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# CONCEPT OF DIGITAL TWIN TECHNOLOGY

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**Abstract.** Digital Twin technology is developing technology in artificial intelligence. Usage of the technology in conservation of Cultural Heritage aided with advancement for preserving historic sites of the city for future generation and development of tourism industry. Moreover, tourism industry is increasingly effected by Cultural Heritage, from visiting monuments to get acquainted with country's culture. UNESCO defines culture tourism as "to create discerning type of tourism that takes account of other people's cultures" (UNESCO,2005). Simultaneously, Cultural Heritage tourism and regional development are connected with each other, conserving CH accurately is being the main aim of these times.

**Key words:** Digital Twin technology, Cultural heritage, support, historic centers, conservation, preservation.

Digital Twin (DT) technology is an essential technology related to the Industry 4.0. In engineering education, it is important that the curricula are kept up-to-date. By adopting new digital technologies, such as DT, historical heritages can be conserved for next generation. (Schuster K, Gross K, Vossen R, Richert A, Jeschke S. 2017).

The phrase *digital twin* is commonly used in industry and the scientific community; however, an exact definition of this concept is currently lacking. The concept of using "twins" originates from NASA's Apollo program for which at least two identical space vehicles were built, allowing the engineers to mirror the conditions of the space vehicle during the mission, the vehicle remaining on earth being called the twin. DT is nothing but a virtual replica of an actual physical asset. The present technology known as Digital Twin (DT) was first introduced in 2002 by Michael Grieves. DT definitions in prior research emphasize that each system consists of two systems, the physical system and a virtual system, which contains all of the information about the physical system (Boschert S, Rosen R, Negri E, Fumagalli L, Macchi M. 2017). Siemens defines it as follows: *"A digital twin is a virtual representation of a physical product or process, used to understand and predict the physical counterpart's performance characteristics. Digital twins are used throughout the product lifecycle to simulate, predict, and optimize the product and production system before investing in physical prototypes and assets"* (Plano, 2019, Digital Twin, USA: Siemens).

Figure 1.

The representation can then be simulated in different environments according to the requirements to conclude the final state of the physical object. Through the

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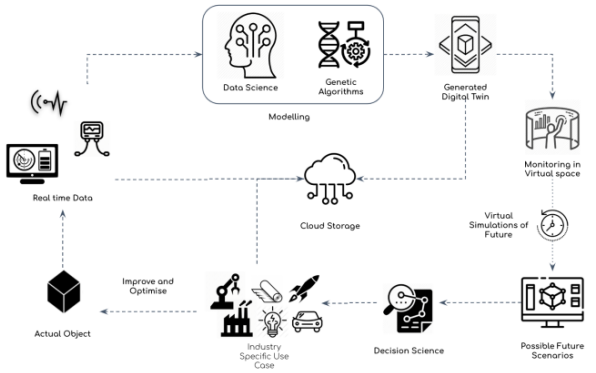


simulation many insights can be drawn about the object. Initially mostly applied in "*astronautics and aerospace area*" (Grieves and Vickers, 2016), recent progress in IoT (Internet of Things) infrastructures and in home automation technologies allowing the development of more affordable sensors to capture real-time data from the physical model led to a greater interest in applying DT concept to the construction sector.

Implementing DT for the management and preservation of heritage assets requires adopting a collaborative integrated approach meaning the inclusion of specialists in disciplines such as building physics, sensing data collection, electronics & IoT, in the data management processes.

Since decades, specialists in Cultural Heritage (CH) preservation use sensing devices to monitor specific factors influencing internal and external conditions of assets to support their preventive conservation (Elfadaly et al., 2018). Based on observation, control, and record of a wide variety of "critical physical parameters, sensors allow scientists to detect abnormal changes in environmental conditions that could threaten buildings and sites' integrity. As mentioned by Moraitou, Aliprantis, & Caridakis (Moraitou et al., 2018), in addition to the obvious short-term benefits, long-term storage of data provided by the sensors can contribute to a better understanding of interferences between CH assets and their environment by comparing such data to the information collected along with the different phases of conservation projects.

Sensors can capture and monitor a wide variety of variables affecting buildings and sites environment. Besides the need to analyze parameters related to climate control within and around CH assets, other categories of sensing devices might attract the attention of Heritage Conservation stakeholders (Klein et al., 2017). As illustrated in a project led by the University of Cordoba (Mesas-Carrascosa et al., 2016), Spain, interior temperature and relative humidity, the external climatic conditions and spaces' occupancy can be monitored in relation to the configuration of the site to better understand their interrelation. The joint analysis of such data can help in identifying issues and potential threats related to the initial design, spatial configuration, occupancy, and understand the process behind to suggest further possible solutions. Apart from the variables linked with climate control, others related to air quality, light radiation, acoustic performances, energy consumption and structural behavior (crack monitoring, vibrations, etc.) can be observed.

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