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Digital Outdoor Advertising Tecoration for the Metaverse Smart City

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Abstract

Developing smart cities increasingly relies on metaverse technology. This has become much more apparent in the post-COVID-19 pandemic urban environment. The demand for fast processing of huge amounts of data and the convergence of various media types is essential for keeping city residents well-informed and safe. This paper builds on recent research on metaverse, smart cities, and digital outdoor advertising media. It proposes that "space culture media", which collectively functions by using physical or virtual spatial information, will play a key role in the smart city, functioning as an augmented city. Specifically, this paper deals with significant issues related to the smart city changes created by tecoration, a metaverse urban media space facilitated and enhanced through digital outdoor advertising.

Keywords: Tecoration, Smart City, Metaverse, Digital Outdoor Advertising

1. CITY OF COMMUNICATION: THE METAVERSE SMART CITY

The smart city, created by merging the megatrends of 'smart' and 'urbanization,' has already been a hot global topic for many years. A critical factor in the growth of smart cities is that 'communications that function as media are cities.' In particular, it is noteworthy that smart cities are applying metaverse technology. "Metaverse," a compound word of "meta," which means transcendence, and "verse," which means universe, originated in Neil Stephenson's 1992 novel, "Snow Crash" [1]. Metaverse differs greatly depending on the researcher who defines it, but the term mainly refers to a "virtual thing." Recently, however, politics, economy, society, and culture have widely used metaverse to refer to a life-type and game-type virtual convergence world, where offline reality and online unreality can coexist.

Recent changes in smart cities show that urban operations are becoming highly intelligent, and various contents are being enhanced, abolishing "the dividing line between online and offline in the city." Of course, we are walking through physical urban space as in the past. However, we are now constantly exposed to real-time public and commercial information through smartphones and digital outdoor advertisements in downtown areas. In addition, we get information by checking spatial information connected to topographical features.

In this paper, we use the concept of "tecoration" (technology + decoration: construction of urban space through digital media technologies') to refer to the phenomenon of the smart city as a metaverse media space. The smart city is now a kind of "urban life and orientation platform" that closely connects the lives of city dwellers through metaverse technology and convergence contents. As a result, this paper addresses important

challenges relating to the changes in the metaverse smart city brought about by digital outdoor advertising tecoration.

2. THE SMART CITY IN THE POST-COVID-19 ERA

According to the Korean Ministry of Land, Infrastructure, and Transport, a smart city is a "sustainable city that provides various urban services based on urban infrastructure built by a convergence of 'construction, information, and communication technology,' to improve the quality of life and competitiveness of the city" [2]. Indeed, this is the heyday of the "smart city" worldwide. Deloitte (2018) predicted that the global smart city market would grow from about $781.9 billion in 2016 to about $1.69 trillion in 2021, increasing the average annual rate by 16.6%. Specifically, the growth of smart cities in Asia is particularly remarkable [3]. As of the first quarter of 2017, developers are promoting smart city projects in the Asia-Pacific region at the second-highest level after Europe. The market size is growing significantly. The world's largest cities are trying to overcome infectious diseases through rapid change to smart cities amidst an unprecedented socio-economic crisis caused by the novel coronavirus (COVID-19) outbreak, which has been terrorizing the world since early 2020. In particular, the trial and error that occurred in China's city management during the early days of the coronavirus outbreak have many implications for effective smart city communication. As much as we don't want to admit it, the "WITH virus" era of infectious diseases is here to stay. So, what will be the fate of the smart city in the aftermath of the pandemic?

For starters, depending on the medical system, it is feasible to forecast the progress of public communication in smart cities. If China's Wuhan city, the controversial location where the virus is said to have broken out, had proactively responded to the spread of the virus by tracking its citizens' health information, the current global catastrophe would not have occurred. Second, it is the customization of communication networks and contents for city dwellers and the ubiquity within the city. As learned from the experience of COVID-19, we can reduce social anxiety when citizens can quickly disseminate unified emergency information at high speed anywhere in the city. Third, it is necessary to upgrade this system beyond simply sending warning messages frequently to smartphones because the area where urban digital outdoor advertising can contribute as an information channel is enormous.

Similarly, prior research [4] pointed out that smart cities are not limited to digital operating systems and suggested metaverse smart cities should focus on solving problems in urban planning and urban development. Finally, we can expect the implementation of various public communication channels to increase the citizens' sense of community belonging and loyalty. We should foresee a rise in communication beyond high-alert public messages and commercial commercials, such as art material delivered via cutting-edge public media.

**Figure 1. A giant digital sign at Piccadilly Circus, London,
displays a message from Queen Elizabeth**

3. METAVERSE SMART CITY: SPATIAL INFORMATION AND CULTURAL, SPATIAL

Metaverse essentially refers to the convergence of the virtual extended physical reality and the physical permanent virtual space [5]. In addition, Smart et al. (2016) proposed a model based on a 2016 MVR Survey of young people in the U.S. using interactive, internet-accessing, 3D visual environments for various social, educational, and leisure activities [6]. The model consists of two primary coordinates that influence how the metaverse unfolds: a spectrum of technologies and applications ranging from augmentation to simulation and a horizontal spectrum ranging from intimate (identity-focused) to external (world-focused). Specifically, augmentation refers to technologies that add new capabilities to existing natural systems in the sheer scope. In the metaverse context, this means technologies that layer new control systems and information onto our perception of the physical environment. In reverse, simulation refers to technologies that model reality (or parallel realities), offering wholly new settings. In the metaverse context, it translates into technologies which provide simulated worlds as the locus for interaction.

On the other hand, in the horizontal spectrum, intimate technologies focus inwardly on the identity and actions of the individual or object. In the metaverse context, this means technologies where the user (or semi-intelligent entity) has agency in the environment, either through an avatar/ digital profile, or through natural appearance as an actor in the system. Meanwhile, external technologies focus outwardly towards the world at large, but in the metaverse context, this means technologies that provide information about and control the world around the user [6].

The two metaverse planes intersect to produce four scenarios. The first, "Virtual Worlds," emerges from the combination of simulation and intimate technologies, which are immersive representations of an environment where the user has a presence within that reality, typically as an avatar of some sort. For example, World of Warcraft, Second Life, or Sony Home. The second scenario, "Mirror Worlds," comes from the intersection of simulation and externally focused technologies, such as information-enhanced virtual models or "reflections" of the physical world represented by maps and geo-locative sensors such as Google Earth. The third scenario, "Augmented Reality (AR)," looks at the collision of augmentation and external technologies which enhance the external physical world for the individual through the use of location-aware systems and interfaces that process and layer networked information on top of our everyday perceptions. The last scenario, "Lifelogging," is a mix of augmentation and intimate technologies. The systems record and report the states and life histories of things and users, improving observation, recollection, and communication [6]. These four dimensions of the metaverse have a highly diverse potential for implementation in smart city development. A recent study [7] suggested that the Internet-based virtual world will gradually evolve into 3D, however, cultural specificity will determine its implementation. For example, in North America, a realistic, social virtual world is emphasized, while in Korea, the emphasis is on a ludic, fantasy virtual world based on a fictional worldview.

The technology that connects the large amount of information created by physical and virtual spaces with the Internet of Things (IoT) plays a vital role in the metaverse smart city. With the power of faster and smarter artificial intelligence, large-capacity spatial information (including location information of city residents) and urban citizen information (demographic and socio-psychological information) are quickly integrated and analyzed in real-time, increasing the influence of spatial data in smart cities. As Professor Nicholas Negroponte, the founder of the MIT Media Lab, said in 1974, "we are going to see a ubiquitous and decentralized form of computer distribution" [8]. Computers will probably exist in every object and space in the home, including toys, iceboxes, bicycles," he said. The word "ubiquitous," etymologically derived from the Latin "ubique," has the dictionary meaning of "to exist everywhere at the same time, omnipresent". "Ubiquitous computing," which was already a big topic in the early 2000s, is now being applied to become more advanced in technology and be felt by citizens. Media based on spatial information range from outdoor advertisements installed in offline spaces to smartphones that urban residents always carry, including games

that exist only in virtual areas.

Recently, the art and education fields implemented metaverse smart solutions. For example, referring to the development of a 'smart exhibition space' in exhibition galleries through the implementation of the metaverse, Kim et al. (2014) called for a ubiquitous environment that provides customized information according to the target audience, strengthens the experiential exhibition elements, and allows for realistic content to be created freely [9]. Furthermore, the study proposed that media elements such as media walls, interactive floor, and media table form an interactive space that answers the increasing demand for experiential exhibitions and immersive content through multisensory media in the exhibition space. Furthermore, autonomous guide systems based on smart devices and digital archive services are becoming more prevalent in modern exhibition spaces.

Similarly, history education content development recently implemented metaverse to represent past times more accurately to the people of the present [10-11]. By adopting the metaverse roadmap model, the study proposed that through virtual worlds, to experience the characteristics of social status and understand its historical meaning, it is possible to empathize with the emotions of people in the past through augmented reality. Through the construction of a mirror world, it is possible to experience the comparative history of how the same character lived in different societies. Through lifelogging, one will personally understand various ways of life in the past [10].

Furthermore, the entertainment industry successfully applied metaverse. Metaverse solutions allowed famous singers to hold immersive concerts and fan meetings using 3D stereoscopic image technology during the COVID-19 pandemic when travel halted, and lockdown measures restricted artists to share a physical community space with their fans [12]. Furthermore, 3D tourism content such as immersive tours has implemented metaverse solutions. For example, Gyeongju Cultural Tourism provided major attractions in Gyeongju in VR tours to online audiences. And the Korea Tourism Organization created a virtual Hangang Park on the Korean metaverse ZEPETO, which allowed people from all over the world to tour the Hangang River from their own homes. In addition, fashion shows, graduation ceremonies, and shopping tours have appeared on metaverses such as ZEPETO, Animal Crossing, Fortnite, and Reverse [12].

This paper addresses the media that collectively use physical or virtual spatial information as "space culture media". We expect it to play a key role in the way smart cities function as augmented cities. Specifically, spatial, cultural media are classified according to their characteristics as follows:

Table 1. Types and characteristics of spatial cultural media [13]

Spatial Cultural Media Types	Representative Media	Media Characteristics	Media Technologies
Real	Digital outdoor advertising	- Providing related commercial/non-commercial services at fixed physical locations or free of charge	- Media facade technology - AR interworking technology
Augmented / Mixed	Mobile media / Drone	- Providing personalized space-related services to users - Providing related services in real-time while moving in space	- GIS technology - AR technology
Virtual	Game / Virtual space experience	- Building a new virtual/mixed space based on real or virtual spatial information - Sale of spatial information and services through virtual space	- VR technology - Game virtual world

Media technology and content elements make up spatial, cultural media. Media technology is sometimes used interchangeably with the term "media." However, media refers to a kind of broad classification, but media technology refers explicitly to "technological elements that make the media function" [8]. For example, we can label various technologies such as drones, holograms, wall-projections, and media facades under the media category of digital outdoor advertising. There are infinitely many kinds of technologies, and even at this moment, new technologies are emerging one after another. When these technologies and content elements meet, they become persuasive. Whether the consumer's access to content is passive (push-type: information is forcibly transmitted) or active (pull-type: user engages in active information search) determines the classification of content elements. On the other hand, we can divide the content information richness into rich content or simple content [8].

Figure 2. Types of content in spatial cultural media [13]

Among the spatial, cultural media described above, outdoor advertising is the type of media that is quickly joining new technologies based on urban spatial information. Unlike other media, outdoor advertisements are frequently used in cities because they have a strong sensory appeal created by a sense of physical scale that citizens repeatedly contact while moving. In addition, outdoor advertisements act as an important element of the urban landscape [14]. Outdoor advertising is the oldest form of advertising, but it is also the one digitizing the fastest. Digital out-of-home media or digital signage is an information system that uses electronic methods to send and receive messages at all urban contact points where consumers leave their homes, city public places (streets), and transportation facilities (stations and airports) [15]. Digital signage creates additional value in space through the combination of advertising, information, design, and art on the back of information technology development [16]. Since it occupies a particular place, it is also Location-Based Advertising (LBA). Naturally, it acts as an essential factor in creating placeness by strategically occupying and executing a particular space. As a result, digital signage has the potential to turn every area of a smart city into a digital information space, including the inside and outside of streets and buildings [17].

4. TECORATION USING DIGITAL OUTDOOR ADVERTISING FOR THE METAVERSE SMART CITY

Recently, urban space transformation is "innovation in urban space," a dynamic information-enhanced space providing various contents through metaverse media, beyond simply building new or large structures. As we pointed out, the proliferation of tecoration is advancing, and advanced virtual information technologies represented by 5G/6G high-speed communication networks and metaverse are accelerating this phenomenon. Specifically, as mobile, wearable information devices become lighter and larger displays become easier to install, the city we live in is changing into a shape that we could only meet in science fiction movies. Physical space is still crucial for humans living with their two feet on the ground. However, the function and role of space should be different in the metaverse smart city environment, as the core function of a smart city is information-based city management. City local governments should now focus on enhancing the quality of life of city inhabitants by rapidly processing large volumes of acquired information around the city and reprocessing it into useful messages sent directly to citizens.

We require various advanced technologies related to the information collection, processing, and message transmission to deliver essential details necessary for urban operations and commercial information, including advertisements according to TPO (time, place, occasion). Currently, we rely on communication using the smartphone. Still, as contactless user recognition technology grows in the future, the era in which various sensors in the city can identify and communicate directly with the users without a smartphone is approaching. For example, Shilov and his colleagues (2019) suggested a methodology for digital signage in smart cities which preserves the citizens' privacy while at the same time using feedback collected through deep learning image analysis techniques to improve the quality of digital signage personalization [18].

There have already been various attempts to connect with the virtual world through various urban facilities. LinkNYC in New York is an exciting example of the latest innovation developed from the traditional telephone booth [19]. As of November 2020, New York City installed 1,809 digital kiosks through the project consortium, joined by many high-tech companies, such as Google's Sidewalk Labs. This device contributes to the advancement of the smart city by providing commercial and public advertisements, provisions of local information, free calls, high-speed internet, smartphone charging, and, more recently, crime prevention functions. Some urban media scholars predict that these kiosks may exchange data with autonomous vehicles, public transit, and other urban systems in the foreseeable future [20]. It is also interesting that advertising revenue covers all costs for the production and maintenance of the facilities. In other words, it serves both a public and a commercial role [19]. Columbus in Ohio has also been installing digital kiosks at key locations throughout the city since 2018 as part of its smart city strategy [21]. Sejong City in South Korea also installed digital signage using digital information displays on pedestrian roads in central commercial areas such as Naseong-dong through its "big data-based digital outdoor advertising pilot operation" plan in 2021 [22].

Furthermore, Incheon City presented the "XR Metaverse Incheon Ieum Project", aimed at boosting competitiveness at international level and fostering Incheon-related businesses through the establishment of an "XR metaverse ecosystem" and fostering a new local industry [23]. Lastly, digital signage enhances reality using AR/VR and provides big data about the contacted citizens (consumers) to the self-employed. In this light, tecoration using digital outdoor advertisements is still underway around the world at this moment.

5. CONCLUSION

In general, there is a tendency to think that smart cities are completed by "technical elements" represented by physical and hyperconnected networks and big data. However, cutting-edge technology is valuable when used as an effective tool to improve the 'quality of life and happiness' that citizens get from a community-driven smart city. In other words, smart cities should aim for a livable city that guarantees the well-being and happiness of its citizens as the final governance goal, not for temporal indicators such as technological development. As Mattern (2017) pointed out, urban developers based the recent technology-driven discourse

on the rationale that urban life is "programmable", which essentially translates an idealized topology of the open web and Internet of Things "into urban form". Similarly, urban sociologist Lewis Mumford (1961) warned against the programming trend proliferated by technologists and political actors, who tend to reduce urban planning to algorithms [20].

Quality of life and satisfaction are determined by "psychological interpretation" [24]. Specifically, active interpretation reprocesses our perception rather than reflecting reality itself. The "proportion of virtualization" in the importance of virtual reality to human life is increasing day by day. As virtual reality becomes as important as reality, the role of the urban space will also change. In light of this, digital outdoor advertising will become more prevalent in the metaverse smart city, transforming it into a "augmented reality place" that merges with virtualization.

Building on Heidegger's existentialist philosophy, human geography scholar Edward Relph (1976) emphasized the importance of place in human nature [25]. Space is inherently one-dimensional, neutral, and geometric and has little meaning in direct human experience. On the other hand, a place is a 'human space' provided by the sense of the participant's experiential context. Various interactions between people and their environment create places. Previously, to be human was to live "in a world full of meaningful places". For a smart city to become a meaningful place for citizens, metaverse technology needs to deploy strategic and continuous communication efforts. Digital outdoor advertising, used as a critical communication channel in smart cities, can provide valuable entertainment in human life by personalizing or characterizing space and architecture through information technology and a combination of advertising, information, and design [26].

The most realistic and efficient alternative for participatory civil society in the face of city deindividuation is to create place attachment and a sense of belonging by augmenting additional content through digital outdoor advertising to create a collective space where people's collective experiences and time accumulate. It is an essential issue for smart cities to consider. As a tool, one could use digital outdoor advertising as a key instrument for the mediatization of cities. Beyond simply delivering information, this will facilitate the formation of authentic urban environments and creative and cultural industries, further strengthening place competitiveness [27]. This competitiveness will make the city a popular attraction for many visitors at home and abroad. The tangible and intangible assets gained through this process will be substantial.

Future research will need to consider how to effectively utilize digital outdoor advertising to boost further communication and participation of urban communities' citizens. An interdisciplinary approach is inevitable to study the transmission of smart cities that are inherently concurrent. Specifically, a multidisciplinary approach is essential, in which related majors such as media/contents studies, urban engineering, architecture, computer science, design studies, and public administration can collaborate. It is time to investigate tecoration ways for a better smart city by ongoing collaboration between researchers and specialists from various backgrounds, as well as government authorities.

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