

Research on Machine Learning Methods That Promote Public Participation in Urban Design

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Abstract: Public participation promotes innovative ways to increase the efficiency of urban design and planning (Amado et al., 2010) but it also presents many challenges to be effective. This paper introduces the current situation of public participation and how current machine learning (ML) tools can support it. Then we propose new methods based on machine learning to improve the communication between urban designers and participants. Finally, we discuss potential effects of this new method on public participation.

1. Introduction

Urban design and planning is the subject of design cities. It is mainly about how to organize different factors, like the street layout, the height of buildings, the planning of sewerage, communication systems, and so on, in the city. Modern cities are complex and require macroscopic consideration by professionals who are well trained in the models and processes of urbanism. Public participation plays an important role in urban planning (Gordon, Schirra and Hollander 2011). Public participation actions promote the involvement of local agents, stakeholders, and people in deciding specific local important issues and setting appropriate priorities within the context of previously defined objectives and strategies (Amado et al., 2010). As a consequence, public participation promotes democratic decision-making in urban design.

1.1 Current situation and challenges of public participation

There are many different social activities included in public participation, like the opportunity of written opinion, referendums, mass demonstrations, legal actions, among others (Mostert 2003). In general, it is believed that public participation should be organized. For example, it could lead to more informed decision-making and create more creative schemes in the process of urban design and planning (Scheer 1996).

However, there are many problems in public participation, which consequently leads to urban design projects that could not adapt to the needs of local people. First of all, many governments do not recognize the importance of public participation, since they are not willing to listen to the opinions of the public. Second, most comments from the public are limited and could not represent most of the population. In some cases, these groups are mainly from interest-related companies or social groups, highly educated people, and people who live close to the project. However, their opinions could not represent other people in the city, which is also relevant for such decisions (Mostert 2003). Third, the quality of public response is difficult to guarantee because most of the public are not professional in this field. So the public is sometimes perceived as short-sighted, ill-informed, self-serving, over-emotional, or lacking in democratic attitudes (Pateman 1970; Scheer 1996).

This paper studies how machine learning can help in the process of public participation by using available data in different ways. In particular, we present some ideas to help urban designers to identify groups of interest for some specific project, and others to improve the communication between participants and urban designers in the design process.

2. Related background

2.1 Traditional methods in public participation

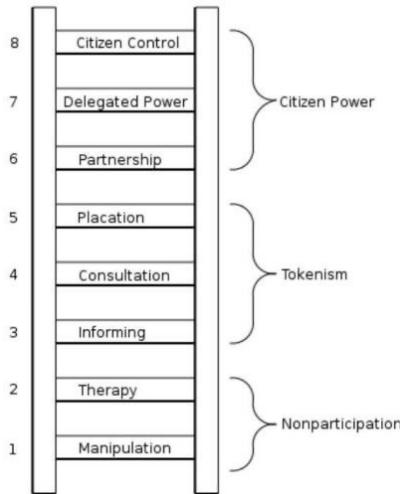


Figure 1. Levels of public participation (adapted from Arnstein 2019)

Public participation is a form of citizen control, which is divided into 8 levels. According to figure 1, the bottom levels are manipulation and therapy. The aim of these two levels is not to encourage the public to participate in the project but are simply means used by the government to control and pacify the masses. The third and fourth levels are informing and consultation. At this level, citizens could be informed of their right to participate and to express their views. However, they have no guarantee that their views will be taken up by the government.

The fifth level is placation, which allows participants to post their advice but the government could also reserve their opinions. The top three tiers of public participation are levels of citizen power. As public participation levels rise, the influence of citizen decision-making grows. The sixth level of public participation is a partnership, citizens could negotiate with traditional rights holders and participate in the planning of projects. The seventh and eighth levels are delegated power and citizen control. At this level, participants are given a majority of decision-making seats and full management rights (Arnstein 2019).

Table 1. Current situation of public participation in urban design and planning project

Stages of Urban Design Project			
Interview and Investigation	Project Scheme Making	Project Hearing	Report to Government
Participation Process		Participation Process	
Legend: Stage of public participation in current urban design project			

According to table 1, we consider that the traditional model of public participation requires the project team to mainly interview the stakeholders. At the last stage of the project, the project team would organize a project hearing for stakeholders to introduce their project scheme and hear their opinions. So it can be seen that the traditional project model is only in the third and fourth levels, since it only receives feedback through the stakeholders. The reason is that the government could not collect all opinions from different social groups efficiently because of complex and changing situations in the project. Another reason is that most stakeholders and other social groups lack professional knowledge about the related project, so their opinions may lack the value for the guidance of the project (Mostert 2003).

2.2 Machine learning

Machine learning is a tool to design systems that can improve through experience (Jordan and Mitchell 2015). In order to do so, it uses past data to learn models that can be used for different

applications. It can learn models by its own (unsupervised learning) or it can use labeled data (supervised learning).

2.3 Machine learning for public participation

Nowadays there are many machine learning systems designed to promote public participation. One system is called 'consul', which mainly uses the website to collect and analyze the opinions of the citizens through different machine learning methods (Procter et al., 2021).

First of all, data set collection. The data set contains preliminary, comments, and tags. Secondly, it's NMF topic modeling technology, The system analyzes the collected data and generates the optimal number of topics. Proposals in the topic space are represented as linear combinations of different topics. Thirdly, evaluation summary, the comments related to each proposal are merged to produce a separate text for each proposal and then summarized. At last, user clustering, the purpose of this module is to connect users who may have common interests to promote their collaboration. This machine-learning system mainly uses NMF topic modeling technology and user clusters to screen and match topics that may be of interest to the public, and at the same time promotes mutual cooperation and communication among the public with similar interests to better participate in the project. But it could not promote participants to communicate with urban designers in the process of design. This paper would design a machine learning method to help urban designers to select a group of participants and communicate with participants in the process of design.

3. Proposed method

In this work we propose two methods to improve public participation. According to figure 2, the first one aims to guide urban designers working in a specific project to find related social groups. The second one tries to make the communication process easier between urban designers and the public by simplifying the language involved in the project proposals.

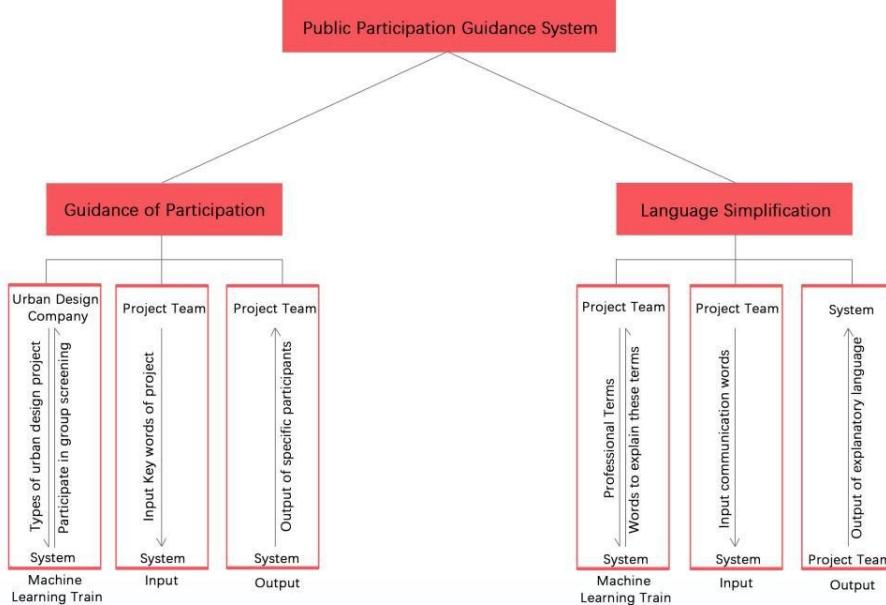


Figure 2. The structure of machine learning based system

3.1 Guidance of participation

3.1.1 General overview

The first method aims to guide the participation. The main idea is to relate different types of urban design and planning projects with social groups relevant or interested in this kind of project. Then, the design team could enter the specifications or features of the projects, like some urban design projects related to religion, and the system would output the specific participating groups that the project should consider.

3.1.2 Implementation

In order to implement this method, it would be possible to use clustering algorithms (unsupervised learning) to divide different participants into different kinds of the urban design projects through outcomes of interview. Then, the learning process will divide the public into relevant groups.

3.2 Simplification of technical language

3.2.1 General overview

The second section of the system is language simplification. The goal is to help participants to communicate with the project team by designing a decision tree that allows the interviewers to identify if the participants understand the project (see Figure 3), and a more advanced method to translate technical language to simpler terms.

In the process of learning, the project team could input some professional terms in the system, and set the output to explain these professional terms by language that participants can understand. So when the project team wants to communicate with the participants about their design schemes of the system. The system would transfer these professional sentences into vernacular to help the participant to understand these sentences. So the participants could discuss and modify the scheme with the project team with this system.

3.2.2 Implementation

According to figure 3, the decision tree can be implemented by an expert using the interviews from the design team. The system to simplify the language would require a dataset (training set) of professional terms and labels of some possible explanations. This could be also obtained and trained from previous interviews.

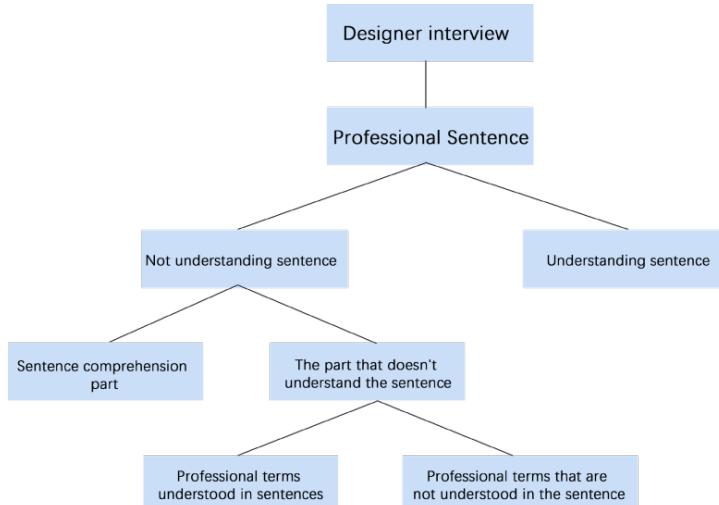


Figure 3. Decision tree model of the proposed language simplification system

3.3 Example of applications

This system could be tested in an urban design project. First of all, the urban designers could input some keywords of related urban design projects, like community renovation. And then the guidance of the participation system would filter out some specific social groups, like aging people, disable people, as the recommended participants. Later, in the process of urban design, the urban designers would communicate with participants through the second system. This would transform some professional terms, like “volume rate”, into explanatory sentences so that the participants could understand them. The criteria for judging the test results are the participants’ understanding of the translation language and the degree of cooperation with the designer throughout the design process.

4. Conclusions

This essay presented some methods to improve public participation using machine learning methods. They could increase the participation level from the fourth level to the sixth by identifying

relevant groups and making the language involved simpler for the participants. This could make the process more efficient and increase the coverage of participation in specific projects. However, the main challenges are human resources required and initial data collection to implement such a system.

With the future development of smart cities and the generation of large amounts of data, AI may become one of the main forces in future urban design. This will greatly contribute to the public participation process for such design projects.

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