The Application of Digital Technologies into Utilizing Urban Voids

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Abstract

As time passes and cities gradually expand, an urban void resulting from land-use transformation has been with the inadequacy of the current urban situation. However, by generating appropriate urban voids, urban quality of life can be improved from social, economic, and environmental aspects. Thus, this paper focuses on the role of digital technologies in utilizing abandoned urban voids having the potential for applying Landscape Urbanism principles. This paper uses an exploratory methodology that involves both a literature review and a case study, analyzing urban void exploitation projects and their practical approaches. This study largely depends on selectively collected data, while it contributes to a better understanding of digital technologies to utilize urban voids. Furthermore, the developed parameters can guide urban planners responsible for the creation of urban voids and their re-imagining process. Finally, this paper aims to improve the quality of urban life in cities and to avoid past weaknesses and deficiencies in the field.

Keywords

Urban voids • Virtual reality • Augmented reality • Collaborative virtual environments • Media facades • Interactive public displays

1 Introduction

Recently, urban voids have gained great attention in urban design due to their impact. Urban voids can be identified as the spaces among public and private realms, either on the urban macro-scale or on the architectural micro-scale. It means that urban voids are areas that are neither city nor nature (Carmona, 2010). Accordingly, urban voids are an opportunity to apply landscape urbanism (Klever, 2017). Architectural scale and urban scale are the two scales that are typically used to categorize urban voids. Life activities occur in an area bounded by structures to form a built environment (Gehl, 2011). In the same context, quality of life could be regarded as a tool for measuring and guaranteeing the optimal exploitation for existing urban voids, as the quality of life, as it focuses on social relationships, surroundings, housing, community services, income, health, nutrition, resource management, recreation, unemployment, and family harmony. Shortly, it concerns both social and economic constraints (Lyles-Chockley, 2008).

Importantly, the process of transforming urban voids into public spaces has a great impact on the quality of life in cities. The real challenge is not only in the transformation process but in keeping the public space alive. Therefore, it is essential to take advantage of the growing digital technologies to maintain the vitality of the public space. Correspondingly, as technological advancement accelerate, several advanced information technology approaches arise. Moreover, there is a gap in coping with the increasing diversity and its applications in urban design, especially in the Middle East and North Africa (MENA) region. Additionally, urban void as terminology appeared in several types of research before. However, most of the researches discussed it either in terms of socio-economic impacts or the challenges that obstruct the exploitation process of urban voids. That is to say, the technological aspect of exploiting urban voids still needs to be redefined. In this context, the study aims to identify a range of applications in which digital technologies can support the generation of valuable urban voids.

This paper consists of five components. Following the methodology section, this paper describes urban voids and their origin, taking into account their classification. Secondly, the impact of the rapid development of digital

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technologies is investigated. Besides, various techniques for applying digital technologies in exploiting urban design projects are discussed. The third describes a case study addressing the role of digital technologies on urban voids and their effect on the user experience. A potential urban void (Ghamra's Urban Void, Cairo, Egypt) is then selected to apply digital technologies to enhance both the visual and contextual experiences of the user to exploit the urban void using a proper contemporary approach. Finally, the research findings are focusing on the role of digital technologies in exploring urban voids implementation.

1.1 Research Methodology

This exploratory research identifies how digital technologies can support the utilization of urban voids. Since the research is designed to provide a better understanding of the role of digital technologies and their applications in urban design, it selectively conducts a literature review on five digital technologies: virtual reality (VR), augmented reality (AR), collaborative virtual environment (CVE), digital media facades, and interactive public displays.

A case study approach is then conducted to learn lessons from similar cases. This paper investigates three cases: Fresh Kills landfill at New York City, the Millennium Park in Chicago City in the United States, and the AR journey at Miami City, United States. In this exploratory research, open-ended questions are more suitable because using digital technologies for exploiting urban voids can be achieved by several means.

2 Urban Voids Classification

Urban voids can be classified into seven types; landfills, Brownfield lands, train yards, parking lots, passenger terminals, abandoned railways, and slaughterhouses. See Fig. 14.1. The figure is developed from several literature reviews. For example, Lethugile (2011) claims that both landfills and brownfields are lost spaces. Additionally, Rose (2008) suggests that unused infrastructural roads and facilities are considered wasted treasures. In this context, the urban void type should affect the method of its utilization. Linear infrastructural urban voids could be a potential virtual journey, using a proper intervention.

Generally, urban voids harm their surrounding communities (Yuan & Norford, 2014). On this occasion, those urban voids need reusing to have a positive impact on their communities. Accordingly, urban voids are defined here as useless, unused, and underutilized urban spaces (Lee, 2015). However, the unused metro railway of Misr Al-Jadida could be a potential for applying Landscape Urbanism concepts to exploit the existing urban void. Al-Azhar Park is a landscape urbanism project that was a landfill full of poisonous and salty materials since the late Mameluke Era in old Cairo. It was transformed into an urban park (Salama, 2011). In other words, converting this large-scale urban void into a useful park is a method for improving the quality of urban life in Cairo city, which in turn affects environmental, socio-economic, and cultural aspects of life.

To put it differently, landfills and Brownfield lands are usually located outside the border of the cities. However, these locations were relocated inside the city itself as a result of the city's gradual expansions. Thus, the new situation is inappropriate for the quality of life in cities (Gul, 2016). Urban voids can also be classified into three categories according to the extent of contamination, which can be either contaminated, uncontaminated, or potentially contaminated urban voids (Bullock, & Gregory, 2009). However, this classification may matter in the case of Brownfields and landfills in particular.

3 Digital Technologies Applied in Urban Design

First of all, the rapid development of digital technologies affects all aspects of life (Siemens, 2014). Accordingly, urban design is influenced by such technologies. This section discusses the impact of digital technologies on urban design. In this section, a set of digital technologies is chosen to discuss its validation to be applied in urban design in general, and exploiting urban voids in particular, these technologies are VR, AR, CVE, digital interactive media facades, and interactive public displays.

3.1 Virtual Reality (VR)

VR is a computer-generated simulation as a replacement of one's environment, where a headset is worn to isolate the user from the real-world view and replaces it with a virtual environment (Carmigniani, & Furht, 2011). In other words, VR can be considered as mental teleportation via fully immersive with no real-world stimuli (Partala, 2011). VR is a digital approximation of our reality, but not the reality itself, where the user feels that he is in another place (Bailenson et al., 2008). Furthermore, VR technology started to take place in 1962, when the filmmaker Mort Heling created the Sensorama, which is an arcade-style cabinet. Its features include a 3D display with a vibrating seat and stereo sound. However, this technology did not gain the expected popularity (Hirota et al., 2011).

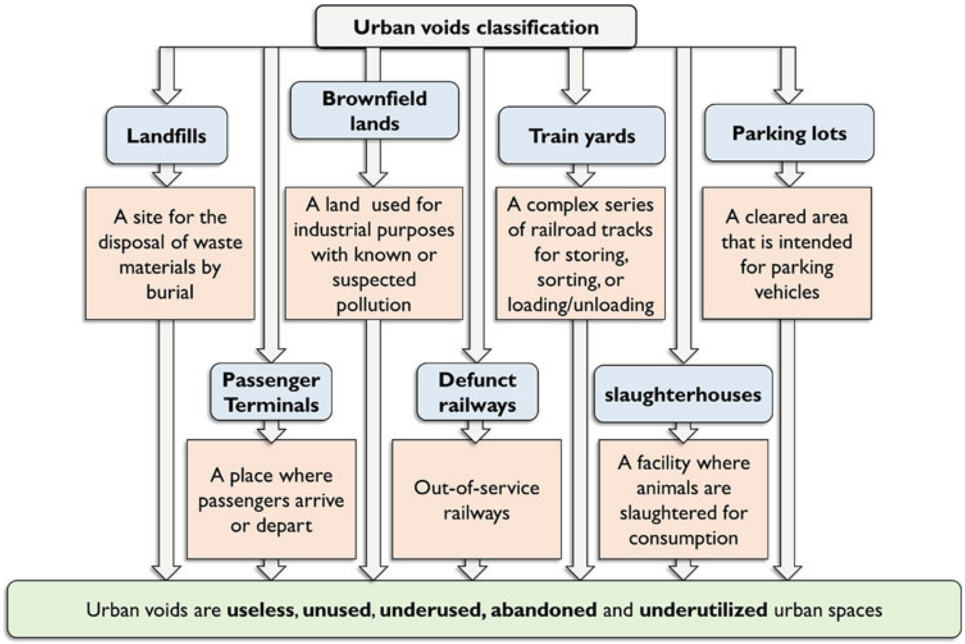

Fig. 14.1 Urban voids classification

However, the practical beginning of VR was in 1966 by the scientist Ivan Sutherland, who invented the first VR headset called The Sword of Damocles. However, the scientist Jaron Lanier was the first to coin the term itself in 1987 (Carmigniani et al., 2011). To sum up, VR is a process where a user can be embedded within an imaginary context, either fully or partially. It allows the user to feel the context through the specific device (Black et al., 2012). In conclusion, VR helps the designer to express his ideas to the users in an interactive way.

3.2 Augmented Reality (AR)

AR is also known as mixed reality (MR). Moreover, its purpose is neither to cut out the real-world nor transport it to another one, but rather to be an enhancement of our real world by introducing a set of virtual components in it (Wang & Dunston, 2011). Moreover, AR was coined by the researcher Thomas Corder in 1990. The word augment is derived from the Latin word Guerra which means increase or add. Accordingly, AR means adding virtual objects to our real world (Haugstvedt & Krogstie, 2011).

AR is a digital addition to reality. Both VR and AR affect the perceptions and processes of the human mind. In conclusion, AR helps in creating an enjoyable experience for urban space users through mixing existing reality with additional digital and virtual inputs. To point out, the street museum in London is an example of applying AR in urban design (Styliani et al., 2009).

3.3 Collaborative Virtual Environment

Collaborative virtual environment (CVE) is a technology in which multiple participants or users can virtually share and interact in the same virtual space. These participants are not obliged to maintain a certain distance between them (Naughton & Redfern, 2002). Also, collaborative virtual environments are most popular and common in digital online multiplayer interactive games, where each player may have a specific avatar and identity. CVE applications extend to architecture, urban design, and other disciplines (Erickson et al., 2011). Another key point, CVE started to appear in the late eighties of the past century, as an attempt to share one virtual space that allows remote collaboration and interaction via connecting multiple computers (Geers, 2011).

Many CVE engineering software has also been introduced, including CollabCAD, CoCAD, and CyberCAD. The software integrates collaborative environments to enhance urban and architectural design processes (Wang & Tsai, 2011). It is important to realize that the main role of collaborative virtual environments is to provide a three-dimensional virtual multi-user space for the planning process. This system allows teleconferencing (audio, video, and shared boards), cooperation between users in the form of avatars (Churchill et al., 2012).

3.4 Digital Media Façades

Media Facades are associated with the so-called media architecture, which indicates any building that has the potential to include a media façade, regardless of the building type, which could be an office building, shopping mall, cultural or industrial building (Stalder, 2011). In this context, media facades should be an integral part of the building that depends on an information and communication technology platform (Clements-Croome & Croome, 2004).

Media facades can be categorized into four main types according to how they integrate the urban environment: sender-recipient mode, interactive mode, environment mode and organicistic mode (Dalsgaard & Halskov, 2010). On one hand, the sender-recipient mode is a mode in which the media façade contains certain predefined content. On the other hand, the interactive mode allows the users to communicate directly to the media façade via smart mobile phones, where users can play multiplayer games, or transfer content, as in the case of public museums and exhibitions, or get involved in a voting process (Boring et al., 2011).

In this context, the environment mode is a mode in which the media façade is affected and has sensors to react to external effects including traffic density, weather, and temperature changes, light exposure, or even daytime and traffic density. The Tower of Winds, implemented in 1986 in Yokohama City in Japan, is an example of the environment mode media façade where wind intensity affects the light pattern used in the media façade (Dalsgaard & Halskov, 2010) whereas the organistic mode is the mode that depends on an intelligent skin that can identify various parameters from the built environment around, then using its computing power and memory. It can interact with the surrounding media facades on adjacent buildings to create what is known as a digital urban reality (Boring et al., 2011).

3.5 Interactive Public Displays

According to (Müller et al., 2010), interactive public displays can be classified into four categories according to their mental models, depending on the context and environment: poster, windows, mirror, and overlay. There is another classification of interactive public displays that are split into two categories: passive and active engagements, in which the first is when people interact with digitalized items, and the second is where people interact with both digitalized objects and each other (Ylipulli et al., 2014). One of the examples is digital interactive signage paired with smartphones (Müller et al., 2010).

Table 14.1 summarizes the digital technologies recommended for exploiting urban voids. The table introduces information technology features and their possible exploitation in urban design in general and urban voids in particular. In the same context, the information technologies are categorized into five main sections: VR, AR, CVE, digital media facades, and interactive public displays.

4 Case Study

This section explores some cases that witnessed the exploitation of the urban void affected by digital technologies to create interactive public urban spaces. Digital technologies play a role in the exploitation of urban voids, using the techniques mentioned above. In addition, many of these ideas are expected to be applied on site. For example, West Covina's landfill in Los Angeles in the United States, where a concept is adopted to convert this landfill into a VR park. VR roller coaster and Arena-style CVE shooting range are also expected to be done.

4.1 Fresh Kills Landfill, New York City, USA

Fresh Kills landfill was the largest landfill in the world. It was situated on the western edge of Staten Island in New York City in the United States. The project opened in 1948 covered about nine million-meter squares. In 2001, Fresh Kills landfill was closed and its exploitation process started in 2008 due to the large value of its land, as it contains large amounts of wildlife and its harmful effect on the built environment of New York City. Therefore, the landfill was to be transformed into a public recreational park (Molnar, 2015). Figure 14.2 illustrates the smartphone application developed to view AR at Freshkills Park.

This AR application compatible with smartphones allows Fresh Kills park visitors to imagine the expected development for the landfill after completing all its transformation phases into a public recreational park. It allows observing future modifications and understanding the features and the characteristics of the site (Molnar, 2015). This application does not only provide AR but also provides georeferencing for various site features. It also allows exploring construction stages. AR interact with the site using georeferencing, articles, photos, panoramic views, and videos (Pham, 2011). Furthermore, regarding the relative vastness of the park, global positioning system (GPS) is used to determine user location and suggests routes to any location at the park. The purpose is to facilitate wayfinding, either via bike or on foot. This project is supposed to be finished by 2035 (Molnar, 2015). Figure 14.2 shows the navigation capabilities of the application.

4.2 The Millennium Park, Chicago, USA

The land occupied by Millennium Park in Chicago was a transportation hub consisting of Illinois central railway yards and a large parking lot. The new land-use applied to this land was a public recreational space acting as a platform for public art. The roof of the existing building was transformed

Table 14.1 Digital technologies recommended for exploiting urban voids

Digital media type	Role in exploiting urban voids
Virtual reality (VR)	• Helping the urban designers to create three-dimensional walk-through models to simulate urban spaces • Allowing interaction via the internet, either immersive or non-immersive (Black, et al., 2012)
Augmented reality (AR)	• Helping in creating an enjoyable experience for urban space users through mixing existing reality with digital inputs • Example: street museum in London (Styliani et al., 2009)
Collaborative virtual environment (CVE)	• Providing a three-dimensional simulated multi-user planning space teleconferencing and avatar-based collaboration are all possible with this system (Schroeder, 2010)
Digital media facades	• Increasing the interaction between users and context, where users can interact with digitals facades via smartphones by either sending messages or even play games (Clements-Croome & Croome, 2004) • Examples: “Haus des Lehrers” in Berlin, where users can control façade lights; “Aarhus by light” in Denmark, where users’ movement in urban spaces are captured and simulated as a silhouette via large media façade (Dalsgaard & Halskov, 2010)
Interactive public displays	• Interactive public displays are divided into two categories; passive and active engagements, the first where people interact with digitalized objects, whereas the second is where people interact with each other and with digitalized objects (Ylipulli et al., 2014) • Example: digital interactive signage, which can be paired with smartphones (Müller et al., 2010)

Fig. 14.2 The visitors are allowed to interact with the expected exploitation features of Fresh Kills landfill. *Source* https://www.dexigner.com/news/23925

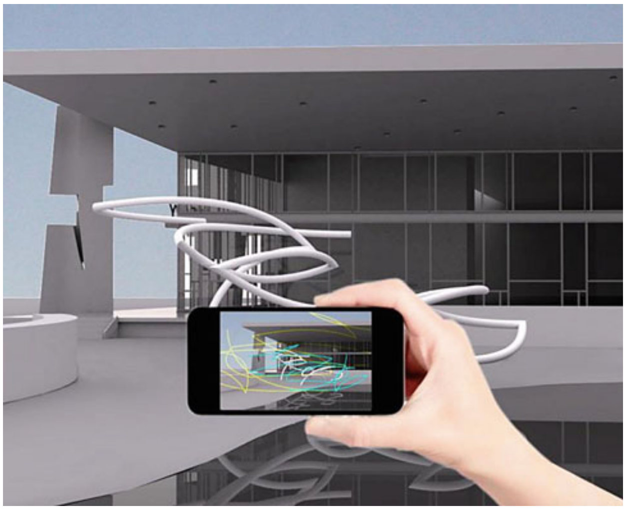

Fig. 14.3 The visitors are allowed to watch an indication for the wind passing the arc sculpture at Aventura, Miami. *Source* https://www.zoesoroko.wordpress.com/2017/03/31/lapse-augmented-reality-art-app

into one of the largest green roofs in the world (Francis & Lorimer, 2011).

Millennium Park serves several interactive public displays, one of them is the Crown Fountain, which is an interactive public display that consists of two units, each one consists of a glass brick transparent tower that has an embedded LED lights to display digital videos on it. The nozzle pours water into a reflecting pool, which is coated with black granite tiles (Mathew, 2014).

4.3 Augmented Reality Journey, Miami, USA

An AR journey along Miami's urban voids was invented by Ivan Toth Depena. This application was called the lapse. It is spatially defined by global positioning system (GPS) and connected to mobile smartphones using a specific application (Papagiannakis et al., 2008). The AR application starts from the Aventura district, where an urban void exists in a site hosting a destroyed public library due to a hurricane (Furht, 2011). An art sculpture was designed using the smartphone AR. Visitors are allowed to watch a virtual representation of the wind currents passing around the arc sculpture in Fig. 14.3.

The second interactive sculpture is activated with a cell phone, and when applying augmented reality to see virtual sculptures, black squares indicators are triggered. Utilizing Miami's Metro mover, a public elevated train system activates the third interactive component, termed the noises, which is a soundtrack tied to the surroundings (Papagiannakis et al., 2008).

5 The Application of Digital Technologies to Ghamra's Urban Void, Cairo, Egypt

Ghamra is a residential district in Cairo, in which exists an urban void represented in the underutilized gap resulting from the existence of metro, trainyard, and warehouse buildings. The district itself is located nearly in the central region of Cairo City, where its northern side is bordered by the 6th of October Bridge. Moreover, the district is considered an important transportation node due to its location near Nasr city and Misr Al-Jadida toward the east. In addition to its adjacency to Ramsis district towards the west.

Ghamra's urban void bisects Ghamra district into two semi-isolated parts, in terms of urban connectivity for pedestrian circulation. As a result, this urban void has a spatial impact on its surrounding. In addition, it can be considered as a wasted vacant space that needs utilizing to have a better impact on its surroundings. Furthermore, Ghamra's urban void bisects Ghamra district into two semi-isolated parts, leading to the lack of urban connectivity for pedestrian circulation. As a result, this urban void has a spatial impact on its surroundings, besides, it can be considered as a wasted vacant space that needs to be utilized to have a better impact on its surroundings as shown in Fig. 14.4.

In the light of the previously discussed case studies and ideas, this node and linear axis could be converted from an underutilized urban void into an urban recreational park to improve the quality of life in Ghamra regarding social, economic, and cultural aspects of life. Collectively, Table 14.2 introduces a list of suggested information and communication featured to be used in the exploitation process of Ghamra, in addition to the idea or objective of using that technology, including creating an AR mobile application for that purpose. Moreover, applied cases are mentioned to ensure the probability of applying those cases to Ghamra's urban void.

6 Discussion

This section discusses the outputs of this research, where the implementation of digital technologies is reviewed depending on the past sections. The selected digital technologies for this research are VR, AR, CVE, digital media facades, and interactive public displays. First of all, VR can interfere in exploiting urban voids in several approaches. For instance, VR coasters add VR experience to roller coasters, especially at theme parks, depending on positional tracking sensors. The purpose here is to enhance user experience and entertainment. One of the examples: Shaman roller coaster at

Fig. 14.5 Ghamra's Urban Void, Cairo, Egypt. *Source* https://www.google.com.eg/maps/@30.0651673,31.255182,16z

Table 14.2 Ghamra's urban void suggested exploitation via digital technologies

Digital media type	Application	Direction	Example
Virtual reality (VR)	VR coasters	Applying VR for train passengers to increase their cultural knowledge via creating virtual walk-throughs with historical and infographic background	Six flags magic mountain amusement park, near California, USA
Augmented reality (AR)	Street museum	Developing an AR application that virtually restores vintage early nineties residential buildings in black and white mode	Street museum in London, UK
	AR as a design phasing tool	The urban park phasing could be virtually visualized via an AR application, to allow the user to predict the future designs for the park, as well as the metro station and trainyard	Freshkills Park in New York, USA
	The sound-scape	Creating an AR mobile application that interacts with the surrounding architectural context along with the train passengers" journey	Lapse in Miami, USA
	AR sculptures and artworks	Adding wall scannable triggers to be detected via mobile smartphone's specific application to generate AR sculptures and artworks at the metro waiting areas	
Digital media facades	Media facades as a public participation tool	Using smartphone applications, media façades could be a tool for creating surveys and voting, where answers and responses could appear instantly in an interactive way	Media façade festival in Berlin, Germany in 2008
Interactive public displays	Interactive parking detector	Providing parking spaces at the urban void node. This parking could be a potential for applying interactive applications for detecting available parking spaces, todecrease the traffic congestion in Ghamra	A application developed by San Francisco Municipal transportation agency in USA

Gardaland, Verona, Italy, where VR technology creates a unique experience to this roller coaster since 2017. (Wei et al., 2019). Besides, VR simulators can be used as a gaming tool, to make the user feel an enjoyable informative experience of being fully immersed in a multi-sensory story or experiment. One of the examples is Derren Brown's VR Experience at Thorpe Park in the United Kingdom. VR Simulators are used as a public participation tool. This technique was applied in Lithuania as a tool to engage users to interact with the urban voids redesign proposals. Also, VR is used as a design tool, because it is used to pre-visualize the urban void before utilizing it, in addition to the possibility of dividing the design into phases (Wu et al., 2010). Similarly, AR can be used as a smartphone-based AR. However, this type depends on adding virtual objects to the existing urban void reality. Besides, AR can be applied by adding virtual objects via periscopes (Styliani et al., 2009).

CVE can be used in exploiting urban voids by using arena-style CVE shooting. This process depends on multi-player gaming, where MR is used. On the other hand, a collaborative virtual environment can be used as a design tool. This process depends on utilizing specific software for intruding design stakeholders as avatars in the same virtual

Table 14.3 Classification of digital technologies recommended for exploiting urban voids

Digital media type	Application	Its implementation in exploiting urban voids
Virtual reality (VR)	VR coasters	• Adding VR to roller coasters, especially at theme parks, depending on positional tracking sensors • Enhancing user experience and entertainment • Example: Shaman roller coaster at Gardaland, Verona, Italy, where the VR technology was added to this roller coaster in 2017 (Wei et al., 2019)
	VR simulators as a gaming tool	• VR Simulators can be used to make the user feel an enjoyable informative experience of being fully immersed in a multi-sensory story or experiment (Wei et al., 2019) • Example: Derren Brown's VR experience at thorpe park in the United Kingdom
	VR simulators as a public participation tool	• VR was used in Vilnius, Lithuania as a tool to engage users to interact and be updated with the urban voids redesign proposals (Wu et al., 2010)
	VR as a design tool	• Pre-visualizing the urban void before utilizing, in addition to the possibility of dividing the design into phases (Wu et al., 2010)
Augmented reality (AR)	Smartphone based AR	• Adding virtual objects to existing urban void reality (Styliani et al., 2009)
	AR periscopes	• Adding virtual objects via periscopes (Styliani et al., 2009)
Collaborative virtual environment (CVE)	Arena-style CVE shooting	• Depending on multiplayer gaming, which employs MR (Pearce, 2011)
	CVE as a design tool	• Depending on utilizing specific software for intruding design stakeholders as avatars in the same virtual space to perform the design process for urban voids and decision making • Example: a study on three groups of architects to analyze their collaboration in design process using CVE (Maher et al., 2006)
Digital media facades	Sender/recipient mode digital media facades	• Example: the Bayer headquarters building at Leverkusen, Germany: T-mobile headquarters at Bonn, Germany (Dalsgaard & Halskov, 2010)
	Interactivesssss mode digital media facades	• Example: the media façade at Paris national library (Dalsgaard & Halskov, 2010)
	Environment mode digital media facades	• Example: the tower of winds in Yokohama (Dalsgaard & Halskov, 2010)
	Organicistic mode digital media facades	• Example: the weather tower, Brussels in Belgium (Dalsgaard & Halskov, 2010)
Interactive public displays	Poster interactive public displays	• An electronic interactive paper of variable content. That is to say, digital interactive signage, which can be paired with smartphones • Example: the city wall in Helsinki, Finland (Müller et al., 2010)
	Window interactive public displays	• Creating a virtual connection or port to a virtual remote location (Müller et al., 2010)
	Mirror interactive public displays	• They look like a mirror that reflects the users and surroundings, in addition to augments like making a ribbon effect when touching the screen (Müller et al., 2010)
	Overlay interactive public displays	• Characterized by creating overlays, which integrates the surrounding environment (Müller et al., 2010)

space to perform the design process for urban voids and decision-making (Maher et al., 2006).

Digital media facades have many applied cases. To put it differently, the Bayer headquarters building at Leverkusen and the T-Mobile headquarters at Bonn, Germany, are both two examples of a sender/recipient mode media façade. Furthermore, the media façade at Paris national library is an example of interactive-mode media façades. Also, the tower of winds in Yokohama is an example of interactisssssve-mode media façades. Besides, the weather tower, Brussels in Belgium is an example of organicistic mode media façades (Dalsgaard & Halskov, 2010).

Public displays can be used as electronic interactive paper of variable content. That is to say, digital interactive signage can be paired with smartphones. For example, the city wall in Helsinki, Finland. This type is considered as a poster interactive public display (Müller et al., 2010).

In addition, interactive public displays can be used to create a virtual connection or port to a virtual remote location. This type is called a window interactive public display. In the same context, mirror interactive public display is also a notable type of interactive public display, where they look like a mirror that reflects the users and surroundings. Besides, making a ribbon effect when touching the screen is an additional possible feature. Moreover, overlay interactive public displays are characterized by creating integrating overlays with the surrounding environment (Müller et al., 2010). To sum up, a classification of digital technologies recommended for exploiting urban voids is illustrated in Table 14.3.

7 Conclusion

Urban voids have been classified into two main categories, contaminated and infrastructural urban voids. Contaminated urban voids include landfills and brownfield lands. The infrastructural urban voids include train yards, parking lots, passenger terminals, abandoned railways, and slaughter-houses. The case study in this paper has highlighted some implementations of digital technologies in transformed urban voids. It was concluded that their usage became indispensable for urban voids operators to maintain their vitality.

Consequently, the reviewed cases had an impact on their context, including social, economic, environmental, and spatial aspects. First, the application of digital technologies into utilizing urban voids affects social life within its context, where people are allowed to gather and interact together using unconventional approaches. Second, the utilization of those techniques helps the created public space to be remunerative. People will be attracted to pay and try those playful attractions. The revenue can be used for paying the running costs.

From the environmental point of view, those techniques could be used to raise awareness of environmental issues. Moreover, virtual attractions could gradually replace several printed and wasted raw materials. Furthermore, the spatial user experience for the utilized urban voids would be full of diversity, as it provides a unique virtual dimension for the existing reality that enriches the spatial experience of the users. To sum up, using digital technologies in the exploited urban voids maintain their livability, by adding playful experiences for the users. This will create an added value to the public space.

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