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Introduction of Augmented Reality Instances utilizing Matter-Information Hybrid via Technology in Urban Spaces

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ABSTRACT: Today city residents are experiencing a new way of life which is unprecedented ever since the urbanization concept appearance. The continuous demand to build and maintain the real city space with all the well-known problems, alongside the simultaneous management of urgency and the presence of a developing virtual parallel world, has baffled the city's management systems and city's residents. One of the proposed solutions is employing a machine approach to solve these related issues. The general purpose of this research is to provide a comprehensive definition of the concept of urban technology synthesis in the area of physical space as an urbanism machine. This investigation is a comparative study to allocate and provide a particular paradigm for the introduction of augmented reality instances utilizing matter and information combination via technology in urban spaces. After the semantic framework formulation of the mentioned concept, recognition of tools instances in the context of nowadays cities have been considered. In the process of this research, the phenomenon of augmented reality has been retrieved, with its definitions and capabilities as tools for the realization of technological synthesis in the context of current cities. Another result of this research is the introduction of some advantages in applying augmented reality in cities.

Keywords: *Urbanism Machine, Technological Synthesis, Augmented Reality, Urban Fabric, Virtual Space.*

INTRODUCTION

The beginning of the 21st century has been accompanied by more sophisticated urban systems, in recent years there has been a huge shift in the world's population divisions and more than half of the world's population now lives in cities. By 2030, according to the UN " s forecast, it will reach 60 % in 2030 (UNFPA, 2007). Problems in cities have spread in many areas and have created intertwined problems that cannot be solved by a conventional procedure. These problems exist in almost all major cities of the world, with varying strengths and weaknesses, and in practice stems from the lifestyle of their residents. Air pollution, waste management, the inefficiency of transport systems, overcrowding, and lack of social and spatial justice as well as the lack of integrated urban management are known examples of these problems. In addition to the aforementioned cases, in recent years a new range of problems arising from the use of cyber-systems and the use of online services by government management systems has been applied to the set issues of cities. The unbridled expansion of information generation and the lack of management of their use on the one hand and the lack of familiarity with a large part of the urban community, with the use of cyber services has caused the disruption and inefficiency of these systems in facilitating urban life. Townsend In the manual of urban informatics, decision - making for different locations and diversity of people in cities requiring sophisticated models and simulation tools to be needed, tools that can be capable of responding to broad aspects of city behavior and residents, such as transportation, facilities, welfare services and the environment they need. Besides, he believes, these tools should not only be provided by trained city planning and management systems but also the inhabitants of cities should also have access to them. The deployment of web services and services that shared experiences provides on the Internet also opportunities provide for this partnership.

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According to the above-mentioned issues, in many cases, appropriate understanding and action on complex issues need real-time consideration with flexible visibility on micro and macro scale (Foth, 2008, 494). The machining approach to the urbanism paradigm and its related issues has stemmed from the necessity of real-time response to urban issues. Urbanism machines can be considered vertical, comprehensive, inclusive, fast, and reproducible mechanisms that responding ability has to a wide range of city problems through their system logic (Ziaei et al., 2017). Machine approaches to the urban issue have existed in different historical sections and have been applied, although users are not surrounded by it. In Table 1, the evolution of machines has been shown.

Given the explanations provided about the current status of the city and its residents, as well as the role of information and information tools in resolving these issues, the importance of the mediating role of these components is highlighted. Technology has received much attention as a tool capable of linking humans and matter. Emerging technologies have improved the role of the city in response to increasing requirements and its variable and have been involved in providing new public and collective experiences of urban space (Boyer, 1996, 211). With the use of new tools, conventional structures of matter and information relationships, standards and spaces have disappeared in the city and a new system has been created in which the intermediary space is considered the subject matter (Manovich, 2001, 69). The urban machinery can be attributed to a combination of technologies on a different scale in the last few decades that will affect the urban fabric as the intermediary space between man, matter, and information are intertwined By utilizing this machine, to create a living organism that will result in more than common patterns and behaviors. This machine can briefly be called technological synthesis (Lim, 2005, 14).

This research aims to define and explain the theoretical framework of technological synthesis as an urban machine in the present decade, introducing means to its implementation in current conditions. Assuming that the theoretical framework of the research is that the intervention and presence of software in the city fabric be as influential as the type of hardware. Besides, it is expected that the virtual representation of some urban services or the providing of additional cyber services, will significantly improve the efficiency of urban spaces.

Considering the above literature, the questions that this research tries to answer are:

What is technological synthesis?

What are its fulfillment components in urban spaces?

Which aspect of innovations can be the supplier of technological synthesis instances in urban spaces?

What are the interventions of applying the technological synthesis in urban spaces?

Literature Review

During modernism, cities were structured based on the propagation of interrelated forms and dividing them into functional packets, but contemporary urban planning has a much more complicated system capability. In the last few

Table 1: Retrieved machines for some historical eras and their attributes. (Source: Ziaei et al., 2017)

Source	Attribute	Retrieved machine	Historical era
(Morris, 2013, 39)	Colonial development- dual-core evolution- grid pattern	Colonial expansion	Greek civilization
(Morris, 2013, 61)	Perpendicular streets- forming a forum besides the corner of perpendicular streets- grid pattern	Castermetation	Roman civilization
(Hager, 1966, 14)	Undocumented rules	----	Medieval age
(Pakzad, 2010, 346)	Symmetrical axis- Blocking scenes and perspectives with sculpture- repeatable facade pattern	Cellular balance	Renaissance
(Pakzad, 2010, 405)	Endless perspective& Magnificent scale	Square and straight path	Baroque
(Corbusier & Eardley, 1973, 82)	Baroque standards with effects of a new lifestyle	----	Post- baroque & industrial revolution
(Habib, 2012, 171)	Urban refinement- urban planning	Zoning	1930-1950
(Habib, 2012, 171)	Focus on the Urban landscape: public areas, pathway, Neighborhood Center, lightening	Process	1950-1980
(Friedman et al., 2008)	Pluralism, participation, interactivity, and sustainability	Interaction	1980-2000
(Lim, 2005,14)	Impact of the city as the space between man, matter, and information	Technological Synthesis	2000- yet

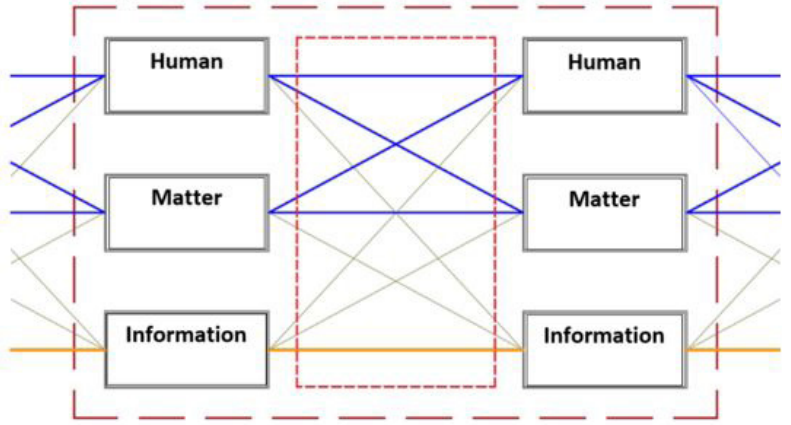

Fig. 1: Abstract diagram of the relationship between human components, matter, and information in the context of a contemporary city

decades, human lifestyles have placed contemporary cities amid complexity and urgency (Palumbo, 2000, 37). The problems and issues of urban life dramatically have expanded while recognizing the nature and origin of many of these problems due to their combinatorial character is unclear and indistinguishable. Besides, the necessity of quick decision-making and timely reaction to solving or controlling problems has questioned the effectiveness of knowledge and common tools of the management system and urban planning. In general, in the present era, topics related to the city can be searched in three domains of the city, information related to urban life and its inhabitants (Foth et al., 2011). In simpler terms, the characteristics and the relationship between the three components of man, matter, and information can be considered as influential parameters of this discussion.

The relationship and feedback between the two components of human and matter, as well as their interactions with each other, in traditional and common living systems, management, and decision-making in the urban area, have been tested and their qualities and standards have also been studied. On the other hand, with the development and evolution of the sciences related to data collection and analysis, data management and communication techniques have also expanded significantly. Given this, as illustrated in Figure 1, the link between the mentioned three components is very complex and varied, in most cases because of the lack of common pattern and language between the components; these relationships are accompanied by problems and have numerous shortcomings.

Many experiences have been made to correct and facilitate this kind of communication. Christoph Vedichko studied the problems of city inhabitants' communications with one another in his article in the architectural dialogue book, and regards intolerance and sympathy with others, especially against the immigrants and strangers, resulting from an inability to communicate properly with one another. Vodichko offers a tool to solve this problem with the help of technology (Figure 2). A portable tool that possesses the ability to mediate between humans and information by relying on technology (Read,

Fig. 2: Strangers' stick (Source: Read, 2002, 93)

Fig. 3: Bandolier (Source: Read, 2002, 107)

2002, 88).

Vodichko goes further in this regard and this tool identifies as an agent's relation with itself or an enhancer of that relationship. (Figure 3)

Regarding other elements studied in this study, there have done extensive studies and developments. The paradigm of a link between objects is one of these. In this attitude, things like the constituent elements of an atmosphere, relying on the technology tool, will be able to receive and analyze the information and will be able to communicate with each other. Kevin Ashton has described how to manage their chain of things and their interactions in his article "internet of things" (Ashton, 2009). In the last few years, the above concept has also expanded in several fields such as health, public services, transport, and transportation (Sundmaeker et al., 2010). In the first decade of the 21st century, technology has played an unprecedented role in connecting people in form of the Internet revolution. The second revolution in this field is to link things together to create an intelligent environment. In 2011, the number of objects and devices connected exceeded the size of the Earth's population. And in 2013 it reached 9 billion objects (Gubbi et al., 2013).

In the new model of communication (Figure 4), there are visible changes in the structural system of constituent components and the relation between them, relative to the previous situation. With the technology of small and isolated human units, matter, and information in the city bed (Figure 1) were organized into new categories, in addition to how the link between them, which was highly variable and varied in the previous model, is significantly summarized and simplified. Due to this level of simplicity and the availability of a wide range of contacts turned to users of the system, this cycle repeats, reinforcing the system and bringing in higher levels of information, capital, and users.

Given these explanations, it can be said that technology has created a hybrid platform that is capable of creating new rules

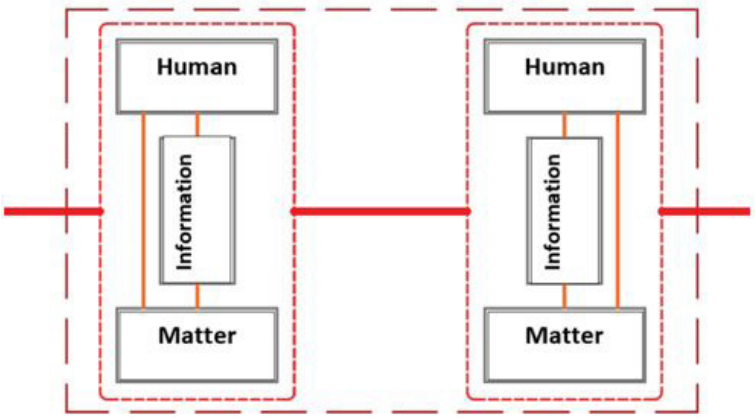

Fig. 4: Abstract diagram of the relationship between human, matter, and information components through technology.

for the relationship between humans, information, and matter. This emerging system has challenged the role of the material city in responding to the public and collective experiences of urban spaces (Boyer, 1996, 27). The conventional system of information and matter, instructions, and space has fallen in the new system, and intermediary spaces have become architectural (Manovich, 2001). In this new paradigm, the role of the present-century urban machine (technological synthesis) can be generalized to a set of tools associated with the experience of urban space.

It (machine) participates in producing living organisms with information and removes common norms in urban behaviors and patterns. CG Lim has discussed this issue in his book entitled “Tools" (Lim, 2005, 38)

As urban issues are more and more produced through their chaotic process, the urban machine, such as a hybrid system, is defined by reconstructing multiple variables in the form of a spatially visible form. These machines have the potential to create a new kind of sustainable or temporary urban geography on a large scale using their tools or plugins. Urbanism machines influence the patterns of urban life and urban life through communication in the city. In this new definition, context refers to the spatial-environmental relationship that the machine creates, especially how the context directly affects the interaction and behaviors that occur in it. The subject which we have to pay attention to is the capacity of these machines to accommodate spatial parameters in a manner that acts as a mediator of the environment and human scale because the scale-related issues in this connection related to the type and amount of human interactions resulting from technology.

Based on the above, concepts such as contextual, human scale, spatial cognition, interaction, and social participation have been redefined in the present context of cities and have new meaning. The change in the meanings mentioned will also change the procedures for realizing the structural concepts. Hence, the necessity of changing or developing the tools and strategies for achieving related objectives is identified. In other words, in parallel with the expanding complexity and complexity of management and life problems in cities, the spatial expression of "mixing of matter and information by technology" will be clearer with a direct ratio.

McLuhan discusses how human empowerment and the scope of his work are enhanced by technology in the book "Understanding the Media: Additions to Humanity". He believes that individual and social consequences of each activity arise from a new scale that will be added to our daily lives by any of our extensions or any new technology we apply (McLuhan, 2003, 19).

MATERIALS AND METHODS

This research is based on a comparative study on phenomena or selected items for allocation and presentation of particular patterns to the technological synthesis of cities. Library studies have been done for literature review. The methodology of this research is based on conformation and analyzing the content of the kinds of literature, therefore, in order to achieve the aims of the research, a theoretical framework for creating a codified model based on the topic is provided, and then the studied phenomena are compared one by one with the created pattern to retrieve the most similarity. Finally, the result of the process is categorized and presented in the form of codified definitions.

Theoretical Framework

Based on the above explanations and completing the theoretical framework created for discussion, technological synthesis can be defined as merging, cohesiveness, and mixing, which is created by mediating technology between the physical, information, and human components in the city. Lim, in his book "Devices", has introduced technological synthesis as the urbanization machine of the present century (Lim, 2000(. This material machine contributes to the creation of a living organism with information and eliminates common norms in urban behavior and patterns. Urban physical due to the flexible features of this organism as a host has overcome its Conventional physical constraints and with the technology tool for the achieving to expected purpose has been empowered.

The information diffusion coefficient, as well as its efficiency index increases, and the production cycle and information feedback, are accelerated. Consequently, the range of services that can do remote has increased and there will be significant changes in the loading of urban transport systems and direct and indirect costs resulting from it. On the other hand, the diversity of communications is reduced and their quality and amount of selectivity are increase.

Applying technological synthesis[1] can increase the efficiency of the city, dramatically reduce urban and urbanism costs, promote social justice, improve the level of security and citizen satisfaction with urban life, increase the level of sustainability, and, in general, the agility of the entire organism's collection, can be considered toward incentives. These machines are tools designed to respond to specific urban conditions and they are part of the city. They provide an environment that is an inquiry to the use of space production or is manipulated to achieve a specific purpose.

The scope of the new definition of user interaction with the artificial environment in the technology-based mixing process is more widespread than its previous kind. In this case, in addition to the conventional relationship between the user and the environment, a virtual relationship is also extracted from information exchange processes (Figure 5). The information is collected by environmental sensors in this process that capable of recording and retrieving environmental data and transmitted to computer servers for analysis and storage. In the next steps, The generated information is used by different systems and presented to the user in different translations.

With precision in the process of working this machine, its

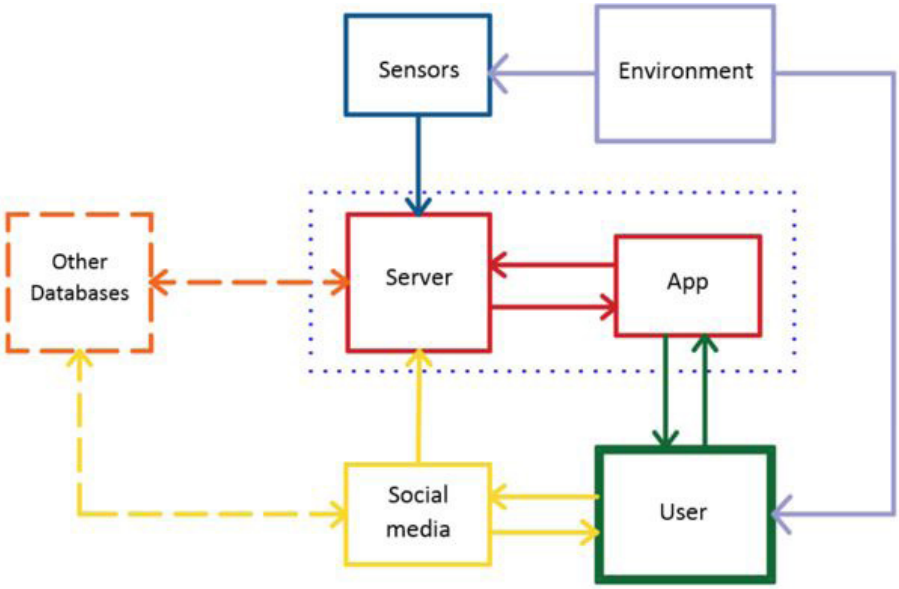

Fig. 5: Performance diagram of a technological synthesis unit in the context of the city physical

distinctive feature is the addition of information components to the actual operating context of the machine, is marked. Adding information layers to the functional framework of the machine mechanism enhances its ability to dealing with urban problems and solving them. With the comparative analysis of the new paradigm defined, the above explanations can be described by defining the same augmented reality phenomenon.

Augmented reality is an interactive technology in which the physical environment is integrated with virtual elements. Virtual layers are located between the physical environments and expressed as textual information, photos, videos, and other virtual elements that the user sees from the environment (Carmigniani et al., 2011).

Virtual and real duplication in architecture and urban development are phenomena that do not just belong to today's specific time and technologies. The real space ideas, which were enriched with virtual, existed from the seventeenth century, perhaps before. The confusing boxwood mazes that were made in gardens and Or a reflection of mirrored galleries, Spaces where vision and reasoning become weak and lost, according to the logic of reflection, they have input for entry of augmented reality to the palpable world)Zellner, 2000, 134). In fact, in an urban context, there are four key ways in which power is manifested in augmented realities: two performed largely by social actors, distributed power and communication power; and two enacted primarily via software, code power, and timeless power (Graham et al., 2013).

Virtual reality with eliminating the visibility of the surrounding environment, leads to a full immersion of the virtual world user, while augmented reality enhances user's senses by integrating virtual data with the real world, and reinforces their connection to the real world. This technology is not just limited to the sense of vision and the ability of other senses, such as smell, touch, taste, and hearing (Geroimenko, 2012).

In other words, augmented reality is a user interface that embodies geospatial information in place-based applications (Reitmayr & Schmalstieg, 2003). On the other hand, augmented reality can be used as a tool in the context of consciousness and be also used in some cases such as navigation, planning, and prediction of systems performance.

RESULTS AND DISCUSSION

As noted, human, matter, and information are the three influential components and interventions of applying technological synthesis in the city physical. Due to this, positive influence on each of these fields will play a significant role in improving the efficiency and quality of the machine. The role of each of the components and the degree of the effect of each with considering the current situation is shown in Figure 6.

In the above diagram, we can observe that the efficiency and quality of augmented reality are more effective in the city's bed with increasing levels and the number of effective elements and direct relationship between them. However, increasing the smart of objects and expanding its learning, has a more tangible effect than other parameters, and the efficiency of the machine increases with the promotion of this element. The growth of the other two components -the speed of information exchange and the ability of users to use - is significantly influenced by

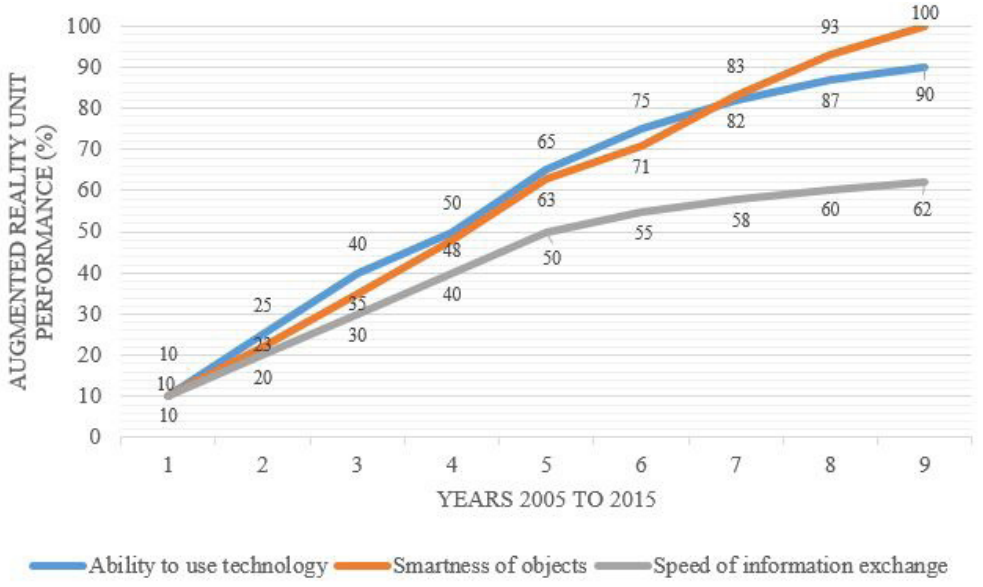

Fig. 6: Comparative graph of the effect of enhancing the components of users' ability to use, object intelligence, and speed of information exchange on machine productivity. (Source: Ziaei et al., 2017)

the results and is limited by their effect on higher values. This is especially true about the speed of information exchange, with the evolution of Internet networks and the introduction of new generations of 4 G and 5 G, the limit of speed required for the application of augmented reality systems is provided and higher speeds will not have a significant impact by the system result in current conditions. The simpler language in the current conditions of investing in object intelligence plays a more effective role than the two areas to improve the speed of communication and education and to improve the ability to use technology.

Different forms of mixing of matter and information mediated by technology have become widely used in the lives of citizens today. Some of these technologies are so integrated into our lifestyle that it seems impossible to imagine their absence. As illustrated in Figure7, interactive routing applications whose information is updated by user activity and based on GPS data services, virtual tours, and online information and survey systems are simple examples of using this feature machine.

The system based on images provided by the device (mobile, tablet, or computer) and its combination with the data extracted from the GPS data convert raw images into valuable guidance, which, in addition to addressing, inform the distance and the possibility of communicating, other people's comments about the locations introduced. Also, the importance of achieving awareness in Society plays an active part in the conservation, enjoyment, and dissemination of heritage. For example, Arroyo and his colleagues, present a method for Connect Smart Cities and Heritage through Augmented Reality. Their new methodology is proposed for the organization and storage of documentation, both original and processed, from different areas and digitized and georeferenced by categorized strata: time, originality of information, scope. To do this, it is proposed to use the augmented reality technology as a hub and documentation connection vehicle (from different times, types, and areas), georeferencing it to the place and allowing holistic, more extensive, deep, and rigorous knowledge of the heritage. Thus, a model applicable to the different scales of approach (territorial, urban, architectural and interior or domestic) and transferable to different architectural models, which allows finding new relationships between different documents that will allow in some cases verify or discard hypotheses about states and previous times (Arroyo et al., 2018).

Augmented reality also, helps to improve quality of life and speedups citizen's activities. For example results of research entitled" New Trends in Using Augmented Reality Apps for Smart City Contexts" show that :

The participants found the AR² View more effective in finding information and services of nearby surroundings more than the Map View, with some participants commenting AR View to be more fun and extraordinary experience in the map sector. The participants have valued, more the interface with information in the pop-ups providing better perceptions of the surrounding vicinity compared to that conveyed by Map View. Also, in this case, extra results showed that, due to the limited knowledge of users about AR technology, they picked specific Apps based on their popularity (Ramos et al., 2018).

Nowadays, many systems have been added to the vast network

Fig. 7: Nokia urban augmented reality software overview. (Source: Arth et al., 2015)

of urban life using the objects internet. Virtual stores, automatic selling devices, vehicle rental systems, all and all are examples of mixing of human, matter, and information in the context new.

As discussed earlier, AR and related technologies can cause an enormously positive effect on urban lifestyle, but it should be considered, when new technologies emerge, they often raise new privacy issues and alter privacy norms, especially when they change how personal information is collected, stored, and processed. While AR and other immersive technologies gain more widespread adoption, there will be two sets of important privacy questions: one set about the collection and use of data about AR users, and one set about the collection and use of data about AR bystanders. This report focuses on the latter set of questions.

As more consumers utilize AR in their daily lives, and governments and businesses explore how AR can improve operations and services, individuals increasingly experience the world through the hybrid realities AR creates. If history is any indication, this transition will challenge existing parameters of privacy and public space. When the virtual and the physical world collide, social backlash and legal challenges are all but inevitable. While the underlying policy questions around privacy and public space have remained largely unchanged in over a century, AR raises new questions that shape how individuals interact in both physical and virtual worlds. Recognizing these distinctions in this nascent stage of advanced AR technology is necessary to develop proactive policy approaches for a new era of digital information (Dick, 2020).

CONCLUSION

The duality of reality and virtual of today's intertwining is sweeping across cities and social classes of countries around the world, which has provided the perfect context for merging the key elements of today's urban life. With these definitions, technological synthesis can be merging, cohesiveness, and mixing, which is created by technology between elements of physical, information, and human being in the city. The components of the realization of this interaction, as defined by it, include:

Prepare and welcome the inhabitants of the cities to use relevant technologies.

The deployment of smart service services and systems with functionality to network, in the physical of the city.

Providing the information exchange infrastructure as well as increasing its speed.

Each of the above-mentioned issues can be formulated as a comprehensive description and strategies necessary for their realization in future research. According to the objectives defined in this study and during comparison of the pattern created, with examples of technological synthesis, the

phenomenon of augmented reality can be introduced as a means to realize technological synthesis in the urban space. Adding functional layers of information to the city's physical body and allowing public access to it, is a manifestation of using Augmented Reality as an urban machine. the main purpose of using technological synthesis in the field of a city can be called planning, design, management, and use of urban space, using this mechanism, the advantages of machine use, including the creation of partial justice, increasing the speed of processes, repeatability, and predictability of phenomena, are spread in the area of the city bed, and It will help improve the level of life fit for the inhabitants. Regarding the policy to promote the expansion of the components of augmented reality in the geographical area of cities, according to studies, it has been suggested: that investment in the intelligentization of urban installations, structures, and furniture as well as their related platforms is a priority. And, along with that, planning for public education to use augmented reality symbols. Considering the status of existing communication infrastructure in cities, especially on the internet bed, it is currently an investment to upgrade and develop the network in lower priorities.

Considering the scope of augmented reality application in urban life, it can be said that conscious mixing of reality and virtual in urban contexts will create a sense of place and shared memories for residents, increase citizens' socio-spatial participation and influence their decision making and Decision-making in the field of urban management will increase. It will also improve the quality of urban services and increase the income and economic prosperity of cities, especially in the service sector, by establishing links between service providers and service receivers. Besides, investment in this area increases tourism and attracts urban tourists, and balances its costs. In short, the use of augmented reality as an urban machine will embody the Big Data in urban life and the use of its numerous benefits in the life of citizens.

ENDNOTES

1. Matter-Information Hybrid via Technology
2. Augmented Reality

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