
ITU

An Overview of how Digital-Twin and Generative AI are Optimizing Products and Services

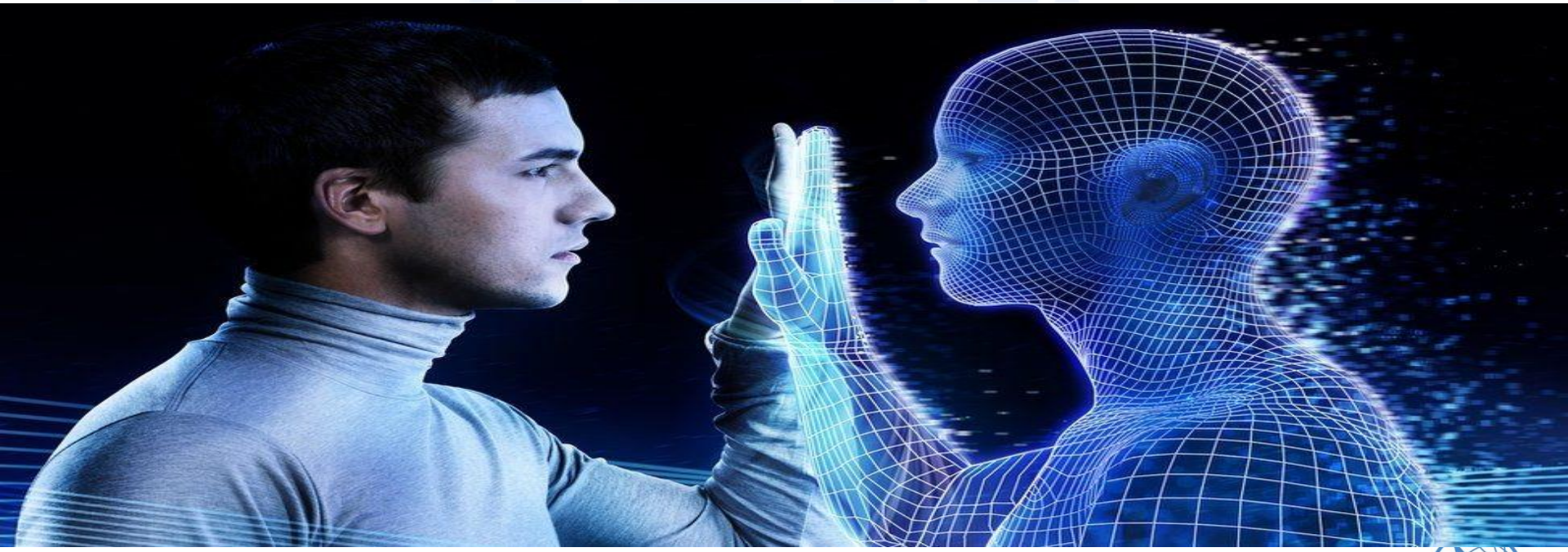
James Agajo(Professor)

(PhD. Telecommunication and Computer Engineering)

Federal University of Technology Minna, Nigeria

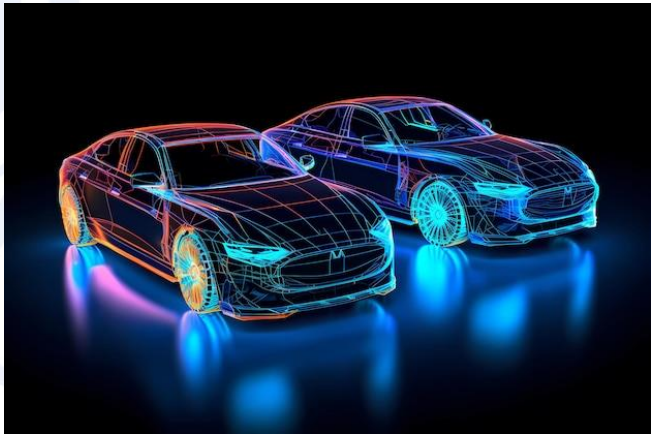
Introduction

Digital Twin technology is an emerging concept that has become the centre of attention for industry and, in more recent years, academia.



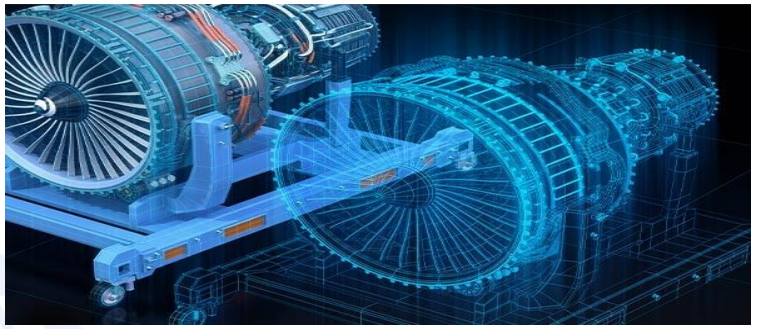
Digital Twin

A digital twin is a digital representation of a physical object, person, or process, contextualized in a digital version of its environment.

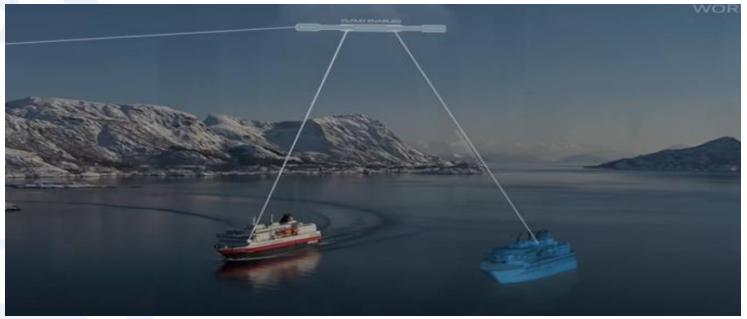


introduction

It is a digital replica or a representation of a physical object **(e.g. aircraft engine, person, vehicle)** or an intangible system **(e.g. marketing funnel, fulfillment process)**



It can be used to examined, altered and tested without interacting with it in the real world and avoiding negative consequences.

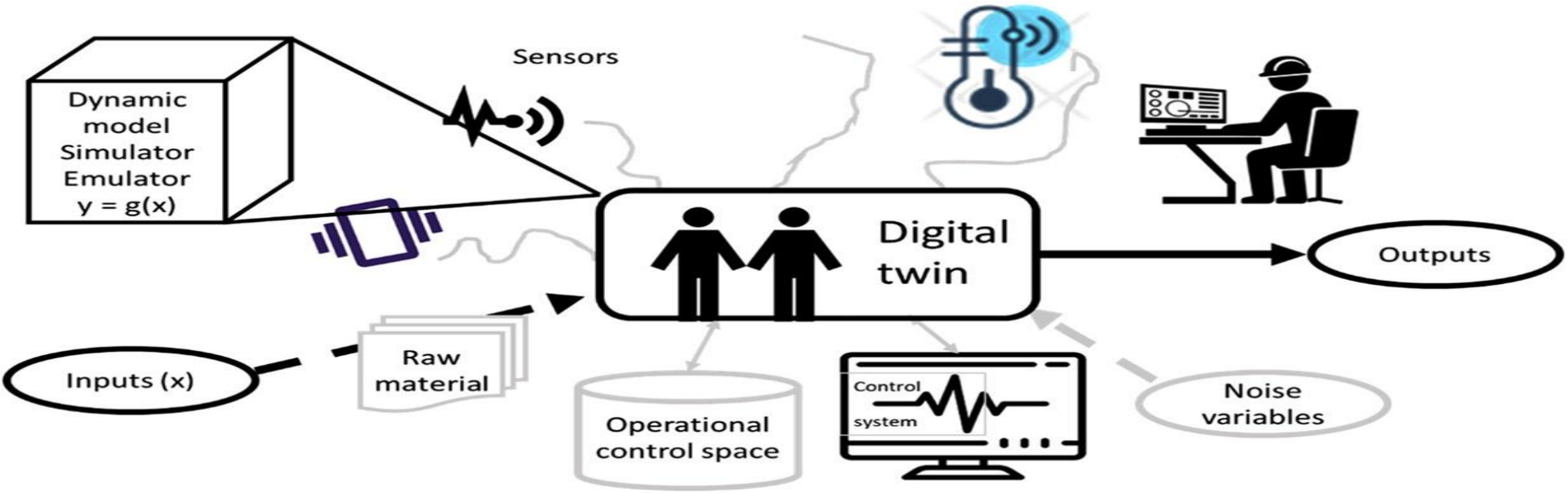


Digital twins can help an organization simulate real situations and their outcomes, ultimately allowing it to make better decisions.

Major Driver of Digital

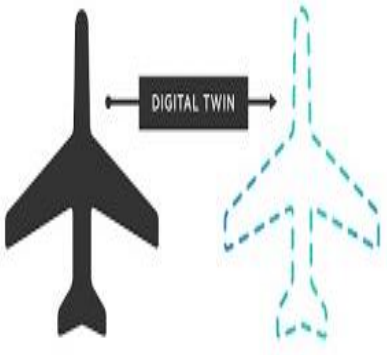
The advancements in industry 4.0 concepts have facilitated its growth, particularly in the manufacturing industry.

The Digital Twin can be described as effortless integration of data between a physical and virtual machine in either direction.



What does digital twin mean in business and why is it so beneficial?

The rise of the Internet of Things (IoT) has complimented the adoption of this new technology, as IoT has resulted in its cost-effective implementation.



Virtual twins have become imperative to business today, consistently named as a strategic technology trend in recent years.

It changing the way design, planning, manufacturing, operation, simulation, and forecasting is traditionally functioning?

IoT is the Backbone for Digital Twin

Fact about Digital

A physical twin that was replicated on a virtual platform is a near **real-time digitized copy of a physical object**.

It is a bridge between the digital world and the physical world.

Its core use is to optimize business performance, through the analysis of data and the monitoring of systems to prevent issues before they occur and prevent downtime.

It is a bridge between the digital world and the physical world.

The benefits of Digital twin technology are astronomical, with industries such as agriculture, government, transportation and retail experiencing rewards from the technology and benefits going forward.

Why use digital twin and how it works

- Companies must find methods to prevent the risk of potential product defects among their assets and future products.
- This piece of tech allows production costs to be minimized, as companies will save expenses when products are right the first time.
- There is no need for expensive physical tests or updates to the products or process.
- Research with manufacturers has found that this concept will enable the **reduction of development costs of the next generation of machines** by well over **50%**.
- The features of the tech also provide added confidence to boost product performance and aid complex decisions, preventing costly downtime to robotics and machinery.

Hologram

Holography is an innovative imaging technology which creates detailed imaging that can be used for different applications.

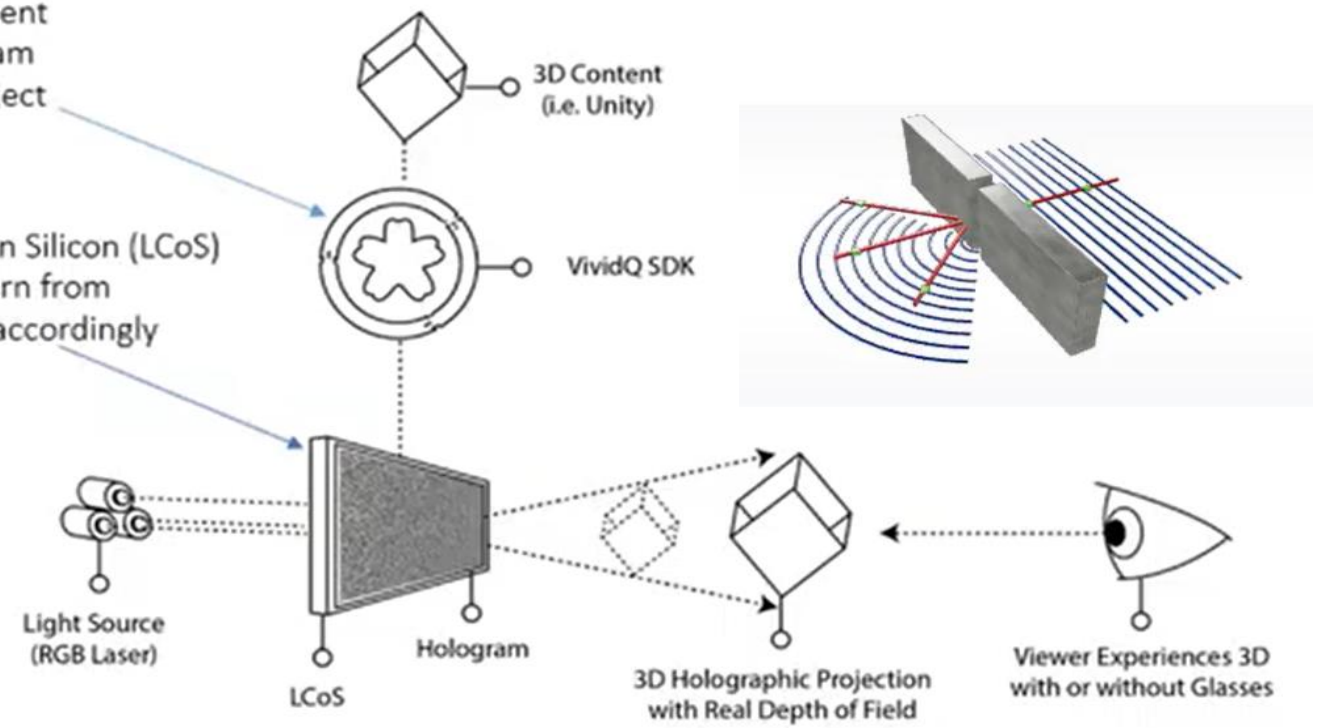
Hologram

- Holography is an innovative technology that depicts an effective interaction of humans with the digital world.
- It is a disruptive innovation; where 3D imaging technologies are used effectively to address challenges in education, training, research, gaming and other associated areas.

How Holographic Technology works

Computer/Software Development Kit (SDK) computes the hologram that will generate intended object

Phase modulating Liquid Crystal on Silicon (LCoS) device receives interference pattern from computer/SDK and diffracts light accordingly



Future impact of Digital Twin technology for employers and businesses

- Offices that adopt this technology early will attract innovative and leading talent.
- Offices will be able to incorporate interactive features to improve employee satisfaction and productivity using data-driven simulations.
- Employees who will use digital twin technology will be able to expand their engagement with online tools, such as interactive maps to locate colleagues on the floor, book meetings and complete tasks with more **diligence and accuracy**.
- Managers will also be able to supervise remotely with the tool that will be similar to a 3D map that will be created using virtual online platforms that are based on simulations.
- It is evident that the digital twin concept will benefit many people within the supply chain.
- Combining this disruptive concept with IoT technology is an incredible opportunity for businesses to improve.
- Ultimately, it will also allow stakeholders to improve the overall efficiency and cost of their business, and improve many aspects of work for employees.

How can an organization get started on building its first digital twin?

- A key element an organization needs for implementing digital twins is digital maturity. This essentially means data: a high-quality data infrastructure that delivers reliable data from both testing and live environments, as well as the talent needed to build and maintain that infrastructure.
- once the initial use case is established, organizations can add more layers of information and real-time feedback to further improve the twin.

Building and scaling a digital twin requires a three-step approach:

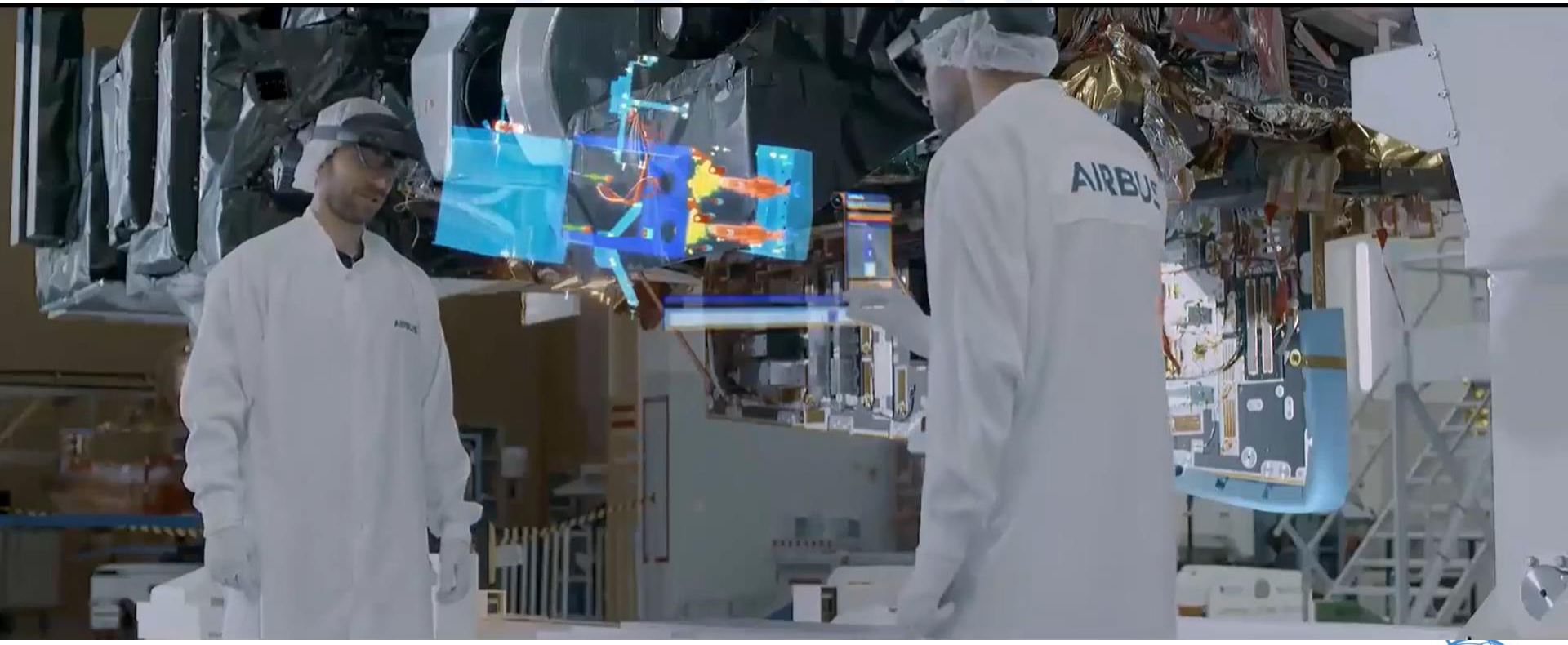
- *Create a blueprint*. A blueprint should define the types of twins an organization will pursue, the order for building them to maximize value and reusability, the way their capabilities will evolve, and their ownership and governance structures.
- *Build the base digital twin*. A project team then builds the base digital twin over the next three to six months. This phase begins with assembling the core data product, which enables the development of visualizations and allows data science professionals to build out one or two initial use cases.
- *Boost capabilities*. Once a digital twin is running, an organization can expand its capabilities by adding more data layers and analytics to support new use cases.
- At this stage, organizations frequently advance their twins from simply representing assets, people, or processes to providing simulations and prescriptions through the use of AI and advanced modeling techniques.

How are some companies already using digital twins

- *Emirates Team New Zealand.* A digital twin of sailing environments, boats, and crew members enables Emirates Team New Zealand to test boat designs without actually building them. This has allowed the champion sailing team to evaluate thousands—rather than just hundreds—of hydrofoil designs.
- *Anheuser-Busch InBev.* A brewing and supply chain digital twin enables brewers to adjust inputs based on active conditions and can automatically compensate for production bottlenecks (for instance, when vats are full).
- *SoFi Stadium.* To help optimize stadium management and operations, a digital twin aggregates multiple data sources including information about the stadium's structure and real-time football data.
- *Space Force.* This branch of the US Armed Forces is creating a digital twin of space, including replicas of extraterrestrial bodies and satellites.
- *SpaceX.* A digital twin of the SpaceX's Dragon capsule spacecraft enables operators to monitor and adjust trajectories, loads, and propulsion systems with the goal of maximizing safety and reliability during transport.

Application in the medics

Application in the medics



Generative AI

- Generative artificial intelligence (AI) describes algorithms that can be used to create new content, including audio, code, images, text, simulations, and videos.

- Generative AI builds on existing technologies, like large language models (LLMs) which are trained on large amounts of text and learn to predict the next word in a sentence

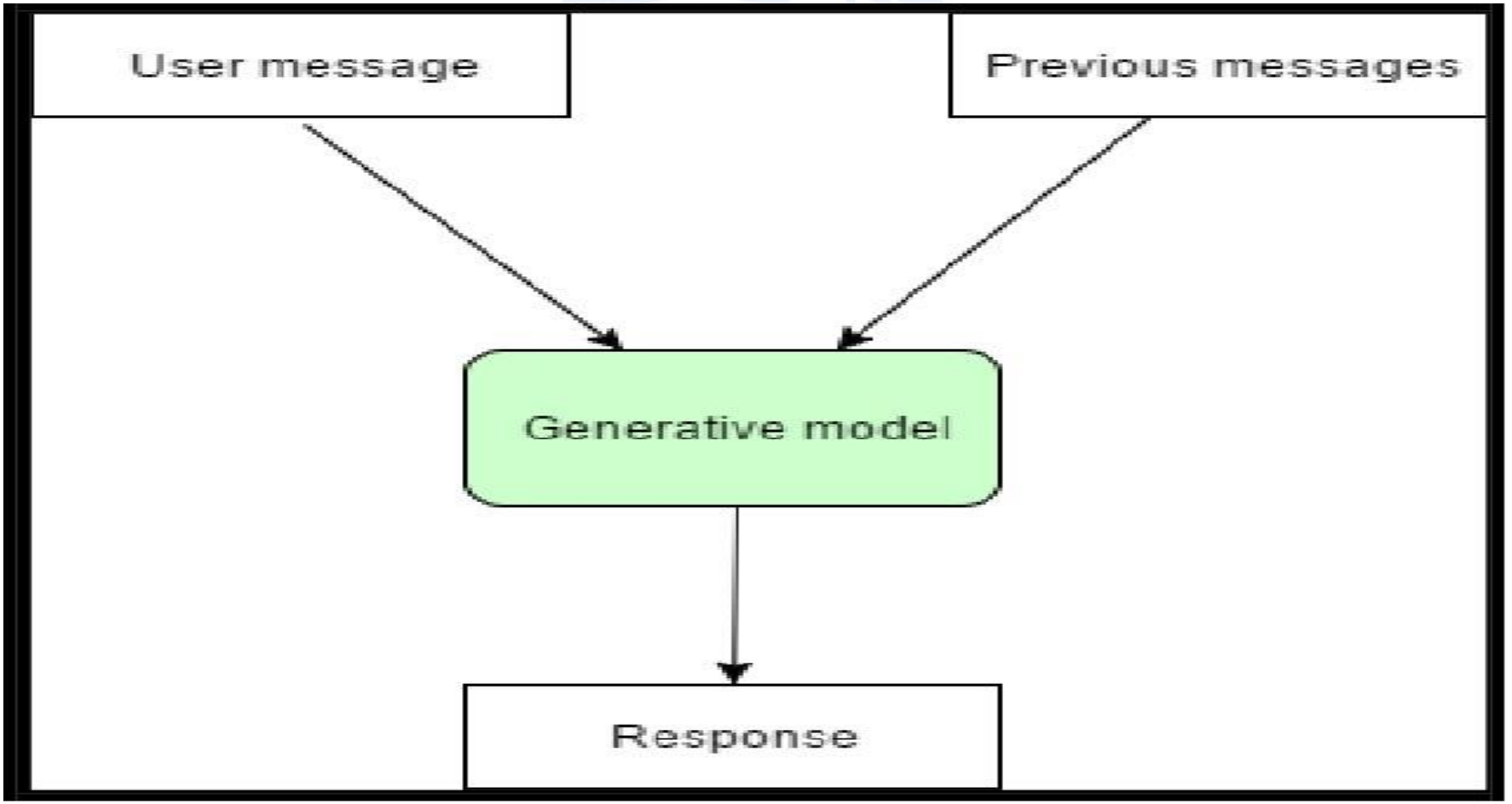
What are large language models (LLMs)

A large language model (LLM) is a type of artificial intelligence (AI) algorithm that uses deep learning techniques and massively large data sets to understand, summarize, generate and predict new content.

The term generative AI also is closely connected with LLMs, which are, in fact, a type of generative AI that has been specifically architected to help generate text-based content.

The term generative AI also is closely connected with LLMs, which are, in fact, a type of generative AI that has been specifically architected to help generate text-based content.

Block Diagram of Generative AI



How Generative AI Works

- Generative AI uses various machine learning techniques, such as Generative adversarial networks (GANs) and variational autoencoders (VAEs) or LLMs, to generate new content from patterns learned from training data.

- These outputs can be text, images, music or anything else that can be represented digitally

How Generative AI Works

- Generative AI is a type of machine learning, which, at its core, works by training software models to make predictions based on data without the need for explicit programming

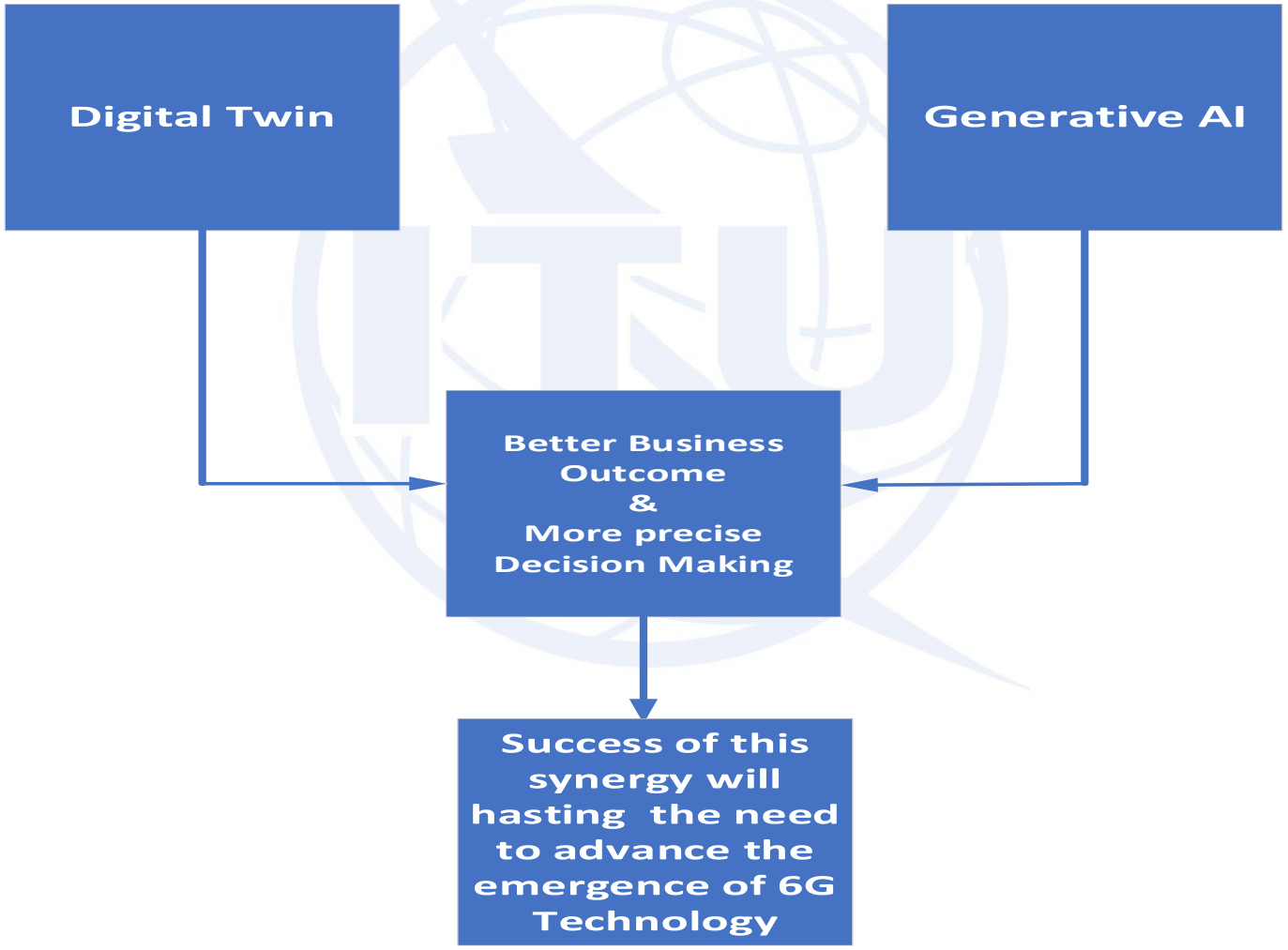
- They learn to identify underlying patterns in the data set based on a probability distribution and, when given a prompt, create similar patterns (or outputs based on these patterns).

Synergy Between Generative AI and Digital Twin

- The power of generative AI-digital twin synergy can be used to create virtual worlds that mirror reality with detailed simulations and get real-time information about the world.

- This can improve business outcomes across industries by enhancing decision-making from real-time Data and pattern

Conclusion


Digital Twin
Generative AI
Better Business Outcome & More precise Decision Making
Success of this synergy will hasting the need to advance the emergence of 6G Technology


感謝你
Danke
Gracias
Grazie
Merci
Thanks!
THANK YOU!