

# Digitalization Within the Informal Settlements. Participatory Technologies in Design for Upgrading the Informality in Maputo, Mozambique

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**Abstract**— Participatory Technologies in design offers an opportunity for architects to re-design cities and find new opportunities, in different scales, with their citizens, to create new economic, social, environmental values and provide better public realms and empowering the community by engaging them in participatory actions, aiming at the sustainability of urban public space and rapidly suppress its insufficiencies.

Accordingly, the city and architecture of the future face the challenge of innovation in an evolution that involves society, economy, environment, etc. But what about the informal settlements which are dealing with socio-economic and environmental issues? These neighborhoods present the greatest challenges to human sustainable development and equity, safety, environmental quality, and resiliency central to the New Urban Agenda.

As information and communication technology (ICT) becomes pervasive, the architect has to rethink the rules for communication between the citizen and physical urban space for adapting to the period in which we are living in. Over the last few decades, an increasingly collaborative work developed among spatial practitioners such as architects, urban planners, artists and, media designers; has produced a particular landscape of projects that engage information technology as a catalytic tool for interactions in the physical urban space.

ICT, mobiles, applications, and digital technologies are tools to empower slum residents and their youth to have greater control over their lives. Communities and prosperity through access to information and knowledge are going to be more engaged and empowered. Basically, to develop a public realm or neighborhood or a barrio, the first tool is data. Architects and decision-makers will be the data users. Moreover, citizens will be the Data collectors and, in this system, they can get aware of individual impacts on themselves and the whole. Enabling communities to participate in settlement planning and upgrading including, the management of new infrastructure undoubtedly, requires action at the political level but, we cannot hesitate architect's role to society aim to provide lasting solutions to specific needs and, the active participation of the community lends these additional values.

In this context, the proposed paper will present an overview of the participatory digital technologies involved in civic engagement in informal cities in Africa. This analysis is essential to define the application of spatial acupuncture or plug-ins in the public realm and urban environment to upgrade the informality in Maputo, Mozambique.

**Keywords**— Civic engagement, Participatory design, Participatory technology development, Informal settlements.

## I. INTRODUCTION

**I**N the post-industrial era, cities translated to a human scale, both in physical form and how citizens participate in making decisions and developing their city [1].

By the late 1970s and 80s, participatory architecture got shaped. Scandinavians Pioneered in the 1930s, and Britain and Australia in the 1960s movement gained ground on both sides of the Atlantic [2],[3]. Portuguese experience SAAL in the 1970s was a fruitful experience too. Enabled communities to participate in settlement planning and upgrading including, the management of new infrastructure, undoubtedly requires action at the political level but, we cannot hesitate architect role to society aim to provide lasting solutions to specific needs and, the active participation of the community is needed [4].

In decades, cooperation developed among spatial practitioners such as architects, urban planners, which produced a particular landscape of projects that engage IT as a catalytic tool for interactions in the physical urban space [5]. Civic Tech, participatory technologies, and digital collaboration have gained increasing interest in urban planning. [6],[7],[8],[9],[10],[12]. Simultaneously, African countries are integrating; technology-based tools (ICTs) at the center of global socio-economic transformations [13],[14],[15]. As ONU Secretary states: The United Nations system will support the use of new technologies. We must work closely with new and current partners to overcome challenges and reconcile interests, especially in privacy and human rights, ethics, equality and equity, sovereignty and responsibility, and transparency and accountability. Moreover, MaimunahShariff, the UN-HABITAT Executive Director, mentioned in November 2020, in live Smart City Chanel, promoting the utilization of technology within African countries and informal settlements for upgrading lives, especially public spaces. Once people

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create their own space, they would not vandalize it, and citizens will feel a sense of belonging. Accordingly, ICT, mobile, and digital participatory technologies are, helping to empower slum residents and their youth to have greater control over their lives, communities through access to information and knowledge [16] and also often considered to provide new opportunities to engage citizens and improve the quality of political deliberation and decision.

Besides all, it is worthwhile to visualizing ideas, thus promoting shared understanding and facilitating interaction between citizens and government. For example, crowdsourcing data can provide opportunities for urban citizen observatories in which citizens crowdsource urban information, which can be important for policymakers.

In the focus of urban design, various approaches have been developed to target active participation of citizens through gamification technology. In this context, this study presents an overview of the participatory gamification technology involved in civic engagement in informal cities.

The final contribution is a theoretical framework to evaluating the different digital participatory technologies and their possible applications in planning processes to implement inclusive approaches towards getting all actors, including communities, involved in decision-making and planning for interventions. The research outcomes will demonstrate that Information technology and digital media are tools for making urban places [17]. Moreover, the technology and tectonic tools can penetrate the public realm and territories to change the existing socio-economic issues by citizen's knowledge and awareness. In particular, the use of participatory technologies to build a better sustainable environment such as video gaming applications, AR/VR reality technics, or digital fabrication. The methodological approach proposed by the project will focus on the research phase, how to observe technology, and finally, use and generate it for the public spaces to answer the demands of the society like; socio-economic issues. And on the other hand, how can we deal with participatory activities such as video gaming, applications, AR, and more.

## II. PLACE MAKING AND PUBLIC SPACES

Space is no longer considered a neutral backdrop for people's lives as space becomes a place when endowed with meaning and value [18],[19]. Place values are in both the physical and social environment in which relationships are constructed [20]. It suggests that place incorporates physical dimensions, social relations, symbolic meanings, and subjective human experiences [21]. Placemaking influences the physical form of urban space and the method communities interact with one another [22]. Place-making is considered an empowering process during which people are; involved in renovating, maintaining, and representing the places in which they live [23],[24],[22]. Place-making implies that places are not products of deliberate intervention such as Spatial Planning, which involves active and ongoing community participation. Therefore, places cannot be designed from the outside (e.g., by experts) [20]. Active involvement of communities is; especially

important when making decisions concerning their living environment [26] as involving communities in decision-making gives them a feeling of ownership and re-responsibility towards their environment [27] and ultimately improves their quality of life [28].

Public space has often been overlooked and undervalued by urban authorities but is increasingly being considered the backbones of the city and sustainable living. Public space is accessible and enjoyable by everybody without a profit motive and takes on various spatial forms, including parks, streets, sidewalks, markets, and playgrounds. Upstanding public spaces enhance community cohesion and promote health, happiness, and well-being for all citizens [29]. Open spaces are vital in low-income, high-density residential environments as they are prominent public places that form the heart of communities' social lives [30]. This Citizen involvement may also help produce policies with greater public acceptability and improve trust in government; while promoting the personal growth of participants [31]. Community participation at least has two effects by creating an understanding of the socio-spatial dimensions that underlie space and formulating suggested intervention strategies to address the needs and desires of the community [30].

## III. DIGITAL TOOLS IN PARTICIPATORY DESIGN

ICT and citizen participation in urban planning and design is still a young field, and more research is needed to study its social impact [32].

Technology and social media can play a role in initiating, guiding the condition that they are open enough to allow for collective experimentation [17]. To develop a public realm, neighborhood, a barrio by technology, the first tool is data. Architects and decision-makers will be the data users. Moreover, citizens will be the Data collectors in this system. A citizen can get aware of individual impacts on themselves. The outcome of this research is spatial acupuncture or plug-ins in the urban environment based on Minecraft methodology to support the transformation of neglected urban spaces. To promote public spaces as a keystone for sustainable cities to ensure good quality of life for all. Through policy guides, capacity building, knowledge sharing, carrying out advocacy work, and actual implementation [32]. Participatory technology designs offer the city and citizens new opportunities [1]. Examples such as Block by Block, Toolkit, community empowerments, BIPZIP, and others are evidence of the importance of both technology and the engagement of communities.

Diverse ways exist to bring citizens into an experience during the public participation process, e.g., using 3D environments, GIS-based technologies, Augmented reality, or gaming [33]. Visualization techniques such as augmented reality (AR) offer a range of innovations to support informational purposes. For instance, mobile devices can display urban design planning projects in existing landscapes [34]. With AR technology, can transform a 2D development plan into 3D for a better understanding among non-professionals. Or improving

ordinary city walks by displaying additional information of buildings is also possible [35]. Gaming, Gamification, playfulness, and mobile participation motivate people to engage in public affairs research area on gamification offer solutions [36]. It usually intends to create grateful and playful user experiences, motivate desired user behavior, and increase the joy of use. [37]. Therefore, the Gamification goal is to engage users to take desired actions and to solve real-world problems. This project examines these critical issues in sub-Saharan Africa, specifically in Mozambique, Maputo city that is confronting threats such as weakened economic and social infrastructure, the prevalence of high poverty level about 70 percent of people live in informal settlements in the Mafalala area. According to SDG 11, youth are exposed disproportionately to urban poverty, and they frequently live in slums and informal settlements created by unplanned and compressed urbanization. That lacks primary services and poses safety, health, security risks, and social and economic problems. However, the use of the public realms can solve problems, besides other different problematic conditions of the city like environmental problems. (i.e., through participatory technologies). Creating new socio-economic values provides better public realms. To empower the community by engaging them in participatory actions, aiming at the sustainability of the urban public space of Maputo. Place-making is considered an empowering process during which people get involved in renovating, maintaining, and representing their neighborhood [23], [24],[22]. It aims at redeveloping places with the use of the local community and while appreciating existing local assets. Lastly, place-making adds further steps than only gathering ideas, such as programming and managing the place by local users, who feel the mental ownership of the space. Many aspects make planning developing through using more participatory practices. First of all, these are societal benefits that participatory planning brings [38].

Furthermore, gamification strategies show the potential to raise curiosity for participation to improve long-term user motivation to participate. Commenting and rating design proposals, sharing own ideas, or playing goal-related project missions can be rewarded with points or badges, while formats of discovery motivate people to explore their district to find urban issues of public interest. Conceptualizing a platform that facilitates participation in every stage of the urban planning process is challenging. A gamified crowdsourcing service that effectively collects contributions and ensures in-depth communication and feedback at an early stage covers only one aspect of the process. Over the past few decades, the phrase; community participation has gained increasing usage in academic literature, policy-making documents, and international conference papers as an element to attain sustainable development in African countries. Community participation is now an established principle when one observes issues dealing with decision-making to achieve sustainable development [22]. As Hughes mentioned (2001), most developing, mainly African countries, vigorously employ a non-participatory approach for decision-making. There is a need to engage communities in Africa in participatory planning

and budgeting.

Games are increasingly put forward as tools to support such good participatory planning processes as they arouse interest, motivation, and engagement by connecting personal attributes with real-world scenarios making the voices of others heard in the planning process [39].

City governments started adopting serious gaming—games designed for a primary purpose other than pure entertainment as a strategy to increase the quality and functionality of participatory planning processes ever since the 1950s [40],[41]. Serious games are a form of Gamification because serious games are a specific sub-set of the meta-concept of Gamification. Gamification encompasses the idea of adding game elements, game thinking, and game mechanics to learning content [42]. Games are a critical tool towards uplifting creativity and enhancing human potential as it is on the principle of increasing engagement with various aspects of governance. The fun and psychological fulfillment individuals derive from gamified participatory artifacts stimulates civic engagement [39], [42], [43].

Using new technologies like VR and AR, it is possible to work with defined urban interactively, rehearsing various strategies of action, and collaboratively evaluate public spaces. It is vital to comprehend how VR Technology that is applied accurately can be a tool to involve society and democratize decision-making in complex projects, like urban ones. Considering the basis of VR is to create an immersive experience and allow the user to interact with objects. In general, the results of this experience support the hypothesis that VR is an effective tool for the representation of urban design projects in participatory design processes with participants not familiar with the technology. The project with the VR model showed a higher level of spatial comprehension and a more precise understanding of the characteristics of the project than those who examined it using only technical drawings and 3D images. For example, participants could quickly identify the different zones in the park (e.g., kids' area, walking area, open plaza); and describe the differences in pavement type or vegetation density. They could also give specifics about the color, quantity, and size of the benches and playground equipment. In the case of the participatory design project, held by professionals from the Housing and Urban Planning of Chile, which followed the standard protocols for public projects results, were surprising. They chose a fixed, predetermined navigation path with a slow-motion pace proved; to be effective and reduce dizziness, disorientation, and visual discomfort. However, some elderly participants chose to sit, which was an unexpected request that created dissonance with the walking; and avatar movement. In this case, a stationary visualization scenario (e.g., pretending to be sitting on a park bench) would have given a more natural spatial perception.

Distraction Factors were affected by the nature of the experimental setup. Isolation (from their actual, physical environment) was not entirely successful, as the research design required the researcher to interact orally with the participants during the visualization process. Selective attention (on the VE stimuli) was limited not only by the researcher's questions but

also by the general noise levels during the experiment and the fact that participants were aware that was being recorded and photographed/filmed. Finally, interface awareness was also an issue as several participants felt the HMD unnatural or uncomfortable. However, the study shows that many themes need to be re-investigated. First, it is necessary to study how to increase the number of sensory channels in the VEs to improve immersion and presence, including sound (ambient sound) and kinesthetic (ability to move) stimuli.

For this, the use of the Gamification of a real space generates a virtual space and an urban environment of simulation in which it is possible to make dynamic experiments of participation and generation of ideas, uses, or changes that improve that space [44]. Gamification has been put forward as a tool to support the process of civic participation that leads to sustainable civic engagement through a process of collective reflection [17]. This tool citizen enables citizens to observe their environment and reflect collectively on spatial issues in their daily environment. There are references to the use of Gamification in urban planning processes linked to other citizen participation such as, the Blockholm - Stockholm, 2014-, a game based on Minecraft promoted by the Swedish Center for Architecture and Design of Stockholm that has invited 100,000 users, technicians and experts in urban design and citizens to participate. Other examples are the Play the City; City Foundation implemented throughout 2012 in different cities of Holland, Belgium, Turkey, and South Africa and which based on a World of Warcraft type game, or the use of the SimCity game in its different versions in urban planning workshops, highlighting the case of Cape Town in 2013. And on the other hand, how can we deal with participatory activities such as video gaming, applications, AR, and more. As urban planning processes are often complex and protracted, fostering public participation in this sector has to be seen as the main challenge [45].

Taking advantage of technology from visual simulation and virtual reality provides a delivery system for organizations to get closer to final users [46].

#### IV. MINECRAFT AS COMMUNITY PARTICIPATION TOOL

The Minecraft participation process can be; adapted based on the local context, the type of projects, the capacity of the implementing partner/s, education, and level of IT skills of community stakeholders and objectives. The projects implemented so far indicate that using Minecraft adds value to community participation processes. Power relationships are changed, communities are involved; in new ways, and the process presents vast opportunities to engage hard-to-reach groups, particularly young people. Therefore, UN-Habitat recommends the use of Minecraft as a community participation tool in all public space projects. Between 2012 and 2016, UN-Habitat implemented a global public space program; to influence the development and delivery of around 300 public spaces. As part of the development process, participatory planning workshops were held with local communities' members in which they provided input into the design and

eventual implementation and management of the spaces. The projects got implemented as a partnership between UN-Habitat and local development partners such as local authorities, non-governmental and community organizations. Minecraft has been used for community participation in the regeneration of 1970s high-rise housing developments in Stockholm, Sweden, and public space design in Nairobi, Kenya, Les Cayes, Haiti, and Mexico City, Mexico. UN-Habitat promotes the applicability of Minecraft as a community consultation tool in a wide range of public space projects. However, it is worth noting that this is a brand new, innovative approach that is very much in the pilot phase. Video gaming is often considered more of male activity. It is therefore crucial that the involvement of women and girls is proactively encouraged in each project. The aim should be to have a 50/50 gender split in each workshop or organize separate workshops where women and girls can safely and securely give input into the models. Considering times and spaces, enabling women and girls, and young people to take part [32].

#### V. CONCLUSION

In conclusion, Human Behavior, emotions, and interpersonal relationships are assumed to be the result of mental processes that are impacted by the many elements of public places.

As Abraham Maslow, a behavioral theorist who established the Hierarchy of Needs, "physiological, biological, or aesthetic need, the need for safety, the need for love and belonging, and the need, for self-actualization, status, or esteem are the most important variables in motivating behavior."

Games, in this case, can engage citizens for multiple purposes with variable motivation. Playing the games generates spaces of social interaction and allows the strengthen of playable habits. Each digital technology scenario fosters various levels of engagement, environmental expectations but what raises the challenge more than the technology is the number of participants or the representative part of the population which creates democracy. As more people get engaged in the co-creation as better the results get and the final concrete project won't be vandalized. Besides this challenge, games can make the complex topics accessible and comprehensible to citizens who are not experts especially, when it comes to the African neighborhoods and their informal settlements. In addition to this, games facilitate the interaction of the governors, stakeholders, and citizens.

Minecraft game has got communities to design the public space, and this highlights the capability of the users by design their own public space. It Encourages social engagement, designing, inactive uses, and feels safe and relaxing once you are representing; your ideas through a game and have the confidence to choose what is necessary for the neighborhood and fosters the freedom of speech within a tool. Furthermore, Minecraft experiences; showed that the digital Lego game functions in Informal settlements, especially; in African neighborhoods, and it even helps; to foster; engagement. Moreover, we should not forget that no one knows a place better than someone who uses, lives space every day, or grew up in it. As architects, we should listen, understand and debate. And try to plan what, why, and how? Finally, the outcomes of this

research are fundamental for fruitful cooperation between Portuguese-speaking countries (SGD 17 project goals) and the definition of set recommendations for enhancing inclusive and sustainable urbanization and capacity for participatory, integrated, and sustainable human settlement planning and management (SGD 11 project goals) and might gain importance in Maputo municipality and urban department. Therefore, will be promoted reciprocal learning and opportunities to progress knowledge within the field in Portuguese-speaking countries.

#### ACKNOWLEDGMENT

The authors are grateful for the financial support provided. "This work is partially funded by national funds through FCT - Foundation for Science and Technology, I.P., under the project FCT UIDB/04466/2020".

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