Experimenting a Healthy Ageing Community in Immersive Virtual Reality Environment: The Case of World's Longest-lived Populations

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December 1, 2020

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***Abstract*— The ageing of the population in developed countries asks for smart solutions to promote elderly people's inclusion in society. Therefore, how to shape a place that is both smart and encourages healthy ageing is a key question in the field of creating smart and inclusive living environments. Smart placemaking, i.e. the augmentation of physical place with location-specific digital services, offers a range of powerful opportunities to add value to public spaces in ways which can translate into health promotion in society and improved living environments for all. In order to successfully shape a healthy ageing living environment through smart placemaking, one could learn from the experience of successful practices of existing healthy communities. An example of such communities can be "Blue Zones" which are home for the world's longest-lived populations[1]. This paper aims to integrate the process of smart placemaking with learnings from socio-spatial characteristics of Blue Zones in a neighborhood-scale environment in The Netherlands. This integration will be presented in the form of proposing urban and architectural design interventions. The process of integration will be experimented in an immersive Virtual Reality (VR) environment. This paper reports on the feedback received from the participants (inhabitants of the Malvalaan neighbourhood) of the experiment which can lead to a better understanding of the proposed design interventions and, consequently, can help to provide better place-based architectural and urban design guidelines. (*Abstract*)**

Keywords*— Healthy Ageing, Smart Placemaking, World's Longest-lived population, Blue Zones, Immersive Virtual Reality Environment.

I. Introduction: The Question, The Opportunity, and The Proposed Solution

In many developed countries such as the Netherlands, the population is ageing and consequently people are getting more vulnerable to age-related issues[2]. With this notion in mind, the **question** of how to shape a smart and inclusive living environment for healthy ageing still is a key societal issue. Smart placemaking, defined as the augmentations of physical place with smart technologies, offers a range of powerful opportunities to add value to public spaces, in ways which can translate into health promotion in society and improved living environments for all[3]. In its core, smart placemaking is focused on making places better for people, attracting people to deepen their connection with the public realm and, in turn, with each other[4]. Nowadays, local governments, cities, developers, built environment professionals and health organizations are seeking – and often competing – to create successful, liveable neighborhoods[5]. Smart placemaking supports the development of these neighborhoods in a smart and flexible manner[6].

Especially when it comes to execute new projects to promote health, there is an **opportunity** for smart placemaking to learn from the experience of successful practices of existing healthy communities to figure out how they have provided a social and spatial environment for their people to age in a healthy way. An example of such communities are "Blue Zones" which are home for the world's longest-lived populations[1], [7]. Theses Blue Zones are Ikaria, an island in Greece; Okinawa, an island in Japan; the Barbagia region of Sardinia (Italy); Loma Linda, a small city in California, and the Nicoya peninsula in Costa Rica[7]. The Blue Zones' communities are unique because the people there not only live longer, but also stay healthier longer[8], [9]. Besides having a large percentage of people that reach the age of 100, the Blue Zones' population also remain active well into their 80 and 90s, and typically do not suffer the degenerative diseases common to the elderly in most of the industrialized world[10], [11].

In Blue Zones, the concept that residents' healthy ageing can be both an outcome of their socio-spatial environment and their lifestyle characteristics has profound **implications for its measurement**. In 2012, Buettner et al. presented the healthy ageing model of Blue Zones and trademarked it as 'The Power

9'[7]. The Power 9 offered a holistic and imaginative framework for improving health and well-being in a community[12]. According to Power 9, many residents living in the Blue Zones share nine healthy socio-spatial and lifestyle habits that help them to live healthier. Among these habits, moving naturally is the prominent spatial characteristic. Blue zones are spatially shaped in a way that nudge their people to move naturally rather than separating fitness from their daily life activities[9]. For example, in Blue Zones, people walk to a neighbor's house to pick up the latest gossip, they spend their work days in the fields with their sheep, they spend the afternoon gardening, or they walk to work because their village is designed with the human foot in mind, rather than designed for maximum parking spaces and ease of driving[13]–[15]. Among the social characteristic, getting connected to their close-knit companions to create a social network and support system is eminent in Blue Zones[9]. For example, people in Okinawa shape a social support group that begins in their childhood and extends into their 100s. They call this group of lifelong friends as their "Moai"[15]. Originally, Moai was formed to pool resources of an entire village for projects or public works. Today, the idea has expanded to become more of a social support network such as a friendly meeting for a common purpose like to gossip, experience life, share advice, or even financial assistance when needed[16]. Among the lifestyle habits, healthy eating by prioritizing plants and sticking to eating rules like the 80 percent rule - which means not to overindulge in food and stop eating when you are 80 percent full - is noticeable in Blue Zones[17]. Also, nurturing the spirit by belonging to a faith-based community, living with purpose, and building stress-relieving rituals into their daily routines are lifestyle habits that contributed to Blue Zones' inhabitants healthy ageing. Fig1. presents these nine socio-spatial and lifestyle characteristics.

Fig. 1. The Power 9, Source:[12]

Blue zones' socio-spatial characteristics can provide new **opportunities** for smart placemaking to (re)shape the current living environments in a way that is healthier and more inclusive for people to live in. Malvalaan is a small-scale neighbourhood (area= 19073 m2) nearby Eindhoven - the Netherlands. This neighbourhood is located in a high rental cost and property value area in Eindhoven. However, it is socially and spatially segregated from the nearby areas and therefore its residents discern a kind of socio-spatial discrimination. Meanwhile, a high proportion of these residents are senior population with an age above 60s. So, as the Malvalaan population ages, the chance of being alone and getting vulnerable to health-related problems such as cognitive decline, depression, and heart disease increases. Currently, a Dutch community developer aims to revitalize this neighbourhood into a smart and healthy living environment for its residents. From this standpoint, it is assumed that the fusing the learnings from Blue Zones' socio-spatial characteristic with the recent community development's approach such as smart placemaking may lead to reshaping the current socio-spatial environment of Malvalaan so that it is healthier and more inclusive for its people to live in.

In smart placemaking, the proposition of **immersive Virtual Reality (VR) environment** – as an altered experience of the real-world environment through the imposition of computer-generated elements[18] – can study/explore new solutions by virtually projecting Blue Zones' characteristics in Malvalaan before practicing in real life. Especially, immersive VR can bring an opportunity to investigate what the (re)shaping of Malvalaan based on Blue Zones' socio-spatial characteristics may look like and how the future residents will appraise the proposed design interventions. Hence, a mixed media and prototyping approach is adopted in this research. The mixed-media approach in this experimental study is two-legged. First, using 3D spatial modelling of the neighbourhood and the proposed design interventions in the VR environment. Second, prototyping social VR to enable participants to experience meeting their friends and to socialize in the virtual neighbourhood. The combination of spatial and social VR environments can generate a more comprehensive experience of living environments. As participants are walking through the proposed neighbourhood, they can socialize with their friends and discuss the proposed design interventions. After the VR experiment, gathering participants' feedback can provide the community developers with a better understanding of the proposed design interventions, and consequently can lead to more efficient place-based urban and architectural design guidelines.

II. Methodology and Prototype Development

A. *Project set-up*

This research is led by conducting a mixed-media and prototyping approach using immersive VR environments. It is the first stage offshoot project of a larger research agenda regarding shaping an inclusive smart environment for healthy ageing.

For this study, a spatial VR prototype was developed using Unreal 4 gaming engine, (Oculus RiFT) and Oculus Touch and was conceived as an interactive and highly customizable urban and architectural exploration platform. The spatial VR prototype encompassed the collection of urban and architectural designs based on the idea of naturally moving of Blue Zones including walking routes, meeting hotspots, parking lots (in the furthest space from the building) in the outdoor environment, and stairs, building entrances, and meeting hotspots in the indoor environment (Fig2). This was followed-up by a social VR prototype made in Unreal Engine 4 by Helios plugin based on the idea of Moai involving a group of three to five individuals to gather and socialize in the proposed virtual environment. The Helios plugin used in this prototyping offers a more immersive and interactive environment and enables to explore virtual worlds with other individuals through the steam experiment (Fig2). The final stage of this research involved the actual testing of the prototype: group evaluation of the proposed healthy ageing neighbourhood, collecting feedbacks from the users, and assessing the results.

B. Prototype Development

The development of the prototype adopted mixed-media approach involved 3D VR models, spatial sounds, bitmap textures, and photos. A game engine platform, Unity3D, was used to integrate these varied media inputs and allow a set of proposed user functions.

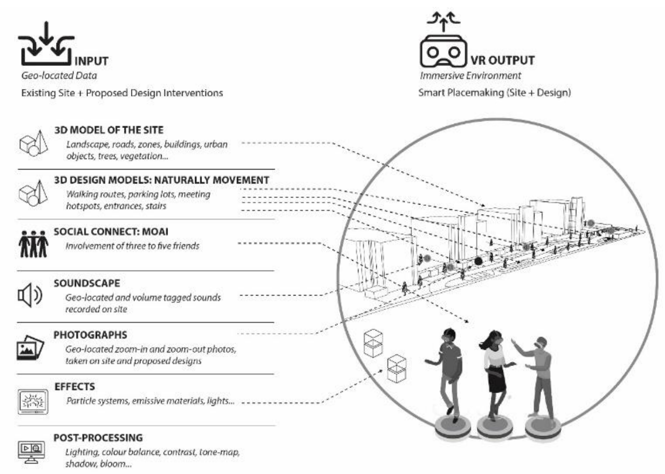

Fig. 2. Prototype Input-Output

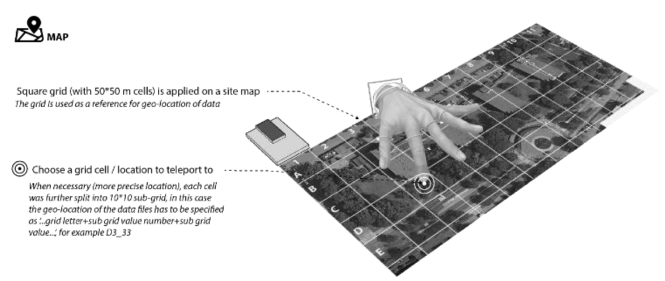

Fig. 3. Spatial Grid and Data mapping / Virtual Interface (Map)nput-Output

To bring all these elements together, the two components of spatial design model (existing site and proposed design interventions) and social networking were integrated in the virtual environment platform, as illustrated in Fig.2: a collection of media representations of the existing site, as well as proposed design interventions, sounds, and visual effects. Such a mixed-media approach was adopted to provide an immersive and interactive environment to the observers (Moai), so that they could socially and spatially experience the place, which included both the existing site of the Malvalaan neighbourhood and the proposed design interventions in a virtual way.

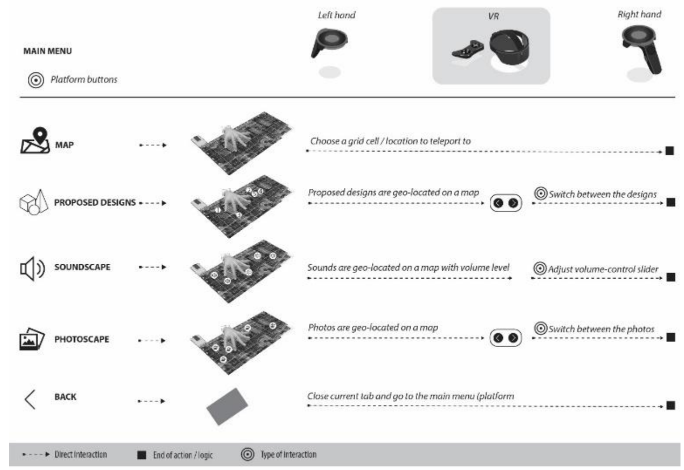

Fig. 4. Virtual Interface (Functionality / Logic)

The user interface (UI) for the virtual environment was designed using the smartphone metaphor. The main menu has five functions and each function has its button on the virtual platform (see top-left in Fig.4); where the observers holds the platform with their left virtual hand, and the buttons are clickable with the right index finger. Once clicked, the buttons would bring up their corresponding sub-menus, which include: (a) 'Map Menu' – teleporting the observer to different grids; (b) 'Proposed Designs' –teleporting the observer to the proposed designs; (c) 'Soundscape', – visualizing the location of sounds on the site, with a master volume slider; (d) 'Photoscape' – showing a collection of photos that propose place-based design interventions; and (e) 'Back' button that closes the current tab and backs to the main menu.

III. Case Study / Testing the VR Smart Placemaking Prototype

The first pilot experiment was organized as a two day "Immersive VR Experience" event that took place at VR laboratory of Eindhoven University of technology (TU/e- The Netherlands). This experiment initiated during Corona pandemic in November 2020 and due to the Corona restrictions announced by Dutch government, the number of participants were limited to 10 inhabitants of Malvalaan. Also, a group of academics including undergraduate and postgraduate students were invited to observe the process and give feedback about the overall VR smart placemaking prototype. Six participants were asked to involve in the VR environment in the form of two-persons groups, and four participants were asked to involve in individually. Since the VR Malvalaan was developed as a replica of actual physical Malvalaan with all spatial details (Figure6), the inhabitants were asked to use the VR environment like the way they use the actual physical environment.

In the VR Malvalaan, nine design scenarios were placed (figure6). The design scenarios were architectural and urban design interventions for corridors, building facades, meeting hotspots, and soundscape hotspots. Each design scenario had its own specifications. For corridors and building facades, three design scenarios were developed, and the participants were asked to give feedbacks about each design scenario and to

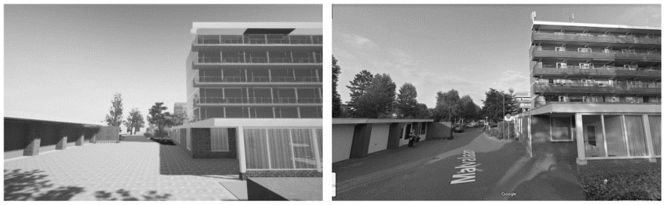

Fig. 5. The picture on left is the VR Malvalaan, which is the digital replica of the actual physical Malvalaan (picture on right). The picture on right is taken from Google Map Street View.

discuss their preferences. Then, while they were walking throughout the VR environment, they were asked to determine their meeting hotspots. This question was asked to consider these hotspots in the future design intervention scenarios. Also, in the walking routes, four soundscape hotspots were located. The participants were questioned if they like to hear the suggested sound content. If not, they were asked to upload their favorite sound content. Also, there were asked to determine their favorite soundscape hotspots

The above process was repeated when the participants were asked to involve in the VR Malvalaan individually. At the end of the event, the Malvalaan inhabitants and academics involved in this project evaluated the positive and negative aspects of this VR smart placemaking prototype. Although many technical aspects of the prototype are in need of redevelopment (e.g. Helios plugin crashed a lot when the group of two-persons were involved in the VR, some widgets in the scenario window functioned incorrectly, some of the mesh actor's collision were disabled) the smart placemaking prototype was considered by those involved in the evaluation to have potential to provide tangible and inspiring experience of socio-spatial characteristics of urban design and architectural design scenarios in an urban setting.

IV. Discussion and Conclusion

The proposition explored in this study was that the past successful practices of healthy ageing communities such as Blue Zones could feed the current community development's approaches like smart placemaking to better shape a smart and healthy living environment for people to live in. The Blue Zones' learnings that led to providing specific mixed-media urban and architectural data mapped within interactive immersive environments could allow for virtually experiencing social and spatial characteristics of a new healthy ageing neighbourhood before experiencing these in real life.

Development of the VR smart placemaking prototype of a proposed healthy ageing neighbourhood suggests that this approach can be successfully used as a foundation/basis for other neighbourhood development projects that are pursuing to empower healthy ageing or other related topics. The "naturally movement" characteristic that is learnt from Blue Zones, appeared to be a key spatial element of a healthy ageing neighbourhood. Although this characteristic in not something new in urban design and planning studies and can be found under the topics like pedestrian neighborhoods (etc.,[19]) or walkable neighborhoods (etc., [20]), Blue Zones' studies, once again, reinforced its importance in designing healthy ageing neighborhoods and therefore reminded us to more concentrate

Fig. 6. The smart placemaking VR exploration of proposed design scenarios in Malvalaan neighbourhood

on the design of walking spaces like walking routes, the location of parking lots (the distance between parking lot and building entrance) in outdoor environments and corridors and stairs in indoor environments. Especially in our VR experiment, it was seen that the ways participants were using the neighborhood walking spaces were rather different than our initial expectations. For example, the way they choose to go home (after parking their car) was rather different than the way we expected to be used. Many of the participants were frequently using green spaces to go home and less were willing to use the predesigned and specified walking routes. It indicated that the walking routes were not being used sufficiently. Also, feedbacks from participants indicated that the proposed design scenarios were yet to be satisfactory. For example, the design scenario for building façade did not meet the participants' expectations for social interaction and instead they suggested other possible designs solutions such as connected balconies can be considered in future implementations.

Our learnings from Blue Zones indicated that social characteristics are important for healthy ageing too. This notion was confirmed in our experiment because we found out that when participants involved in the VR environment in the form of Moais (groups of two-persons), they had less feelings that the time was ticking away, and were more satisfied with the sense of environment compared to the form of individually involving in the VR environment. Probably, one of the main reasons for this result was that when Moai members were socializing during the experiment, they were paying less attention to the details of the environments and were enjoying being together more instead. Based on this latter finding, we concluded that if we invest in improving the sense of social cohesion and inclusion among the community members, it may be possible to reach out to healthy ageing goals despite insufficiencies in spatial environmental design. However, more experimentation is needed to gain a more comprehensive insight into this issue.

Overall, our results confirm that learnings from successful practices of healthy ageing communities have high capacity to be fused in community development approaches like smart placemaking. In addition, our results showed that the affordances of immersive VR environments can allow for better social and spatial engagement between the constructed spaces, and can consequently facilitate more comprehensive exploration and evaluation of the proposed designs in architectural and urban planning settings.

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