

Children and the Mediated City. Place Attachment Development Using Augmented Reality in Urban Spaces

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Abstract. Nowadays technology has become an essential component in our urban environments. The mediated city is a concept that takes advantage of various kinds of technology to enhance the functional efficiency of daily urban life. Augmented spaces are one of the main elements of mediated cities which use Augmented Reality (AR) to facilitate communication and interaction between digital and physical spaces. Children, as users of augmented spaces, have the potential to explore mediated cities using various AR-enabled accessories. This ability gives children the opportunity to get a closer sense of connection to their city and experience place attachment which is the emotional bond formed between themselves and the place. This paper explores three case studies that exhibit how children use AR technology to develop various skills. Our goal is to promote AR as a contemporary tool that helps children better perceive and experience the feeling of place attachment in their city.

Keywords: Augmented Reality, Children's media, Children's urban perception, Mediated City, Place attachment

1 Introduction

In Kudriavtsev's opinion, childhood is a period of human life where one's potentials, which are the building blocks of future growth, are developed. These potentials, such as a child's physical and mental abilities, flourish as they experience social interactions with their peers [1]. Urban spaces are one of the places where children spend their time walking along streets, playing in alleys, and taking part in various activities. Children can acquire their much-needed life skills by engaging in their city environment and developing abilities while enjoying urban experiences. On the other hand, the knowledge of using technological devices such as video games, entertainment software, and different forms of recreational technology are considered essential life skills in the twenty-first century. These days the use of technological devices is so prevalent among

children and has been documented in different countries by numerous researchers in recent years. Touchscreen devices like tablets and smartphones have become significantly more commonplace after 2010. Nowadays children spend more time on their mobile devices than they do watching television. According to recent United States data, 97% of households have at least one smartphone, 75% of families own a tablet computer, and 44% of young children have their own tablet computer [2]. This finding shows that technology has become so commonplace nowadays that even a very young child can communicate with it and spend significant amount of time using it. However, the other side of the coin of children being entertained at home with a tablet, mobile phone or other technologies, is their diminished presence in the city. Therefore, in order to make the urban space more attractive for children and increase their desire to engage in such environments, one can use technologies such as AR due to its fun yet educational nature. The focus of this paper is on AR as a tool that can attract children and provide them the means to interact with their environment and the virtual world in the form of augmented 3D spaces. By using AR, some concepts like place attachment can be developed. Place attachment is one of the senses that the child builds while interacting with the surrounding space and makes them feel closer to it. In that follows we shall investigate three case studies that show how children feel experimentally closer and more connected to spaces with the use of AR. We also study how this technology can be used to enable creative interactions where children can develop abilities such as physical and social skills and spatial cognition.

The research sub-questions are as follows:

- 1- How can children improve their urban spatial perception with Augmented Reality?
- 2- How can children interact within the augmented city and the physical environments simultaneously?

1.1 Children and Urban Space

Children need to gain experiences in different environments such as home, school, and urban environments in order to develop their abilities and skills. Outdoor activities are an opportunity for children to experiment freely, run, climb, and jump to explore the world that surrounds them. To this end, cities as outdoor spaces play an important role in a child's health, wellbeing and development. Furthermore, urban spaces can provide opportunities for children's play, social interaction, and independent mobility [3]. Historical data shows that while growing up, children use the same urban spaces as adults such as buildings, bazaars, public spaces, and pathways [4]. Compared to adults, children probe their environments by being physically active and playing in various ways like climbing, jumping and balancing. By this way, children set their own rules to use the environment and adapt themselves to their surroundings. Streets, as an urban space used by children as a playground, are a place to spend time with peers and encounter adults. Jane Jacobs in 1961 cited that children need "an unspecialized outdoor home base from which to play, to hang around in, and to help form their notion of the world". Streets and alleys could exactly be this type of space. Children while are in the street, can explore their social relations, improve social competencies, and gain independence. Furthermore, streets provide a variety of playing choices for children

like ball games, wheeled toys and equipment from home [5]. The other spaces that children use in the city are playgrounds. Playgrounds are specialized open spaces in towns and cities which are designed for children. The concept of playgrounds came out during the nineteenth-century when the rapid growth of urbanization happened [6]. Aldo Van Eyck was one of the pioneers in playground design. Cities, architecture, and playgrounds for children were his main subjects, which led to him introducing the concept of “City as Playgrounds” around 60 years ago in Amsterdam [7]. Aldo Van Eyck playgrounds are simple and contain familiar shapes which children can easily perceive and communicate with [8].

In the early 1970s, the study “Growing up in Cities Project” conducted by Kevin Lynch in collaboration with UNESCO, investigated how children’s utilization and understanding of the environment affects their behaviours and characteristics. According to this study, by roaming and playing in the urban environment, the child learns to use the city as a learning ground. The study was revisited, expanded in scope, and performed in several more cities during the 1990s. Also, this study found that, children who take part in the life of their city “gain a strong personal identity and sense of belonging from the cultural richness and social density of their daily lives” [9]. Nowadays technology has an important role in various aspects of children’s life such as in games, relation with friends, and education. In many instances, children’s relation and familiarity with the technology is more than that of adults. The technology that children use today has substantially changed from past decades. For instance, video game devices that are no longer limited to consoles that attach to TV sets but are now available in the form of handheld devices or even in smartphones [10]. Also, compared to the previous generation, today’s children start their interaction with the digital world at earlier stages of their environmental perception development. This further emphasizes the digital divide between generations. However, as a result of children being entertained with technology at home, their presence in the city is slowly diminishing. Yet by bringing technology into the city, citizens will become more fond and satisfied with their environment. Also, children as citizens of the digital city, can be entertained by healthy experiences that improves their quality of life and encourages them to engage more with the city environment [11]. Based on the above, with their presence in the city, children can improve their knowledge base about the urban environment and go through various experiences that further help in developing their physical and mental abilities.

1.2 Children’s Urban Perception. The Obsolescence of Traditional Public Space

Perception is the procedure by which humans receive information, process it, and utilize it to understand their environment. To this end, Kootler defines perception as a thought process that involves receiving information, selecting, categorizing, and then interpreting it [12]. People can communicate with the environment by taking part in it and gaining information in order to perceive their surroundings. On the same subject, Norberg Schulz mentions that people’s immediate awareness about their environment is obtained through the perception procedure. This procedure helps humans to understand, translate, and draw relationships with their surroundings [13].

Children recognize their environment and perceive it using tactile, auditory, and visual senses and develop environmental cognition by observing, questioning, and using their skills over time [14]. In an urban environment, children are present alongside adults. Their growth and skill development is substantially influenced by their interaction with the environment. Children learn and become familiar with the urban space through cognitive, affective and evaluative means. Cognitive development occurs with the child's recognition of play spaces and discovering spaces, facilities, and features. Affective development is gained through awareness and sensitivity to the physical and environmental factors. It also alludes to positive feelings and emotional attachments to a place [15]. Finally, evaluative development considers the relation of values of nature to childhood development. Among those values are aesthetic (physical attraction and appeal of nature) and humanistic (emotional affection for nature) values, which familiarize the child with nature and inspire the child to form a sense of closeness to it. Children present in the urban environment become sensitive to its features which permits them to explore the space and communicate with it [16]. The children's experiential perception of the environment gives them the chance to experiment various skills while growing up and help them in developing their knowledge [17].

2 Place Attachment

Phenomenological studies are the first class of literature that have dealt with the place attachment issue. Altman and Low described this concept as an emotional bridge between people and their environments. In their statement, place attachment includes interactions that are between emotions, knowledge, beliefs, and behaviours that occur in an environment [18]. The concept of place attachment involves psychological and functional aspects of human's communication with their environment. It also denotes people's desire to maintain a close feeling to a specific place [19]. By understanding place attachment, humans can experience the attraction and meaning of places. Furthermore, they can develop their experiences and behaviours through the network of memories and identities that originates from place attachment [20]. This concept stems from people's emotional feeling towards a particular place and describes how people perceive the environment space and communicate with it. Also, this notion is the positive emotional attachment that expands through place and the person [21]. Humans identify themselves by relating to places which they feel attached to, where they can remember past memories or expect future interactions [22].

Children, just like adults, can also experience place attachment. Chawla describes that this experience in children is not only to satisfy their physical needs but it is also to fulfil their intrinsic qualities. Children attach to a place when they experience joy while they are in it and have undesired feelings of regret when they leave that place. In Chawla's opinion, children's favourable places are those that invoke security, social dependence, and opportunities in the direction of exploration and creative expression. Along the same lines, Sobel concluded that in this kind of places children can have a sense of self-belief and the power to influence their own thoughts [23].

3 Mediated City

Nowadays we constantly witness the utilization of new technologies in our cities. To this end, the mediated city is becoming an integral concept in forming the cities of the future. Generally speaking, mediated city is a city that takes advantage of various kinds of technology to enhance the functional efficiency of daily urban life.

In our daily life, we are often engaged in experiencing and navigating our city environment that is increasingly being integrated with the digital world. Such experiences are manifested in urban people's lives by their daily usage of technology. Among a plethora of mediated city features, one can name online navigation and location sharing services such as Google Maps, digital infrastructure, concepts like urban installations, intelligent cities (ICs), and art projects such as New City¹ and WikiCity² Rome, whose challenges are to imagine, demonstrate, and help people perceive the world with new spatial models and experiences [24].

Augmented spaces are envisioned as one of the core elements of future mediated cities in which Augmented Reality (AR) tools are used as a means of communication and interaction between digital and physical spaces. In Lev Manovich's opinion, an augmented space is a physical space overlaid with dynamically changing information which is in most cases in the form of multimedia adapted to the needs of individual users. This type of space features wearable computers, wireless location services, ubiquitous computing, tangible interfaces, and other technologies the list of which is growing by the day. Many of these technologies, connect their users to their surrounding physical environment -which is often an urban space- in different ways [25].

Furthermore, augmented spaces spread throughout the city can collectively create augmented cities where virtual urban objects that represent their physical counterparts -and that are as reliable as those in the actual world- complement the physical world. This city is a contact point between the digital and physical worlds in which augmented urban spaces improve people's spatial cognition [26].

4 AR and Child's Development

In the current era, technology has become prominent in people's lives, especially for the new generations. Children nowadays, instead of using traditional means of entertainment such as typical toys and tools like blocks, dolls, and balls, are more inclined to use technological and digital devices. Technology gives the child the opportunity to play, explore and learn life skills. AR is considered as one of the technologies that helps children interact with their environment and the virtual world.

¹ New City is a virtual world created by Greg Lynn. This city is created as a topology in which the earth is mapped onto a folded virtual manifold. The information used to create this topology is based on live data fed from the internet.

² In the WikiCity Rome project, users have the ability to navigate the city using AR. Here users can experience an intertwined physical and virtual environment <http://senseable.mit.edu/wikicity/rome/>.

This communication can develop their abilities such as spatial cognition and physical and social skills. With AR, children have the potential to learn about spatial content which means that the child can explore and understand spatial relationships between digital and physical objects located in mediated cities [27]. Also, Augmented Reality enriches children's senses of touch, sight, and hearing, and enables them to see and/or hear beyond what already exists in the physical world [28].

AR can simulate physical entities for children in order to attract them, and in addition helps them experience imaginative participation and cognitive interaction. Furthermore, AR helps a child's psychological development and arouses their desire to learn [29]. In the opinion of Shelton and Heldey, AR interfaces are the combination of procedural and configurational knowledge. This technology is a procedural knowledge because of the immersive senses that users can experience by the 3D display while standing or moving inside a mixed reality world. The configurational knowledge of AR is due to the interaction experienced by learners while holding a 3D model in their hands and observing the geographical space [30]. Hence, by using the procedural and configurational knowledge-enhancing aspects of AR, children can perceive their environment and learn many things towards developing their abilities and skills.

On the other hand, since children are inherently attracted to use new technologies, tools like AR should be utilized in a positive and appropriate way to help them in improving their skills and get ready for presence in the society. Nowadays, AR is a creative way to introduce the physical and digital worlds and can be used as a modern pedagogy tool for children's education.

4.1 AR and Place Attachment

During the past decades of urban environmental development, the emergence of digital technologies has affected people's experiences in such places. These days, digital technologies have paved the way for a new kind of interactivity in public urban spaces, where we not only use such technologies to interact with other people, but can also be reacted to, and even interact with the urban environment itself [31]. One of these digital technologies is AR that facilitates human's interactions with their environment. Using AR people can grasp more detailed information about their environment and communicate with it better, which is an opportunity for them to explore their living space. By probing their environment and getting a closer sense of connection to it, users can experience the emotional bond between themselves and the place. This phenomenon is called place attachment. People can utilize AR to perceive the sense of place attachment much more deeply, that can substantially improve their spatial comprehension.

Pokémon Go is an AR geolocation game that was developed and published by Niantic in collaboration with Nintendo. In this game, players interact with virtual characters rendered in a physical space while also initiating relationships with other players. This is a fitting example where AR enhances an ordinary environment with the feeling of place attachment. Such features help users see their local area in a new vision and make them more aware of their everyday surroundings. Furthermore, playing Pokémon Go tends to develop memories for future recollection which are tied up with physical spaces and feelings of belonging [32].

5 Case Studies

Magical Park, Minecraft Earth, and Geocaching have been used as the case studies in this article due to the opportunities they provide for children by using AR technology as a contemporary tool to help them develop various skills, better perceive their environment, and experience the feeling of place attachment.

One of the noteworthy AR games is *Magical Park* developed by GEO AR Games, which turns select New Zealand parks into digital fantasy lands. This game has also been launched in the United States' parks as one of the first digital playgrounds in 2020. In collaboration with the New Zealand Recreation Association (NZRA), this application provides a new augmented reality experience for children by getting them to interact with outdoor spaces and attracting them to the surrounding natural environment. *Magical Park*, currently rolled out for nine of New Zealand's urban parks, has turned such urban city parks into digital playgrounds. Using a mobile device, the *Magical Park* app encourages children to explore the park and run around, by engaging them in games played inside a blended virtual environment (Figure 1). This AR game is appropriate for children 6 to 11 years old [33]. *Magical Park* has a variety of games such as Evergreen, Robotica, Ocean Rescue, Alienscape, Augmentia, Prehistoria, Halloween, Christmas, and Easter Dinosaurs. The *Magical Park* game promotes inclusivity where the child can play both alone or collaboratively while searching for treasures and gems [34]. In the video interviews which are accessible in the Geo AR Games YouTube channel, some children who had experienced the game mention that it is a great game because it makes them excited and also is a challenging game filled with joy which is good for their cognitive skills [35, 36].



Fig. 1. Children exploring park by mobile device and the *Magical Park* app [33]

Minecraft Earth is another AR game that was developed by Mojang Studios in 2020 which ended its support for the game in June 2021. This game brings the blocky

construction set into the physical world. Minecraft Earth users do not pursue any specific goal; they can merely create, build, and explore in freedom while playing alone or cooperatively in a real territory or in an environment created by the players [37]. Here, the user can develop a scaled-down version of the intended AR creation on a table indoors, like when assembling a Lego set, and then lay it down outdoors where it scales up to real-life dimensions. These virtual structures are steady and locked down to a specific location, letting any other player who visits that place admire or disassemble and rebuild other people's creations. Minecraft Earth can be a collaborative environment where multiple users can brainstorm and co-operate to make virtual creatures and structures (Figure 2) [38].



Fig. 2. Users creating a virtual creature together [38]

In Minecraft Earth, a user can invite a friend using a QR code so that they can work together on a creation. This way, friends nearby that have the game installed can scan the QR code and join the buildplate and interact with others [39]. This AR game forms communities and groups that share creative creations, demonstrating the social aspect of Minecraft Earth [37]. In this digital world, children can bring their imagination into life using digital representations of various materials. Furthermore, they can play, learn, and explore different skills in this augmented space which they can identify with and own. Minecraft Earth enables the users to build creative structures like buildings, streets, sidewalks, urban parks, entire cities, and landscapes, or even elements of the environment such as forests, trees, and other components. The base of these constructions can be real or fictional spatial contexts, that allows the players create an environment that shows a city, a landscape, or any other place on the planet earth [40]. According to the children's opinions collected from November 2019 to December 2021 about this game in the Common Sense Media webpage, they mention that they like Minecraft Earth because it is fun and is an educational game for them that develops their art, creativity and motor skills, and is also appropriate for children of all age groups [41].

Geocaching is another game that is based on a Global Positioning System (GPS) receiver, internet, and the user's ability to discover their environment. In this high-tech treasure hunting game, users hide a cache (typically a small waterproof container) in

some location and post its coordinates along with some clues on the Internet. Other users by visiting the web site database, can gain the coordinates and use their GPS receivers to find the cache. Although the game is not as easy as it sounds since the GPS receiver usually does not lead the user directly to the cache, and this is where the power of one's observational skills comes into play [42]. This location-based activity requires people to look at specific features in their environment and correlate it to the posted clues in order to be directed to the final GPS coordinates of the cache [43]. Geocaching is an example of a social online game where social interactions between users is an essential part of the game. This game encourages children to navigate and explore their surrounding environment and interact with other children while improving their technology-handling skills [44]. In the video interviews accessible via the Geocaching YouTube channel, some children who had experience with the game say that they love the game because it is a fun game that entails treasure hunting tasks and hiking at the same time as getting them to do some exercise outdoors [45].

Research on games has increased remarkably since 2003 and many efforts have been made for game classification. Rollings and Adams as game designers categorized the games into core mechanics, interactivity, and storytelling and narrative [46]. Another classification proposed by Bernardes is based on the size of the gaming area in terms of physical space, which is divided into three categories: large areas, limited areas, and prepared areas [46]. Also, in another classification, AR games are classified based on the tracking method used. Here, AR games are divided into four categories of marker-based mobile game, accelerometer/gyroscope-tracked AR game, GPS-tracked AR game, and spatial AR game [47].

In this paper, based on the children's activity and their interaction with their environment in the game, the features of the case studies have been categorized into adventure, exploration, and collaboration. These features have been extracted from articles and papers and the main web pages of the game developers that are referenced in this article.

The features in Table 1 such as adventure, exploration, and collaboration emanate from children's play in the studied case studies that help children to feel the features of place attachment. Children in these case studies explore their environment alone or collaboratively to find treasures and hidden caches or make their virtual creatures and structures in the physical environment. These case studies have the potential to attract children to the physical outside space by the adventure, exploration, and collaboration features which they gain through the game.

Exploration is the urge that encourages the user to participate in the game. By acquiring this sense in such augmented spaces, children can increase their knowledge about their environment and better communicate with it while enhancing their skills such as creativity, communication, and responsibility. Collaboration makes the users explore their environment through teamwork. By encouraging them to interact with each other throughout the game, children subconsciously build relationships with other users and hence improve their social and physical skills. In these case studies, children go through adventures to explore spaces and become familiar with the environment which helps them build their spatial awareness skills.

Table 1- Case studies and their features (Author)

	Adventure	Exploration	Collaboration
Magical Park	The imagination of fantasy and imaginary creatures in the environment and interactions with them	They explore the park to search for treasures and gems	While playing collaboratively they have interaction with other children to search for treasures and gems
Minecraft Earth	They can have their own digital territory that has been made by themselves in the city environment	They can disassemble and rebuild each other's creations	Multiple users can brainstorm and co-operate to make virtual creatures and structures
Geocaching	Players in this game have the challenge to find the hidden caches	Users discover their surroundings on the way to find the caches	Social interactions between users while they are searching for the caches

Table 2- Case studies and place attachment's features (Author)

	Closeness feels to place	Interaction between people and place	Memorable space
Magical Park	Communication with the environment through the game	Play alone or collaboratively while searching for treasures	Makes children spend their time exploring the environment
Minecraft Earth	The users themselves creating creatures and structures in the environment	Players can create, build, and explore while playing alone or cooperatively in a real territory or in an environment created by the players	Children can bring their imagination into life using digital representations of various materials
Geocaching	Users look at specific features in their environment and explore it to find the caches	Social interactions between users and explore their environment to find the treasures	Have challenges in the space to find the caches

In Table 2, features of place attachment such as feeling of closeness to the place, interaction between people and place, and memorable space came from the definition of place attachment mentioned in section 2. In these case studies, children experience the features of place attachment by the activities they perform in the games. Children, by exploring the environment while playing these games, communicate with the place and also, search for treasures or make their own virtual creatures collaboratively.

Through these activities, children spend their time in these places which can make the space memorable for them and engage them further into the environment.

According to the tables, Magical Park, Minecraft Earth, and Geocaching can be an appropriate AR games for attracting children to augmented urban spaces to develop their physical and mental skills and communicate better with their city. These games foster children's relationships with their surroundings, helping them develop place attachment, which can be an ideal situation for increasing the efficiency of mediated cities. Some of these games require predetermined spaces, which responsible institutions such as municipalities can invest in, as well as the expansion of traditional playgrounds. This way, such institutions can help improve the city's relationship with children and enhance their perception of their city as their living environment.

6 Conclusion

As mentioned in the background literature review, technology becomes a strategy to design contemporary places in our cities. After this research, we are able to state that AR technology provides children the opportunity to interact with the surrounding environment and improve their spatial cognition through daily activities in cities. This central issue has been addressed through a layered approach focusing on AR urban design opportunities. From this technological perspective, contemporary cities would become more tangible and empathic for children. This technology helps bring urban spaces closer to children and create spatial experiences such as the sense of belonging to a place, known as place attachment. Place attachment emanates from understanding the city, strengthening the communication links between children and their environment, and making the space more meaningful to them. Nowadays, AR is establishing itself as a modern tool that attracts children to the urban space and helps them develop the skills they need to be present and interact with the city. Through a 3D augmentation of physical spaces, this technology renders an interactive means to familiarize children with their city and helps them acquire various positive feelings such as satisfaction, pleasure, and belonging. Using AR, children can connect with their urban environment, explore the space, and create their own memories. In this article, three case studies were examined to show how children interact with AR technology to develop skills such as collaboration, exploration, and being adventurous in the city. Geocaching, Minecraft Earth, and Magical Park are suitable examples for children to interact with the place, experience the feeling of closeness to it, and create memories of the city. In these case studies, children go through adventures to explore spaces by using AR technology as a contemporary tool to develop various skills, help them perceive their environment better and experience the feeling of place attachment. Interestingly, the same technology that mostly hinders children's outdoor activity and makes them stay at home, can in its correct form be a tool that helps them find outside companions and communicate better with their city.

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