JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue
JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)
An International Scholarly Open Access, Peer-reviewed, Refereed Journal

Digital Twin :Enabling Technologies & Challenges

Surya K G,
MCA , PGDCA

Abstract : Digital twin Technology is an emerging concept that has become the Centre of attention for industry. Digital twin is a system that facilitate through advanced data analytics and Internet of Thing(IoT)Connectivity **.**Digital Twin is defined extensively but is best described as the effortless integration of data between a physical and virtual machine in either direction. The enabling technologies for Artificial Intelligence ,Internet of Things(IoT) and Digital Twins are presented. The paper provide assessment of enabling technologies and challenges for Digital Twins.

Index Terms **– Digital Twin, Enabling Technologies, Internet of Things (IoT) , Machine Learning ,Deep Learning**

I. INTRODUCTION

Digital Twin with AI integrates real time IoT data with artificial Intelligence to create dynamic virtual replicas of physical assets system or process. The AI powered models simulate predict and optimize performance throughout their life cycle enabling predicative maintenance reduce down time.A Digital Twin environment allows for rapid analysis and real time decision made through accurate analytics. The Digital twin can tackle the challenge of seamless integration between IoT and data analytics through the creation of connected physical and virtual twin.

Digital twin is revolutionizing industry. Fired by sensor updates and history data, the sophisticated models can mirror almost every facet of a product, process or service. In the future, everything in the physical world would be replicated in the digital space through digital twin technology. As a cutting-edge technology, digital twin has received a lot of attention. However, digital twin is far from realizing their potential, which is a complex system and long-drawn process. Researchers must model all the different parts of the objects or systems. Varied types of data needed to be collected and merged. Many researchers and participators in engineering are not clear which technologies and tools should be used. 5-dimension digital twin model provides reference guidance for understanding and implementing digital twin. From the perspective of 5-dimension digital twin model, this paper tries to investigate and summarize the frequently-used enabling technologies and tools for digital twin to provide technologies and tools references for the applications of digital twin in the future.

The Digital Twin on Smart Manufacturing project represents an innovative approach in modern industry, bringing together technological progress and digital innovation. It focuses on the development and implementation of virtual counterparts, which are a key element in the transformation of industrial processes.

II. ENABLING TECHNOLOGIES

The Digital Twin on Smart Manufacturing project represents an innovative approach in modern industry, bringing together technological progress and digital innovation. It focuses on the development and implementation of virtual counterparts, which are a key element in the transformation of industrial processes

- **Reduce the machine on board commissioning time**: most of the machine work can be simulated in a very realistic way before the machine construction.
- **Solve design issues before the machine construction**: check of production times and work cycles, test of the hardware and software of the electronics parts.
- **Reduce construction waste**: the virtual commissioning allows to reduce errors and less machine parts will be modified or replaced during the installation.
- **Reduce technicians commissioning travels**, with a real improvement of their life quality and decreasing pollutions.
- **Improve production processes** thanks to the collection, analysis and elaboration of data obtained thanks to the digital twin environment.
- **Improve local and remote assistance** thanks to the virtual maintenance of machines and production lines.

.

Areas of study and learning outcomes:

- **Introduction/prerequisites**: use of programmable logic controllers, management of 3D drawings.
- **Digital doubles**: knowledge of starting virtualization in the industry, analysis and comparison of different virtualization tools, use of Scada systems with virtual and real data sources.
- **Virtual commissioning**: simulation of production machines/lines, integration of simulated processes into physically automated processes.

- **Virtual maintenance**: simulation and virtualization technologies, data evaluation as a key element in a virtual environment, main use of machine learning tools based on "virtual data".
- **Business intelligence**: integration of simulated data into the company's management system, assessment of the impact and usefulness of business management systems.
- **Virtual environment**: assessing the impact and utility of artificial intelligence/machine learning.
- **Industrial Cyber security**: assessing the impact and utility of cyber security focused on the virtual environment.
- **Other technologies**: knowledge of other enabling technologies (using reverse engineering, cloud computing, collaborative robotics, etc.)

III. CHALLENGES

It is becoming more evident that Digital Twin runs in parallel with AI and IoT technology resulting in shared challenges. The first step in tackling the challenges is to identify them. Some of the common challenges are found with both data analytics and the Internet of Things, and the end aim is to identify shared challenges for Digital Twins.

A. DATA ANALYTIC CHALLENGES

Some of the challenges within the field of machine and deep learning are listed below.

1) IT Infrastructure

The first big challenge is the general IT infrastructure. The rapid growth of AI needs to be met with high-performance infrastructure in the form of up to date hardware and software, to help execute the algorithms. The challenge with the infrastructure currently is down to the cost of installing and running these systems.

2) Data

From a data point of view, it is important to ensure it is not of inferior quality. The data needs to be sorted and cleaned, thereby ensuring the highest quality of data is fed into the AI algorithms.

3) Privacy and Security

Privacy and security is an important topic for anyone concerned with the computing industry and this is no different when performing data analytics. Laws and regulation are yet to be established fully because of the infancy of AI. The challenge is more scrutiny, regulation and measures concerning AI in the future as the technology grows. Future regulation ensures the development of algorithms that take steps to protect user data.

B. IOT CHALLENGES

Listed below are the challenges found in the field of internet of things and industrial internet of things:

1) Data, Privacy, Security and Trust

With the huge growth of IoT devices both in the home and industrial setting comes the challenge of collecting substantial amounts of data. The challenge is trying to control the flow of data, ensuring it can be organized and used effectively. The challenge becomes a bigger problem with the advent of big data. The use of IoT increases the large volumes of unstructured data. For IoT to manage the amount of data, sorting and organization of data is a necessity and will result in more data being usable and providing value.

2) Infrastructure The IT infrastructure currently in place is behind, due to the rapid growth observed in IoT technology compared with the existing systems currently in place. The updating of old infrastructure and the integration of new technology helps facilitate IoT growth.

3) Connectivity

Despite this growth in IoT use, the challenges of connectivity still exist. These are especially prevalent when trying to achieve the goal of real-time monitoring. A large number of sensors within one manufacturing process pose a significant challenge when trying to connect all of them simultaneously.

C. BRIEF HISTORY OF DATA ANALYTICS

1) Artificial Intelligence

Artificial Intelligence (AI) is the first topic of interest in data analytics. The overall definition of AI dates back to the late 50s with this concept of creating “intelligent systems” . These are categorized below into topics of potential importance for this project

2) Machine Learning

A subsection of AI, machine learning is the creation of algorithms that can give the computer the ability to learn and act for the user without being directly programmed to do so. Machine learning is used to create programmers that use sophisticated algorithms to collect and analyses data autonomously.

4) Deep Learning

Deep learning is another part of the field of data analytics and a subsection of machine learning. Deep learning algorithms learn unstructured and unlabeled data using complex neural networks with autonomous input feature extraction as opposed to manual extraction .These networks utilize machine learning to create deep learning models that can take longer to train because of the much larger neural networks, but this allows for greater accuracy. Another type of learning is semi-supervised learning, defined as having some labeled data, but more data is unlabeled to see how the algorithms can learn to be more accurate . Many more algorithms appear throughout the field of data science, but these are the most common.

IV.CONCLUSION

The growth in Digital Twin use has seen a shift in recent years, facilitated by an increase in the number of published papers and industry leaders investing heavily in developing Digital Twin technology. It would not be possible without the same growth in the AI & IoT.

AI is becoming a component within Digital Twins and exploring where these algorithms can be applied is another avenue of open research. The effects of AI combined with Digital Twin are topics amongst the publications but on a small scale. The exciting and inevitable future research will explore scaling up smaller successful Digital Twin and AI projects. An important finding is the lack

of standardization and misconceptions with definitions for Digital Twins. Addressing the challenges with standardization ensures future developments are actually Digital Twins and not wrongly defined concept

I hope that our readers will find new ways to make these approaches more powerful and continues the journey to understand the principals.

V.REFERENCES

[1] A. Bilberg and A. A. Malik, "Digital twin driven human–robot collaborative assembly," CIRP Annals, Apr. 2019.

[2] C. Mandolla, A. M. Petruzzelli, G. Percoco, and A. Urbinati, "Building a digital twin for additive manufacturing through the exploitation of blockchain: A case analysis of the aircraft industry," Computers in Industry, vol. 109, pp. 134–152, Aug. 2019.

[3] N. Mohammadi and J. E. Taylor, "Smart city digital twins," in 2017 IEEE Symposium Series on Computational Intelligence (SSCI), (Honolulu, HI), pp. 1–5, IEEE, Nov. 2017. [4] M. Grieves, "Digital Twin: M