

Service Design for Developing the User-Centered Smart City by Applying Real-World Spatial Interaction Data to Generative Adversarial Network

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This paper presents the research results of applying service design for developing the user-centered smart city by the integration of spatial interaction data and generative adversarial network. Researches show that “smart cities are built on technology, focused on the outcome.” It means that the foundation of a smart city depends on the technology used to build it; its main priority is to provide value to the general public. Nowadays, we often see that technological advances tend to have a domino effect on the development of a smart city. It is essential to explore what does the rise of smart cities mean for people who are the most critical user in the city. Hence, this research introduces a user-centered approach to know what does a smart city means in a world where technology has been lifted out of our monitors and into the physical world users experience on a day to day basis.

The implementation of this research divides into three phases. It begins with a service design process and analysis to outline a plan for developing a user-centered smart city. The second phase of this research implements several field observations, and surveys in the case studies area to collect the necessary information of space and the spatial interaction data of users to space as the primary dataset for user-centered smart city development. Notably, we record commercial activities of space and the track of different types of users base on the persona analysis proposed in service design analysis in the space. However, two main issues need to discuss in this phase. The first is the relatively high cost of collecting real user and field survey data. The second is that the simulation analysis limit by various spatial conditions and characteristics of the research area. Thus, this research proposes an interdisciplinary research structure to extract diversified features of city space, to collect and survey the spatial interaction data of different user groups, and then to use the generative adversarial network (GAN), which is an algorithm in the field of machine learning to implement integrated simulation and analysis of spatial interaction of users to the space. The final phase of this research uses data-driven storytelling to explore and explain the users’ behavior in the space. So that people can develop a user-centered smart city by knowing, simulating, and, in the future, predicting the user behavior pattern in a space.

The results of this research show that after applying 45 sets of real-world spatial interaction data to GAN, it derives the best simulation results of users’ spatial interaction to the case study space after 5000 times of training. By comparing and overlaying the simulated results and the real-world data collected from the field survey, there are 450 sets of simulated data that are feasible for future use in the development of the user-centered smart city. This research contributes to the study of the integration of real-world data collected from a field survey with GAN, which is a machine learning approach using deep learning methods, to generate more simulated spatial interaction data to explain and explore users’ behavior in space. Future studies will explore the application of the proposed research structure to the other case study area to evaluate the desirability, feasibility, and viability of the application of artificial intelligence, machine learning, data science, and data visualization to the development of the human-centered smart city.

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