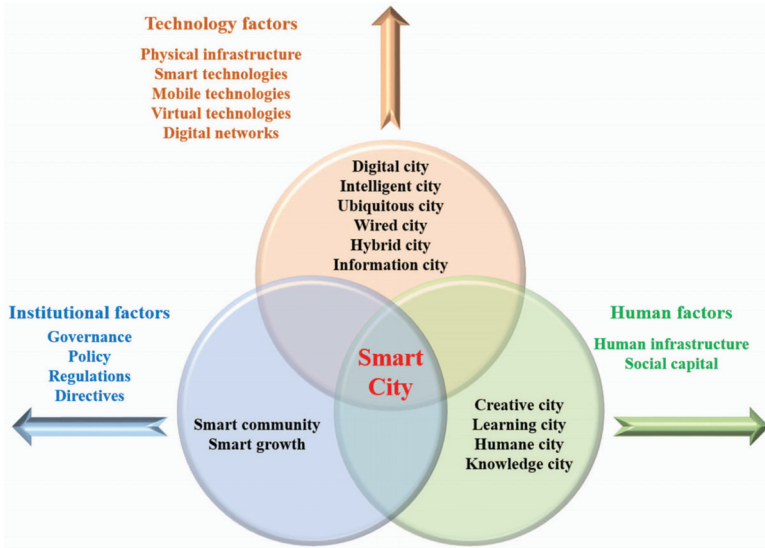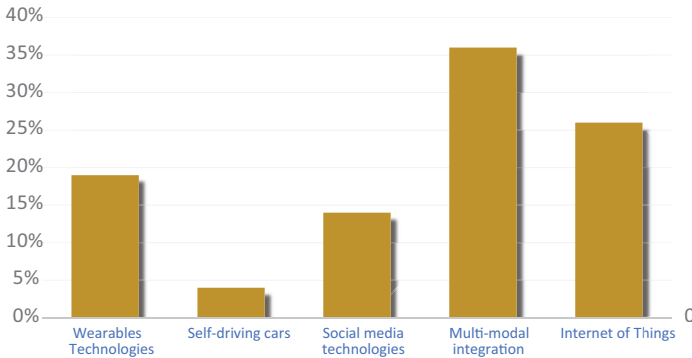
Figure 8.2   The main pillars of a Smart City.

Multi-modal integration will drive further disruption

Question #5: Which of these technologies will cause the most disruption to the industry?

762 responders

Figure 8.3   Disruptive technologies in tourism.
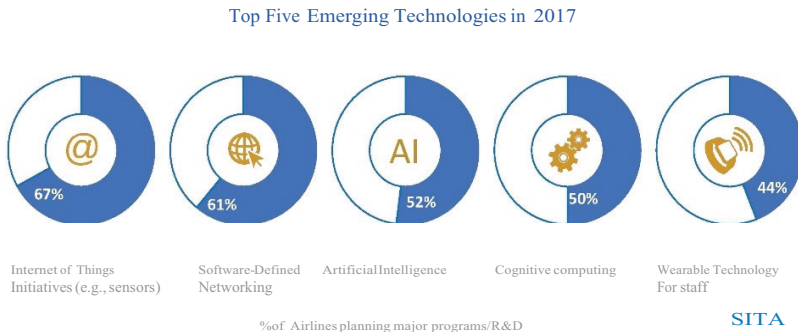
Top Five Emerging Technologies in 2017

Figure 8.4   Top five emerging technologies in 2017.

to receive an answer. One could conclude that the definition of the concept such as the conversion of the things or traditional objects into intelligent ones: Smart [12, 14].

IoT [15] has the potential to have a significant impact on businesses, automating processes without any human-to-computer or human-to-human interaction. Based on the sheer volume of adoption and the ability to offer advanced interconnection and communication among devices, systems, and services, the Internet of Things is expected to disrupt the travel industry. According to SITA 2015 Airline IT Trends Survey, 86% of all airline companies believe that IoT will provide "clear benefits over the next three years." IoT is streamlining the end operations of hotels, airlines, and other travel companies by connecting smart devices, systems, and processes. By taking advantage of IoT technology, the travel industry can implement increased operational efficiency and more personalised guest experiences.

8.3 IoT Applications for the Tourism Value Chain

8.3.1 IoT and Hotels

As stated in an article by Dr. Ajay Aluri West Virginia University, "The IoT platform is the answer to scientific management in the digital life – a "shortcut" to get things done efficiently and effectively for both consumers and businesses" [16]. The boom in IoT Technology will boost the future of the hospitality industry; it will provide a competitive edge in the market and through the interconnection of devices, (sensors, actuators, identification tags, mobile, etc.) through the internet. IoT is no longer just a concept, it is very

much a part of the industry and statistics are growing because IoT enables processes, data, and outcomes [17].

An example of a real use case is NADIA and its applications for the tourism sector. The introduction of IoT in the field of new technologies has not gone unnoticed in the tourism sector, which has probably been the sector to have most benefited from the age of digitisation. However, there are still very few specific IoT applications in this sector.

NADIA was launched in 2017 with the idea of exhibiting the great potential IoT has in the tourism sector. An example of this is '*Hotel Room' by NADIA*. by installing different types of sensors in hotel rooms, this platform helps to monitor the use of the sensors at all times.

It may seem that this is just another simple *Domotics* project, but NADIA's great potential is based on two aspects:

On the one hand, **hotel customers** who can use an App or a browser to set the temperature in their hotel rooms, turn on the television, chose the colour of the LED lights, etc. Allowing them to customise their room and enjoy a unique experience.

On the other hand, **hotel management**, this is a powerful tool to remotely control facilities by turning off lights or air conditioning systems . . . in empty rooms.

Figure 8.5   Hotel Room by NADIA.

Figure 8.6 Sensors and IoT devices used for environmental monitoring in hotels.

But, NADIA's real potential comes from its excellent analysis capacity. For the first time, hotel managers will be able to know how long customers are in their rooms for, their schedules, what they like, etc. From here on, the options available are endless and go from identifying things customers are unsatisfied with before they even happen, adapting the times for cleaning their rooms, or fixing something; identifying things that are not working properly, blown bulbs, cooling systems . . . ; planning times to enter the rooms and fixing things, knowing that the room is empty. If to all of these new features, we add the possibility of making the system smart, we are taking a giant step towards the optimisation of energy consumption without having to affect the comfort and well-being of guests.

8.3.2 IoT and Airports

Airports are the main points of entry for tourism destinations, and they are places where IoT has more direct applications, in the buildings themselves, to improve efficiency and generate savings as well as in relation to users, gaining information, improving services, and personalising supply. But it is also important to remember that airports are hubs that connect the whole world, and this has direct implications related to safety and security.

The authors in [17] state that "Airport council international ACI confirms the potential of IoT in airports and the aviation industry through the operational improvements and data exchange among the stakeholders.

Moreover, the data sharing among the collaborative stakeholders will enable them to make better decisions leading to better customer service at passenger screenings, checkpoint management, and identity management by real-time processing in the lanes and to the border and security agencies. Technology is creating new opportunities at a low cost for the air transport industry and it is ready to transform many novel techniques such as improved connectivity to airplanes and baggage tracking etc. available globally and also easy to deploy.

8.3.3 IoT and Tourist Attractions

In Smart Tourism Destinations, it is important to include a smart structure that allows interaction among visitors and sectors that make it up, as an innovation that opens the frontiers to a greater diversity of the public, as well as institutions and companies that market them [18].

Analysing Smart Tourism Destinations, the perception of visitors must be taken into account in the same way as in Smart Cities. People a primary key pillar. According to relevant authors in this field, we must approach the tourism destination as a brand, including the destination's companies and offers. Everything must be presented as a global, agile and unified experience for visitors, facilitating their interaction with it [12, 19].

The visit to a destination should be understood as a way to obtain new experiences. Visitors seek to consume a product that can be considered as emotional. Therefore, in the case of Smart Tourism Destinations, technology must contribute to an immersion where visitors get information and interact with the environment as part of the network.

Another critical factor is that visitors seek a fluid experience where all the information they need during their stay is easily accessible (such as obtaining information, reservations, purchases, etc.). When the user enjoys a territory the rupture that the lack of access to information could cause the rupture of that immersion, decreasing their sense of satisfaction [20].

For this reason, technologies such as IoT, that allow for the creation of contextualised experiences in Smart Tourism Destinations and which interact with the users' Smartphones, enable the generation of products and services that adapt better to this new visitor profile.

Among the new tools that use IoT in Smart Tourism Destinations, one to underline is the *Be Memories* project, an innovative tourist guide that disseminates the intangible heritage of a destination with the use of IoT and through the collaboration of the residents as content creators. This solution has been deployed in Ceutí (Spain) and Bristol (United Kingdom). *Be Memories* is based on two lines of innovation [10]:

- An Agile channel to interact (IoT): Due to devices called Smart Spots, which create an open Wi-Fi network in different cultural points and tourist attractions of the city, *Be Memories* generates smart areas known as Smart POIs (Smart points of interaction). Visitors can interact with *Be Memories* using their Smartphones. This Wi-Fi network automatically opens a Web-App stored in the device with the cultural content about the area.
- Intangible heritage content for visitors making them feel like short term citizens: *Be Memories* disseminates the widespread knowledge of residents (trailer of the Be Memories content: https://bememories.hopu.eu/#/main), integrating visitors into the city's network. Also, the content is presented in a short video with interviews that visitors and residents can watch and listen to while visiting the different POIs in the cities where these are enabled.

TreSight is another relevant project that uses IoT for Smart Tourism. It has been set up in the cosmopolitan city of Trento (Italy), and it uses IoT technologies to contribute to the immersion of visitors in the experience. The purpose of this solution is to alternate the innovation in the field of tourism with the cultural charm typical of the area, taking care of their cultural heritage. It consists of a tool that alternates the offer of services in the area,

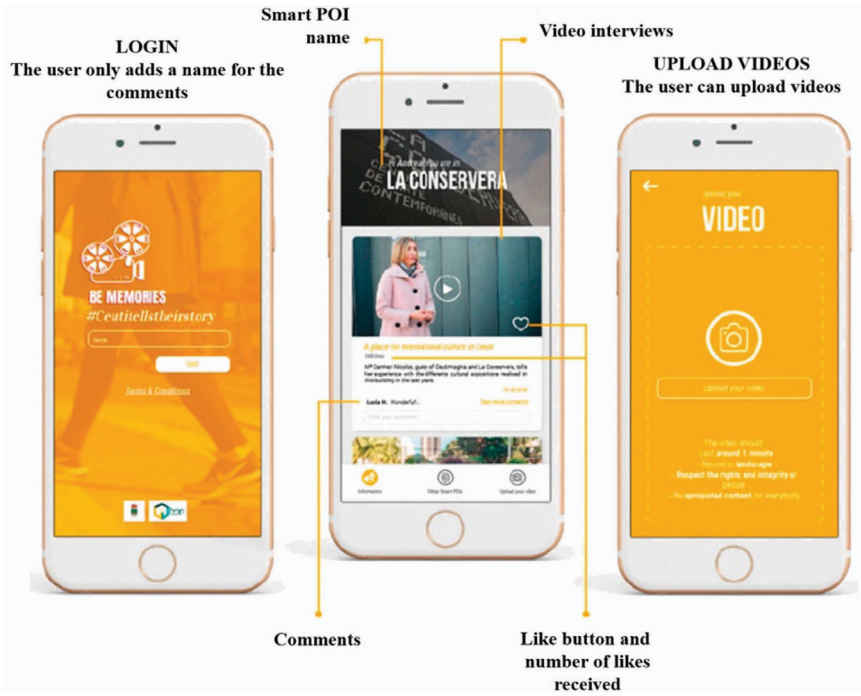**Figure 8.7**   Smart POI of Be Memories project.

Figure 8.8   Web-App of Be Memories.

shops, etc. making use of Open Data from Trento (Open Data Trentino) where you can find information about points of interest, temperature, typical restaurants, etc. [21]. To use *Tresight*, visitors receives a Wearable bracelet and a link to download an app that offers them information and suggestions. The bracelet sends data about the user's location and environment, therefore enhancing the Open Data. The role of the Wearable is to be a tool that analyses the zones in real-time and provides a database with more real updates than the Open Data [12].

8.3.4 IoT and Smart Nature Destinations

The Urban Eco Islands project [22] will turn the Vasikkasaari island in Helsinki and on Aegna island in Tallinn into new types of smart nature tourism destinations.

The islands will be developed based on the principles of sustainable tourism, taking into account the sensitive archipelago nature. At the same

time, the project will examine how experience-based and sustainable tourism can be promoted with new, innovative digital solutions.

The aim is to develop the areas together with the visitors by increasing environmental and nature awareness and attractiveness for both locals and tourists. The accumulated sensor data is visualised and processed further to show more extensively how the area interests' visitors. IoT applications supporting smart nature destinations are listed below:

- Smart IoT solutions can create new value for nature tourists as well as help to conserve the fragile environment on a local and global level. Based on measuring weather condition data, e.g., wind, temperature, humidity, and UV-intensity, recommendations about clothing and personal protection can be given.
- Acoustic and video sensors on sensitive nature areas could provide detailed up-to-date information to tourists as well as the scientific community about nature values and the biodiversity of the area. Virtual view of an interesting spot, e.g., a sensitive remote bird area with nesting birds is a way to reduce tourism-related pressure to the environment since in this way tourists can enjoy the experience without physically visiting the spot.
- Drone and UAV based imaging can be used to monitor the impact of visitors in the area. Time series of images can reveal new paths created as a consequence of erosion caused by visitors.

8.4 Conclusion

IoT still has a lot of evolving to do, and it will revolutionise the travel industry and the tourism sector in general. With IoT, things will be a whole lot easier, we will be able to check-in and out of hotels automatically, find our travel destination a lot easier, monitor the performance of airline engines, etc. IoT will help to improve customer services and increase revenues as well as customer loyalty.

With IoT, vast amounts of data will be at our disposal, but this data needs to be analysed and understood; so, for appropriate solutions to be implemented, investments need to be made in suitable technology.

For companies in the travel industry to benefit from future innovations, they need to start incorporating IoT into their systems now. IoT technology is very relevant in the tourism industry and both tourists and managers are adapting to this new era because sooner than we think, IoT will overtake the whole cycle of operations in the travel industry and this is what tourists expect

more and more. Very soon, this will not only be what they expect, but it will become a real need and requirement.

Nonetheless, the deployment of IoT in tourist destinations needs to have adequate communications and data management infrastructure. Vast amounts of data will be at the disposal of tourist operators, but this data needs to be analysed and understood. In this sense, it will also be necessary to have information quality control systems and a good knowledge of data management. Likewise, it will be a priority developing a framework for collaboration between public and private initiatives to promote the development and exploitation of IoT platforms.

For companies in the travel industry to benefit from future innovations, they need to start incorporating IoT into their systems as soon as possible. IoT technology is essential in the tourism industry, and both tourists and managers are adapting to this new era sooner than what was expected.

Acknowledgements

List of Notations and Abbreviations

UNWTO	United Nations World Tourism Organisation
SEGITTUR	State Mercantile Society for Tourism Technologies and Innovation Management
IoT	Internet of Things
STD	Smart Tourism Destination
UNE	Spanish Association for Standardisation
ICT	Information and Communication Technology
VR	Virtual reality
AR	Augmented Reality

References

[1] "International Tourist Arrivals Reach 1.4 billion Two Years Ahead of Forecasts," UNWTO (United Nations World Tourism Organization), 21st January 2019, online at: https://www2.unwto.org/press-release/2019 -01-21/international-tourist-arrivals-reach-14-billion-two-years-ahead-forecasts.

[2] C. R. a. E. S. M. Spanish Government Presidency, "IET/2481/2012," Spanish Official State Bulletin (BOE – Boletín Oficial del Estado), 20 November 2012, online at: https://www.boe.es/diario_boe/txt.php?id= BOE-A-2012-14286.

[3] E. C. o. S. Tourism, "Home," European Capital of Smart Tourism, 2019, online at: https://smarttourismcapital.eu/.

[4] A. Lopez de Ávila and S. García, "Destinos turísticos Inteligentes," *Economía Industrial*, vol. 295, no. ISSN 0210-900X, pp. 61–69, 2015.

[5] D. Buhalis and A. Aditya, "Smart Tourism Destinations," Cham, 2014.

[6] U. Gretzel, M. Sigala, Z. Xiang and C. Koo, "Smart tourism: foundations and developments," *Electronic Markets*, vol. 25, no. 3, pp. 179–188, 2015.

[7] C. Chen, C. Murhpy and S. Knecht, "An Importance Performance Analysis of smartphone applications," *Journal of Tourism Management*, vol. 29, pp. 69–79, 2016.

[8] F. Gonzalez-Reverte, P. Diaz-Luque, J. Gomis-López, and S. Morales-Pérez, "Tourists' risk perception and the use of mobile devices in beach tourism destinations," *Sustainability*, vol. 10, p. 413, 2018.

[9] B. Brown and M. Chalmers, "Tourism and mobile technology," in *Proceedings of the European Conference on Computer-Supported Cooperative Work*, Helsinki, 2003.

[10] A. Gomez-Oliva, J. Alvarado-Uribe, M. C. Parra-Meroño, and A. J. Jara, "Transforming Communication Channels to the Co-Creation and Diffusion of Intangible Heritage in Smart Tourism Destination: Creation and Testing in Ceutí (Spain)," *Sustainability*, vol. 11, no. 14, p. 3848, 2019.

[11] T. Nam and T. A. Pardo. "Conceptualizing smart city with dimensions of technology, people, and institutions," in *Proceedings of the 12th Annual International Digital Government Research Conference: Digital Government Innovation in Challenging Times*, 2011.

[12] A. Gomez-Oliva, M. Parra-Meroño and A. Jara, "Diseño de un canal de difusión del patrimonio inmaterial para Destinos Turísticos Inteligentes, basado en Internet de las Cosas," Murcia, 2019.

[13] D. Boswarthick, O. Elloumi, and O. Hersent, "M2M communications: a systems approach," *ETSI World Class Standards*, 2012.

[14] P. Pathak, "Internet of Things: A look at paradigm shifting applications and challenges," *International Journal of Advanced Research in Computer Science*, vol. 7, no. 2, 2016.

[15] N. Dave, "8 ways in which IoT is Shaping the Future of Travel Industry," Digital Doughnut, 29th January 2018, online at: https://www.digitaldoughnut.com/articles/2018/january/ways-in-which-iot-is-shaping-the-future-of-travel.

[16] A. Aluri, HITEC 2016 Special Report HITEC 2016 Special Report, 2016.

[17] A. Verma and V. Shukla, "Analyzing the Influence of IoT in Tourism Industry," in *International Conference on Sustainable Computing in Science, Technology & Management*, 2019.

[18] D. Buhalis, "Marketing the competitive destination of the future," *Tourism management*, vol. 21, no. 1, pp. 97–116, 2000.

[19] *Estrategias de marketing para destinos*, 2016.

[20] E. Binkhorst, "The co-creation tourism experience" Sitges.

[21] Y. Sun, H. Song, A. J. Jara and R. Bie, "Internet of Things and Big Data Analytics for Smart and Connected Communities," *IEEE Access*, vol. 4, pp. 766–773, 2016.

[22] Forum Virium Helsinki, "Home," Forum Virium Helsinki, online at: https://forumvirium.fi/en/urban-eco-islands-develops-archipelago-tourism-with-digital-solutions-2/.

[23] D. Buhalis and A. Amaranggana, "Smart tourism destinations enhancing tourism experience through," in *Information and Communication Technologies in Tourism*, Cham, 2015.