Chapter 1
Digital Twins in Healthcare

Jayshree Bhattacharya
https://orcid.org/0009-0009-3118-132X
JIS College of Engineering, India

Trisha Bera
JIS College of Engineering, India

Uddalak Mitra
JIS College of Engineering, India

Sanket Dan
https://orcid.org/0000-0002-7587-4285
JIS College of Engineering, India

ABSTRACT

The idea of a Digital Twin involves creating a digital facsimile of a tangible entity or operational mechanism. Initially developed in engineering and manufacturing, the idea has evolved to revolutionize healthcare by developing virtual patient models, medical equipment, and health care systems. These virtual representations are created to mimic current and instantaneous state, conditions, and behaviors of their physical counterparts, offering valuable insights, predictions, and solutions in patient care, disease management, and operational efficiency.

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1. INTRODUCTION TO DIGITAL TWINS IN HEALTHCARE

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1.1 Definition of Digital Twins

A Digital Twin is a simulated representation of a tangible asset, system, or process that reflects its real-world counterpart by utilizing real-time data gathered from sensors and IoT devices. This dynamic model enables Ongoing tracking, evaluation, and enhancement by replicating the physical entity's real-time state and performance. Digital Twins gather data such as temperature, pressure, and wear, allowing them to simulate scenarios, examine outcomes, and predict future behavior.

1.1 a Overview of Digital Twins in General

Digital Twins are digital representations of physical assets, systems, or processes that replicate, track, and evaluate their real-world equivalents in real time. By leveraging data from IoT sensors and devices, they emulate the behavior, performance, and conditions of the physical entities, providing real-time insights and supporting informed decision-making.

1.1 b Specific Applications in Healthcare

In healthcare, the execution of Digital Twin technology is still emerging, but there are several compelling use cases that demonstrate its transformative potential:

I. **Patient-Specific Digital Twins:** Digital twins for individual patients are developed by combining data from their medical histories, wearable devices, genetic information, imaging, and other diagnostic tools. These tailored virtual models can predict treatment results, optimize personalized care strategies, and track disease progression.