

# Sensing visitor behaviour in museums

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## Sensing visitor behaviour in museums

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#### **1** Introduction

- Understanding visitor behaviour inside museums is complex, time consuming and expensive.
- A digital twin<sup>1</sup> can make different types of information (e.g., digital collections) accessible to visitors and managers.
- Strategically placed sensors can capture environmental information in real time.
- Sensed information can be used to understand visitors and their activities on the premises.
- Sensed information can be used to provide a gamified museum experience via smartphones.
- Information is aggregated in a dash-board in real time.

#### 3 Smartphone Gamification Platform

- Smartphones act as a gateway to provide users with a gamified experience<sup>4</sup>.
- Augmented Reality (AR) can be used to create rich media to engage patrons (e.g., by showing similar paintings next to original or by virtually completing broken artefacts)<sup>5</sup>.
- AR Produces an additional layer of data on user motivation and interaction.
- AR can be used engage visitors in insightful games (e.g., treasure hunts).

- Visitors can show and share their engagement with achievements (e.g. exploring all rooms, spending time at an exhibit, etc.)
- The interaction between the sensor data and user behaviour can be explored for both scientific and operational purposes.
- Sensor and smartphone data can be used to compare user experience to environmental variables to investigate changes in attraction and holding power.



**Fig. 2.** a) Overlaying art work with alternative related displays. b) Overlaying waypoints to help navigation in the museum.



We partner with Geneva-based Orbiwise. Orbiwise will provide the sensor systems, data processing systems and technical support. Their systems are in full compliance with data privacy standards around the globe and widely applied in industry and research.

#### 2 IoT Sensor Network

- Using sensors in museums was already envisioned in the first generations of sensor networks<sup>2</sup>.
- We place small, thumb-sized, wireless, long-lasting, inconspicuous sensors in all rooms.
- Sensors continuously collect a variety on information (e.g., temperature, humidity, noise, CO2, light)
- Sensor data can be combined to provide intelligible information such as the level of comfort within a room.
- Managers can infer number of visitors and duration of stay from CO2 levels, and continuously compute indices such as attraction power and holding power<sup>3</sup>.





**Fig. 1.** a) Sensor data is gathered over gateways and stored in the cloud. b) Sensor data is aggregated and transformed into indices visualized in a 3D representation.

#### 4 VR Dash Board

- A dash board<sup>6</sup> serves as a go-to point for data visualisation and analysis.
- The digital twin consists of the sensor data, user data, and digitized museum collection.
- To explore data, we create virtual reality-based tools for exploration and mining of data<sup>7</sup>.
- The proposed tool chain can also contribute to evidence-based design and post-occupancy evaluation of buildings.
- Collected data can identify locations of high and low activity based on user behaviour and environmental circumstances.
- This data can be used to inform future design interventions (e.g. re-arranging paths through the museum that improve the accessibility and permeability of the layout.

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