

Dublin City University Digital Twin: Test Bed for IoT Sensor Data Visualization

- Jaime B. Fernandez, Insight SFI Research Centre for Data Analytics, Dublin City University, jaime.fernandez@insight-centre.org, ORCID 0000-0001-9774-3879.
- Kieran Mahon, Insight SFI Research Centre for Data Analytics, Dublin City University, kieran@smartdcu.ie

Abstract

It is said that a picture is worth a thousand words, what would it worth a digital 3D model then. A digital 3D model that can be explored and manipulated by the user. Digital Twin is a digital 3D model reconstruction of a specific area populated with normal objects such as Buildings, houses, fields where data can be exchanged between the physical word and the digital version. A digital Model, once constructed, can be manipulated for several purposes and applications such as test bed and data visualization. In this work a digital twin of the Dublin City University is presented and how it can be used to deploy real time sensor information. The digital twins were created using drone imagery and Bentley Context Capture software. OpenCities Planner is used to deploy the models online and to link with the IoT sensors. The steps followed from collecting the drone imagery to the final deployment of the digital twin are presented as they are important points to take into consideration when using the presented methodology.

Keywords

Digital Twins, IoT Sensors, Drones Imagery, Data Visualization.

Statements and Declarations

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Research Purpose

The purpose of this work is to showcase the use of digital twin models to deploy and visualise information of IoT sensors in the context of a university, Dublin City University in this case. At this stage of the research the objective is to evidence how a digital twin can be created in a few days with the available technology. Along with that the other purpose is to showcase how IoT sensor data can be visualised easily in a digital Twin model.

Background

According to [Fuller et al., 2020], a digital model is described as a digital version of a pre-existing or planned physical object. To correctly define a digital model there is to be no automatic data exchange between the physical model and digital model. Examples of a digital model could be but not limited to existing buildings, plans for

¹ <https://www.bentley.com/en>

buildings, product designs and development. In order to have a digital twin there should be an exchange of information between the physical object and the digital version. It is in this sense where IoT sensors help to create a Digital Twin. IoT sensors are efficiently used in various IoT applications for creating a smart environment [Sehrawat and Gill, 2019]. They allow the real time exchange of information between the real world and the digital models, creating this way a digital twin.

Methodology

The next steps were followed to create the digital Twin of Dublin City University:

1. Collect drone imagery: a DJI Mavic 2 pro was used to collect images from the DCU Campus.
2. Create digital model: drone imagery was processed by Context Capture from Bentley Systems.
3. Set digital model online: OpenCities Planner from Bentley is used to publish the digital model online. Once the digital model is create this is uploaded to OpenCities Planner.
4. Set up IoT sensor: an IoT sensor from safecility² was used to capture temperature, humidity, CO2, and air pressure from one of the labs.
5. Link IoT sensor with digital model on OpenCities Planner: the sensor was linked to the digital model using an embedded link which is possible to do thanks to the OpenCities Planner technology.

The Digital Twin model of the DCU Glasnevin campus is presented in Figure 1, where real-time information is streamed from the IoT sensor.



Figure 1. IoT Sensor Information on Digital Twin.

Value

By using the campus of Dublin City University as a microcosm of a city, this Digital Twin research enables the creation of a low cost Smart City Ecosystem where the successful pilots can be proven before large scale deployments.

Practical Implications

This research will be used by Dublin City University to assist in improving the day to day operations of the campus. It will also be used as a planning tool and eventually for simulating different scenarios. Lessons learned will be shared with cities worldwide.

² <https://safecility.com/>

Impact

Even though only one campus is presented, the digital model of the four campuses of DCU were created. These can be used for interested partners outside of DCU as test beds or to show case IoT sensor application in a quick manner without the hassle of creating/developing from scratch their own digital models. Besides, these models can be exported in different formats than can be used for 3D modelling and manipulation.

Reference list

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