

The Urban Realm in the Digital Era

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Digitalisation and the future city paradigm are becoming a trend in recent research and practices. Literature discusses digitalisation and its applications as the main gear in the transformation to the ideal future city vision. Yet, the concept of digitalisation is articulated in many interpretations and presented in different applications in the built environment.

Keywords: future city ; urban realm ; digital twinning

1. Introduction

As the world population rapidly increases and cities expand, many questions stand to envision the future of our cities, its urban realm and the built environment. In the last few decades, research has depicted a broad spectrum of themes that touch on concerns on the future of cities and the urban realm with ongoing and evolving challenges such as city expansion, climate change and population growth. One distinct theme that attracts the concerns, particularly in developed countries, is the future of the city user in the urban realm of the future city ^{[1][2]}. Governmental and non-governmental efforts, along with recent and evolving research directions, are calling for rethinking the future of the city user in the city of the future, highlighting the ongoing changes in the city as a system, its urban realm and the built environment ^{[3][4][5]}.

The 21st century imparted novel advances in technologies changing the way researchers think, perceive and interact with our cities, the urban realm and the built environment ^[6]. Digitalisation is one of the major advances of the 21st century that emerged and developed with the advancement of the information, communication and technology (ICT) industry ^{[6][7]}. In the context of the built environment, the concept of digitalisation is depicted as the restructuring of the physical setting of a physical environment into a digital, intangible and virtual environment ^{[8][9][10]}. The principles of digitalisation are built around the transformation of the physical built environment into an interactive, responsive and interconnected digital system that is accessed, monitored and facilitated virtually. This system is anticipated to enable novel dimensions on learning and analysing the events and conditions of the physical setting, and accordingly, contributes to enhancing the quality and performance of the physical built environment ^{[11][12][13]}.

As described by Kevin Lynch ^[14], the built environment is formed by principle elements that shape the complete image of the city. On the city scale, buildings are rooms, pathways are corridors and the urban space is the living area. All of the city elements together form the image of the urban realm ^{[14][15][16]}. And the urban realm is the physical setting where city users live, interact and navigate dynamically ^{[15][16]}. Digitalisation and the revolution in technology applications, such as digital twin technology, are enabling new dimensions on reimagining the experience of city user in the city of the future ^[17]. The emerging of such dimensions raises questions on the future of the place researchers live in, interact with and navigate through, and necessitates the need to discover recent research, applications and visions on the themes of the digital urban realm, digital twin technology and city users in the city of the future.

2. The Urban Realm in the Digital Era

One of the main drivers to understand the future city paradigm is the concept of the digital city. The concept of “Digital City” emerged in the early 21st century due to the revolution in the ICT industry that revealed many opportunities for thinking beyond the possible ^[18]. The concept started to thrive in related research, presenting a novel perspective for the future of our cities ^{[18][19][20]}. Nevertheless, no consensus has yet been reached around the definition of digital city among scholars. Some studies refer to the concept as the creation of an interconnected and virtual city infrastructure ^[21], and others refer to the concept as the development of a collective city data capital ^[22]. In contrast, others express the concept as the stabilizing of a healthier, environment-friendly and climate-resilient city ^[23]. In general, the digital city concept could be conceived as an umbrella for achieving interdisciplinary objectives, such as smart living, innovative economy and smart infrastructures ^{[20][24][25]}.

The change in the way researchers perceive and interact with our city, the urban realm and the built environment has evolved with the development of the digital city conceptualisation and through the thriving of digitalisation applications [26][27]. According to studies [26][28], with digital twin technology, the physical settings of the actual city are mirrored in a digital environment. The parallel environment, so called “the digital replica”, links the elements of the city together in a virtual, readable and measurable system [18][28]. With ICT applications, the digital replica can learn, analyse and react to the conditions of the actual city with informed decisions and recommendations that have the potential to improve the actual conditions of the city. In this scene, the city gains a dynamic character and the way researchers perceive and interact with the city could change accordingly [18][28].

In order to differentiate between the digital city model and the regular city model, research classifies the city in three main models: regular city, smart city and cognitive city [20][29][30]. In a regular city, city elements are disconnected digitally, and the city fabric is static and non-responsive to changes or interactions [20]. In a smart city, city elements are connected digitally, where a limited manner of interaction occurs between the city components together and between the city and its users. In a smart city model, the digital presentation of the city can learn, measure and document the conditions of the physical settings; however, interaction with the city user is limited to preliminary applications such as sensing and recording [29]. In a cognitive city, city elements are linked digitally in real-time and could learn, adapt and respond to interactions [30]. Research describes the cognitive city model as the collective intelligence of the city, where city fabric acts in a proactive manner to address ongoing changes and interactions between the city components together and between the city and its users, based on an interconnected grid of city elements represented in a collective digital system, as demonstrated in **Figure 1** [29][30].

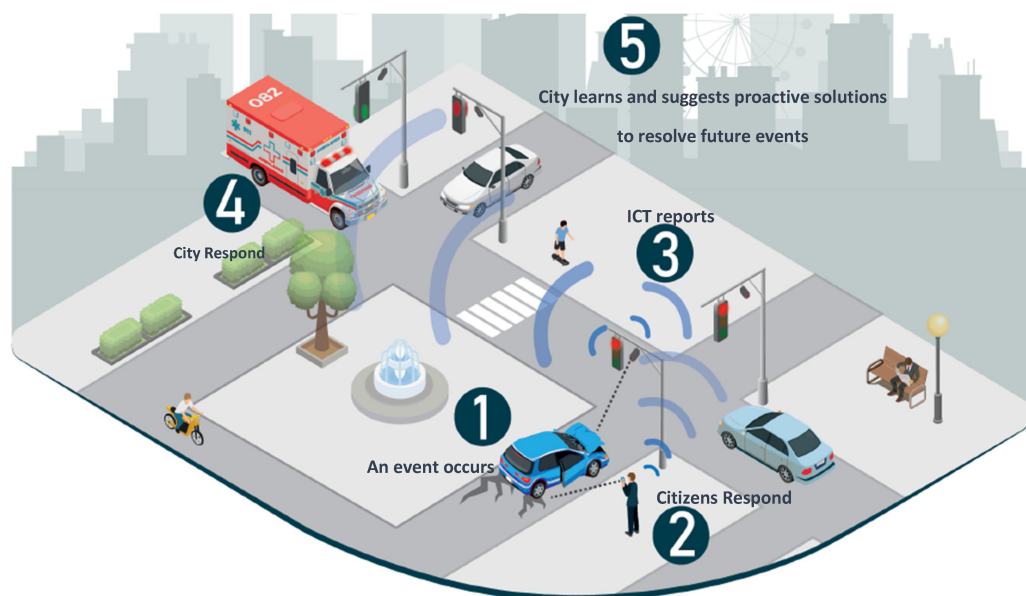


Figure 1. The concept of a cognitive city. Source: [29].

With the developing digital model, such as the cognitive city model, the future of our cities is anticipated to have a different interpretation, as well as the user experience. The concept of digitalisation has changed the perception and how researchers interact with the elements of the built environment, especially in the urban realm. With the advancement in technology, the future of our urban realm would articulate a novel form of living that presents new perspectives to the user experience in the urban realm of the future city.

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