Utrecht University

Geosciences

Human-Emotional Agents in Urban Digital Twins for Healthy Cities (HEADS 4 Health)

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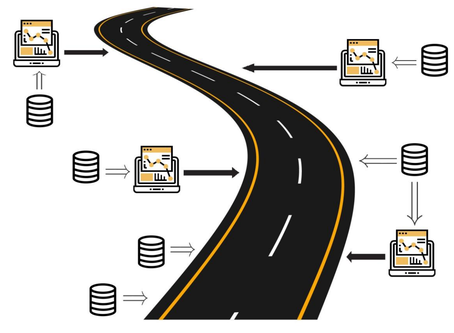
Introduction

Cities around the world are densifying, placing pressure on urban public spaces (Buhaug and Urdal 2013). These spaces are crucial for fostering healthy cities as they contribute to people's health and well-being (Abraham et al. 2010). Urban planning practices strive to provide citizens with positive experiences in public spaces (Mouratidis 2021). In line with these efforts, the concept of Urban Digital Twin (UDT) has emerged as a potential decision support tool for municipal authorities to test future urban design scenarios (Charitonidou 2022). However, we argue that the status quo of urban-scale digital twins is full of 3D buildings but lack humans.

Our aim is two-fold: (i) to devise an agent architecture of intelligent and emotional citizens who can experience the city and articulate their sense of wellbeing in a digital twin, (ii) to form an interdisciplinary research community to tackle this.

Interviews

Amsterdam, Eindhoven, and Helmond have a similar perspective on UDTs. The starting point for creating a digital twin is to attempt to answer a specific question about the city. In this case, the digital twin works as a tool that supports government decision-makers in relation to that particular issue.

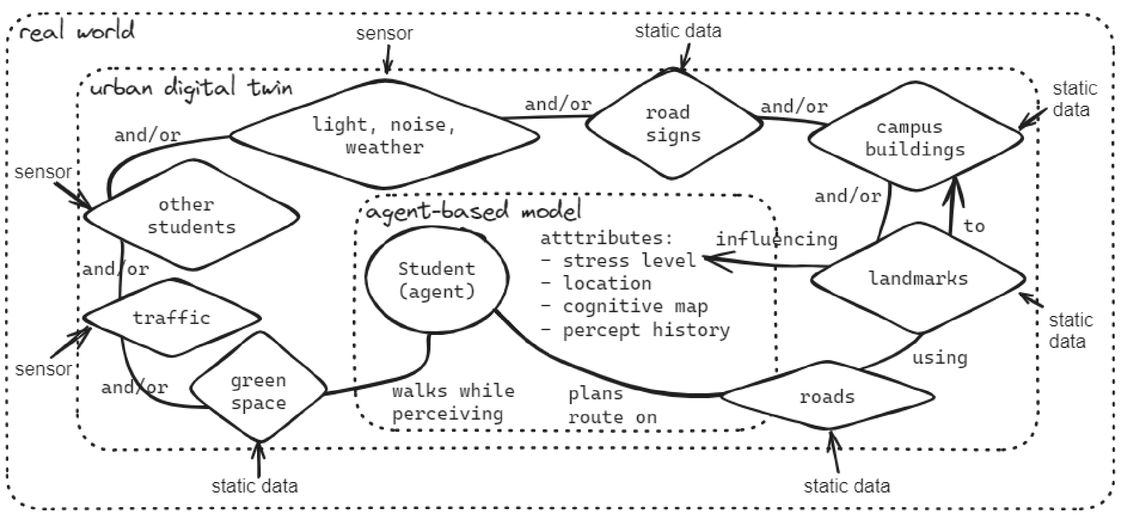


As for Rotterdam, UDT is not a tool, but it is a data concept. UDT would involve establishing rules for a digital infrastructure, particularly concerning data standardization, to ensure a common and shareable view of the city's physical situation.

Workshop

- Interdisciplinary workshop with 16 experts from different domains such as psychologists, computer scientists, geographers, data scientists, and urban planners
- We discussed the lack of representation of human behavior in Urban Digital Twins and explored ways to incorporate it using agent-based models
- We created two agent architectures to exemplify our arguments

Agent Architecture



- Example of a student agent trying to get to a classroom on a campus they are not totally familiar with
- Stressors might include crowds, noise or difficulty of wayfinding (Kanakri et al. 2016; Beermann and Sieben 2023) and the student's stress level is included as an agent attribute in the model
- Dynamic data is measured in the real world, fed to the UDT, and then to the ABM. These include other people on campus, light, noise and weather conditions, and traffic
- Based on the analysis of this ABM output, potential problems in the environment can be identified, such as the lack of clear road signs and nearby green spaces that help reduce

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