A FRAMEWORK FOR A GAMEFUL COLLECTIVE URBANISM BASED ON TOKENIZED LOCATION DATA AND LIQUID DEMOCRACY

Early prototyping of a case study using e-bikes

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Abstract. The participation of citizens in designing their social and built environments is vital for the creation of sustainable cities and communities. However, in practice, collective decision-making remains challenging. Several researchers have proposed innovative models of governance to achieve a more democratic participation. This paper attempts to contribute to this topic from the viewpoint of urban planning. The objectives are twofold. First, to introduce a conceptual framework of a gameful collective process of urbanism based on location data. Second, to present an early stage of prototyping a case study using e-bikes. Research questions are elaborated as follows: How can collective processes of urban planning engage the collective intelligence and the local knowledge of the community? How to utilize technological tools to support new forms of participatory urban governance? The main contribution of this work lies in the combination of the concepts of temporal ownership of public space, tokenization of location data, and liquid democracy, to design a dynamic and gameful decision-making process that promotes collective intelligence.

Keywords. Collective Urbanism; Liquid Democracy; Temporal Ownership; Tokenization; Location Data; Data Dignity; Gameful Design; SDG 11.

1. Introduction

In this paper, the term collective urbanism describes a collaborative process of decision-making in urban planning and design, based on the tokenization of location data, to account for the community's influence on and control over how to improve local urban spaces. This work proposes a framework for building digital citizen

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participation platforms and presents an early prototyping of the user interface of a case study that utilizes e-bikes. The rest of the paper is organized as follows. The first section, titled theoretical grounding, provides an overview of the concepts and theories on which this paper is based; followed by the results section, which presents the designed framework and the preliminary case study. Afterwards, the discussion section demonstrates the characteristics of this framework, its advantages, and limitations.

2. Methodology

This paper introduces the conceptual part of a design-based research experiment grounded in a theory-driven approach. Based on literature review, a conceptual framework for digital citizen participation was designed. It is to be implemented and developed through an ongoing process of case studies. This research takes interest in the potential of location data in merging the physical and digital experiences of urban space and connecting online and offline communities.

3. Theoretical Grounding

3.1. COLLECTIVE URBANISM

Collective urbanism refers to the process of making decisions about urban space in a collective and decentralized way, whereby citizens are involved as generators of solutions (Sakai, 2017). Jon (2021, p. 324) states that urban planning research is about creating collectives, or entities that are sources of solidarity and togetherness, which are essential for creating more inclusive urban spaces. The author emphasises the need for urban planners to broaden the scope of legitimate forms of expertise, by valorising situated knowledge and perspectives often possessed by the public (Jon, 2021, p. 324).

3.1.1. Citizen Participation in the Decision-Making Process

Citizen participation can be defined as 'the process by which members of a society (…) share power with public officials in making substantive decisions and in taking actions related to community' (Roberts 2004, p. 320, as cited in Ertiö, 2015, p. 308). The participation of citizens in democracy achieves both the objectives of civic education and the creation of a feeling of belonging to the community (Michels & De Graaf, 2010, p. 480). Some of the challenges of "real" citizen participation are: the time consuming process and the increasing multiplicity of the stakeholders involved (Pilemalm, 2018, p. 5:5); in addition to the representation of the diverse groups of citizens (Michels & De Graaf, 2010, p. 479).

In the emerging contexts of civic engagement and efficient democratic processes, the integration of ICT solutions contributed to the development of e-government initiatives, to create efficient public services and to involve citizens though e-participation platforms (Pilemalm, 2018, p. 5:2). Estonia's e-government based on blockchain technology adopts internet voting and online platforms for public consultation and for citizens to submit collective initiatives (e-estonia.com). Digital technologies facilitate citizen participation in urban governance by overcoming the necessity of the physical presence at the same time and place, which is required by conventional citizen participation methods (Ertiö, 2015, p.3 03). Nonetheless, citizen

participation platforms still face the challenge of generating structured data that could be translated into practical solutions and actions, without constraining the ability of citizens to express their diverse opinions (Sakai, 2017, p. 27).

3.1.2. Technopolitics Discourse in Contrast with Smart Cities

The 'Technopolitics discourse' is a sociological understanding of technology that contrasts with main smart cities' approaches, which are criticised for being managerial and seemingly participatory (Smith & Martín, 2021). Technopolitics did not develop in reaction to the smart city, but emerged as a bottom-up movement born out of digital activism (Smith & Martín, 2021, p. 314). Consul, an open-source software platform for citizen participation, is one of the tools developed within this discourse. It allows citizens to get involved in debates, proposals and participatory budgets (Secinaro et al., 2021). Smith and Martín (2021) explain that technopolitics is based on two main concepts: 'Democratic participation' using digital platforms to innovate in governance models; and 'Collective intelligence' where both citizens and experts are initiators of proposals. The collective urbanism framework presented in this paper aligns with the bottom-up collective approach of technopolitics. However, it differs by adopting liquid democracy as a model for democratic participation rather than direct democracy to which technopolitics is committed (Smith and Martín, 2021, p. 324).

3.2. TOKENIZED LOCATION DATA: TEMPORAL OWNERSHIP

3.2.1. Citizen Participation Applications Based on Location Data

The technology of Global Positioning System (GPS) allows users to attach information to location points through map-based interfaces. Location data plays the role of a medium between virtual and physical layers of social and built environments. For instance, the Public Participatory Geographic Information System (PPGIS) is a user-friendly platform aiming at involving citizens in the collection of geographic data on a volunteer basis (Poplin et al., 2017). Yet, they remain primarily a tool for data collection through citizens (Nuojua, 2010, as cited in Ertiö, 2015, p. 304). Another example is Commonplace, a platform that invite citizens to share geo-tagged comments about design proposals in their neighbourhood. Furthermore, Public Gratification Palace is a civic engagement and participation framework whereby citizens can interact with each other's comments only when they are physically present in the same location, promoting social interaction in urban space (Jiang et al., 2021).

3.2.2. Temporal Ownership: Tokenization of Location Data

'The process of tokenization refers to issuing blockchain-based tokens that can be traded, stored, and transferred in the digital world. These tokens exist on the chain, act as a store of value and carry the rights of the assets they represent, while the real-world assets backed by these tokens continue to exist "off-chain."'(Becker, 2020, para. 2)

The concept of 'Temporal ownership of public space' is adopted from the work of Sakai (2017, p. 72). It can be defined as an immaterial ownership of public space based on the time people spend in it. In other words, if someone stayed in or passed through a public space, they "own" that space more than someone who has never visited it. This

concept is inspired by the temporal ownership of goods that exists in the sharing economy (Chi et al., 2017). In this paper, citizens' temporal ownership is accounted for through the tokenization of GPS data points shared by citizens (see the Results section). Location tokens act as a proof of temporal ownership of urban spaces.

3.3. LIQUID DEMOCRACY

Liquid democracy refers to a fluid voting model that combines direct and representative democracies. It has been implemented in politics, namely by eclectic political parties in Germany and Sweden (Kahng et al., 2021). In direct democracy, citizens vote directly on policies, whereas in representative democracy, citizens elect proxies to make policy decisions on their behalf. As societies have grown, direct democracy has become an impractical model. Therefore, representative democracy became commonly adopted by modern societies (Michels & De Graaf, 2010). Liquid democracy offers the advantage of allowing voters to delegate their votes temporarily to other well-informed voters, when their knowledge about an issue is limited, leading to better informed collective decisions (Kahng et al., 2021). Ramos (2015, p. 183) indicates that liquid democracy is part of a range of shifts in governance, technology, and social norms; and indicates a transitive voting process enabled by online systems.

3.4. GAMEFUL DESIGN AND MOTIVATION

The goal of informing the proposed framework by game design is to improve the quality of the experience of citizens, by making participation more worthwhile and/or enjoyable (Ryan & Deci, 2020, p. 3). This paper aligns with literature that considers gamification as a design approach of transforming systems to afford gameful experiences, in order to increase user engagement in various fields, including governance (Xiao et al., 2021). Deterding (2014, p. 312) clarifies that mainstream gamification is narrowly understood as the design of software systems and interfaces and needs to be rethought as a holistic design practice of socio-technical systems for motivational affordances. Woodcock & Johnson (2018) distinguish between imposed top-down gamification strategies, described as manipulative; and bottom-up gamification, which is based on the natural inclination towards enjoyable experiences.

The success of a collective process of urbanism depends on voluntary participation and action. Deterding (2014, p. 308) emphasises that what makes games enjoyable is the fact that gameplay is a voluntary action that delivers strong experiences of autonomy, without social or material pressure. Self-determination theory (SDT) is a framework that links intrinsic motivation and autonomous extrinsic motivation to three fundamental psychological needs: autonomy, competence and relatedness (Ryan & Deci, 2020). Autonomy refers to a sense of voluntariness (Ryan & Deci, 2017, p. 10) and ownership of one's actions, free from external control by rewards or punishments; competence describes a feeling of growth and capacity to succeed; and relatedness expresses a sense of belonging and connection (Ryan and Deci, 2020, p.1). According to this framework, collective urbanism could be a process of self-determination if it offers supportive contexts and conditions for autonomous motivational experiences.

3.5. DATA DIGNITY AND DATA OWNERSHIP

Data dignity is a concept that advocates for digital platforms' users to have complete control of how their data is used, and for them to be paid accordingly (Getoor, 2019, as cited in Cheng et al., 2021, p.1156). To implement data dignity, Lanier & Weyl (2018) propose to establish organizations called "mediators of individual data"(MIDs), which are groups of volunteers who will be in charge of evaluating the quality of data shared by people and negotiating data royalties with tech platforms. Considering that data dignity and ownership are fundamental for building a democratic participation, these concepts are integrated in the present framework through a tokenization system that records data transactions and generates 'e-coins' in return (see Figure 1).

4. Results

4.1. A FRAMEWORK FOR A COLLECTIVE URBANISM

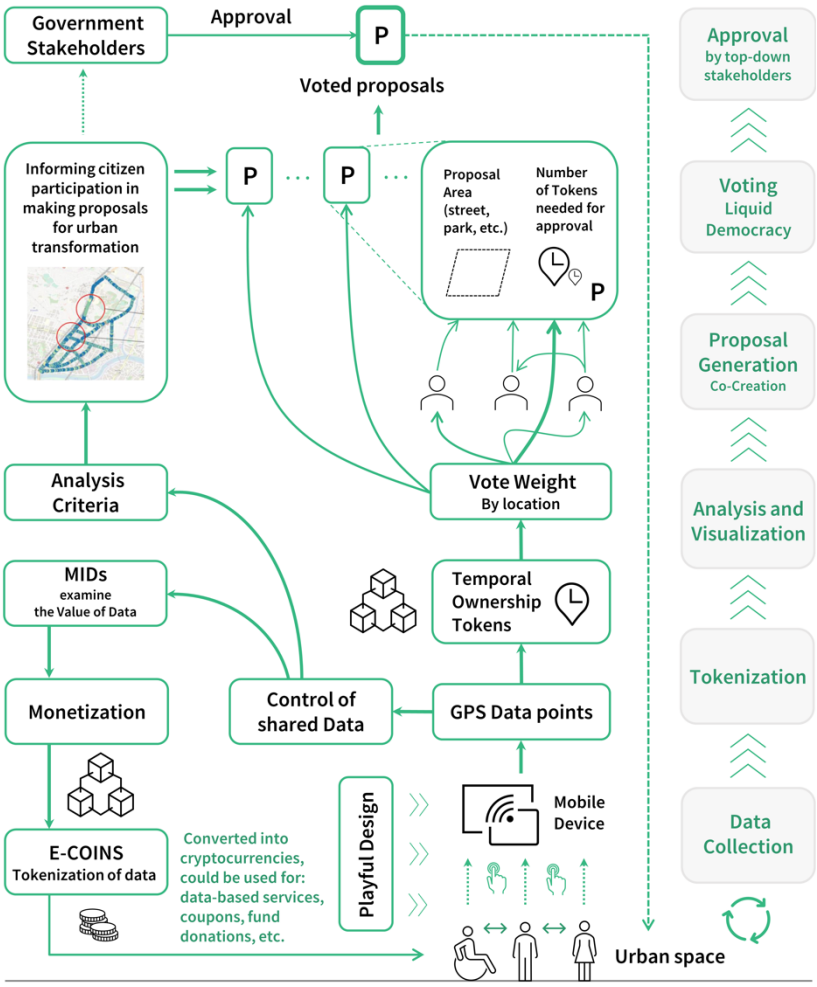

Figure 1: An overview diagram of the gameful collective urbanism framework

As illustrated in Figure 1, the participation process starts from citizens' interaction with a digital device, through which they decide to share their location-based data. By transforming GPS data points into tokens, citizen's temporal ownership of urban spaces is recorded. Citizens may accumulate variable amounts of tokens depending on how much time they spend in an urban space. When the proposal generation phase is concluded and the voting process begins, the collected tokens weigh citizens' votes. In this framework, time is the initial voting power that is equally given to everyone. The time spent in an urban space generates the right of the citizen to intervene in its transformation (Sakai, 2017, p. 72). When voting for urban proposals, only the tokens that citizens have collected within the proposal areas can be used for the voting. At this stage, proposal areas are defined according to urban zoning.

During the liquid voting process, citizens can choose to allocate their tokens to as many proposals as they want, expressing their various degrees of agreement or prioritization. In addition, they can decide to give a share of their temporal ownership of public space to another citizen. As a result, citizens can either choose to: delegate their vote partially or fully to someone else when they judge that the latter is knowledgeable about a specific issue they are not familiar with; or vote directly when they think they have enough knowledge and a clear opinion they want to express.

The present framework includes two tokenisation systems (two blockchain systems). The first is the tokenization of temporal ownership, whereby tokens are converted into a vote weight. These tokens are not monetized as they represent the various degrees of voting rights of citizens. The second tokenization system is the one that converts the value of the data shared by citizens into what "e-coins" (Figure1). These e-coins can be monetized in data marketplaces.

4.2. EARLY PROTOTYPING OF A CASE STUDY USING E-BIKES

The first experiment of this framework is a case study that uses electronic bikes as the data collection device. At the time of writing this paper, a short test of the e-bikes was carried out, with the objective of conducting a preliminary data analysis and studying data visualization on the user interface (Figure 2, (1)). The analysis criteria are still under development. The test took pace in Yokohama city in Japan, from 01/10/2020 to 06/11/2020, during which around 30 bikes were used. The bikers were mainly commuters from a train station, using e-bikes for transportation and shopping. Logs-in cannot be disclosed due to business terms related to the project.

Figure 2 displays prototypes of three main interfaces of the mobile application bike riders are expected to use to participate in designing urban spaces. The first interface (1) allows citizens to access an analysis of their riding behaviours and compare it to the analysis of the collective data shared by the community. The second interface (2) informs about the levels of temporal ownership of urban space. The third interface (3) shows the dynamic process of liquid voting on urban projects. It informs users about the amount of vote tokens other citizens possess as an indication of their knowledge about an urban space. Although this project is still under development, Interface design aims at encouraging a playful mood in the users, when interacting with the application.

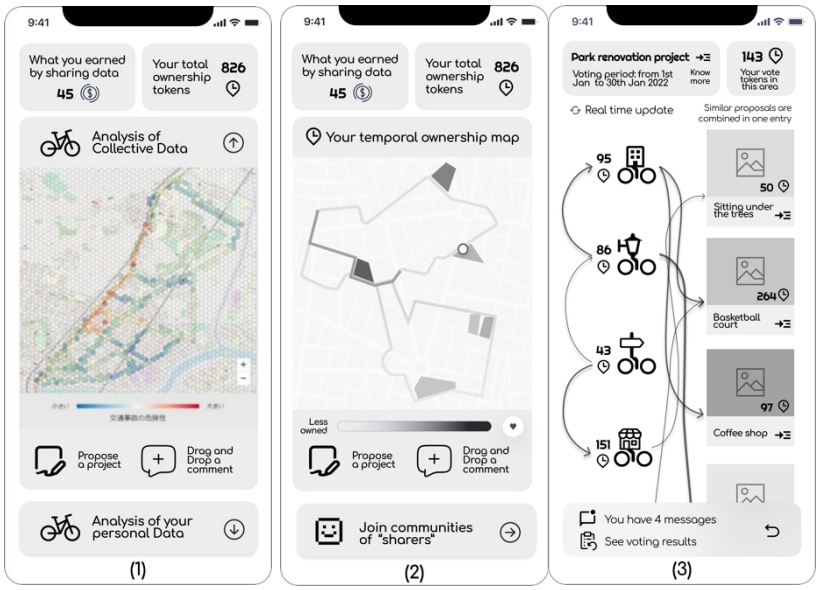

Figure 2: Early Prototyping of user interface: (1) Data visualization, (2) Temporal ownership, (3) Open voting process

5. Discussion

5.1. FOSTERING COLLECTIVE INTELLIGENCE

The proposed framework's main contribution is the combination of the concepts of temporal ownership of public space and liquid democracy, to create a voting model that fosters collective intelligence. On the one hand, temporal ownership based on the tokenization of location data, accounts for the usage of urban space, which is a valuable indication of local knowledge. Liquid voting on the other hand, allows citizens to benefit from each other's knowledge and expertise of the everyday realities of urban spaces, a knowledge that is crucial for improving the act of urban planning and its consequences on those inhabiting urban spaces (Jon, 2021). This paper focuses on the final voting stage to stress the importance of a generative citizen participation that leads to urban transformation. The proposed framework, however, incorporates citizen participation in both civic learning and collective reflection activities (Devisch et al., 2016), such as debates and workshops. These activities generate rich qualitative and quantitative data that needs to be structured into proposals, to translate into urban actions.

5.2. BUILDING LOCAL COMMUNITIES

This framework has the potential of harnessing an intentional interaction with urban space due to the dynamic nature of the voting system. Citizens can change their votes endlessly and keep increasing the number of their tokens in an urban space by simply visiting it more often within the voting period. Hence, this could result in creating

"collectives" (Jon, 2021) where the source of solidarity is the physical togetherness and the common experience of an urban space, thereby multiplying chances of social interaction and knowledge sharing. This framework bridges between virtual and local communities, by bringing together in an urban space, groups of citizens who are interested in having a say on how to improve it, leading to urban interventions that reflect daily realities and consider the scale of the neighbourhood. Respectively, this framework could promote sustainable bottom-up urbanization based on participatory and inclusive planning.

5.3. A GAMEFUL SOCIO-TECHNICAL SYSTEM

The objective of informing the present framework by game design is to harness an autonomous motivation to participate in collective decision-making and foster social interaction within local communities. Based on the game design framework of Mechanics, Dynamics, and Aesthetics (MDA) (Hunicke et al., 2004), the collective urbanism framework presented here has the potential of generating gameful dynamics and aesthetics. Firstly, during the open and dynamic voting process, citizens have access to updated voting results, they can continuously increase their temporal ownership tokens while carrying out daily life activities, and they are able to modify the allocation of their tokens as many times as they want during the voting period. Despite the fact that these dynamics are 'serious' aspects of the decision-making process, which objective is to activate the usage of urban space and multiply social encounters; they hold the potential of creating a playful interaction between the citizens and the system, by triggering a strategic behaviour and an autonomy of action, which aligns with SDT theory of motivational design (Ryan & Deci, 2017). These dynamics could also produce game aesthetics such as discovery and control. Secondly, based on the concept of temporal ownership, citizens can establish collectives that are centred around urban spaces. They can join hybrid communities (online and offline linked through location data) of 'sharers' or 'owners'. These dynamics could generate game aesthetics such as fellowship and expression. As a result, the proposed framework holds a great potential in creating a gameful experience of collective urbanism.

Thiel et al. (2016) indicate that older citizens could be opposed to gamification. However, further investigation is required, as there is limited research that focuses on the effect of gamification on older adults in various domains (Koivisto & Malik, 2021). With that being said, the gamefulness of the presented framework is not dependent on external game elements, but on the dynamic nature of the collective decision-making process. It could be playful or serious depending on the citizen's perspective when engaging the application. Furthermore, this framework can be adjusted to different implementation contexts, target groups and participation objectives, including adapting the degree of gamification, from playful interactions to full-fledged serious games.

5.4. LIMITATIONS AND FUTURE DEVELOPMENT

As described above, the right to vote about urban interventions is weighted by temporal ownership tokens. However, considering the following scenario of a person with disabilities, living right next to an open space, but unable to visit it. They would have no tokens to participate in deciding how to transform that open space despite the

possibility of being negatively impacted by the consequences of the decision (noise disturbances for example). Therefore, to improve the current voting model, the right to decide how to improve an urban space could be determined by a combination of temporal ownership tokens and 'proximity to project' tokens, to consider the potential repercussions of urban projects on individuals. Furthermore, the risk of potential manipulation of the vote weights for personal benefits is acknowledged. For instance, gathering a large amount of tokens by placing the data collection device in a location and leaving. This could be countered by adopting an authentication system that verifies the validity of the collected tokens. A more detailed description of these models is not covered in this paper, but it is planned for future research. At this stage, the potential of this framework is still hypothetical, and experimentation is needed to reveal more about its implications. Nonetheless, this paper presents a novel form of collective reflection on urban space, supported by digital tools, to create a dynamic model of urban decision-making that continuously adapts to the needs of local communities.

6. Conclusion

This paper contributes to existing research by proposing a technology-supported framework for a gameful collective urbanism, incorporating the concepts of temporal ownership of urban spaces and liquid democracy, to design a decision-making model that promotes local knowledge and collective intelligence. This framework is not intended to be comprehensive, but rather it can be extended in various ways. It addresses important discussions about the value of local knowledge in urban decision making and could contribute to the development of digital applications that support citizen participation in deciding how to design their living environments, which is fundamental for the creation of sustainable cities and communities.

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