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A Literature Review of Industry 4.0 and Industrial Internet of Things (IIoT)

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Abstract

The very critical component of Industry 4.0 is named as “The Industrial Internet of Things” (IIoT). With substantial applications for surveilling production systems, this technology brings new and powerful innovative facilities in the area of manufacturing and services offering high performance using internet-operated devices for the collection and sharing of data and information.

IIoT technology is dormant in improving the process of business and production process by providing timely information for manufacturing.

The main aim of writing this review paper is to examine different research discussions and critically analyze the literature which has studied the topic of IIoT, IoT, and Industry 4.0. The objective of this paper is to review the transformation of various IoT-based systems including concepts, devices, and technologies into IIoT-based systems. Also, the discussions will include various applications of industry 4.0.

Keywords : Smart devices, production process, automation, IIoT, IoT, Industry 4.0.

Introduction

The entire globe has been transformed into digitization where the eruption of smart devices and new technologies has given new ways for mankind to communicate.

i. The Internet of Things (IoT)

IoT technology is defined as a webwork including entities that are connected through the internet which enables the flow of communication between the objects and devices. This technology uses both input (analog, digital, audio, video) and output devices (analog, digital, audio, video) for communication purpose. IoT technology is being used in various areas and fields such as health, traffic control, energy & power, and agriculture, and production.

This technology helps in controlling the data & information for efficiency and effectiveness in business processes.

The use of IoT technology helps in :-

1. Automating the business
2. Improving performances
3. Integration of business systems
4. Reducing implementation cost

ii. The Industrial Internet of Things (IIoT)

The Industrial Internet of Things (IIoT) being part of IoT refers to the use of sensors that are interconnected to industrial applications for manufacturing and business processes. The focus of IIoT technologies is to convert manufacturing units into “Smart Factories” by extracting real-time data and information making the entire system of production automated.

The technologies of IIoT are applied through IoT in industry emphasizing consistent digitization and constitutes its major component. The major areas of focus by IIoT are on communication improvement through machine learning, cloud computing, and big data analysis which bring efficiency and reliability to business operations.

Using IIoT in business processes can revolutionize industrial operations, boosting digital transformation while maintaining safety and security.

iii. The Industry 4.0

The fourth industrial revolution, Industry 4.0 is being recognized globally. It is a broad term that ruled the complete change of the industry through digitization. The term is interchangeable with IIoT.

The objective of this revolution is to create customized products to meet the demand of the customers in today’s scenario. Industry 4.0 has a special feature of developing and implementing various products for the same conditions and applications as the requirements and needs do differ for a particular situation and applications.

Industry 4.0 : Components

1. The Cloud
2. Sensors and Connected Devices
3. Augmented Reality
4. Artificial Intelligence (AI)
5. Big Data Analysis
6. Digital Twin
7. Cyber Security
8. Addictive Manufacturing and Digital Scanning

iv. IIoT vs. Industry 4.0

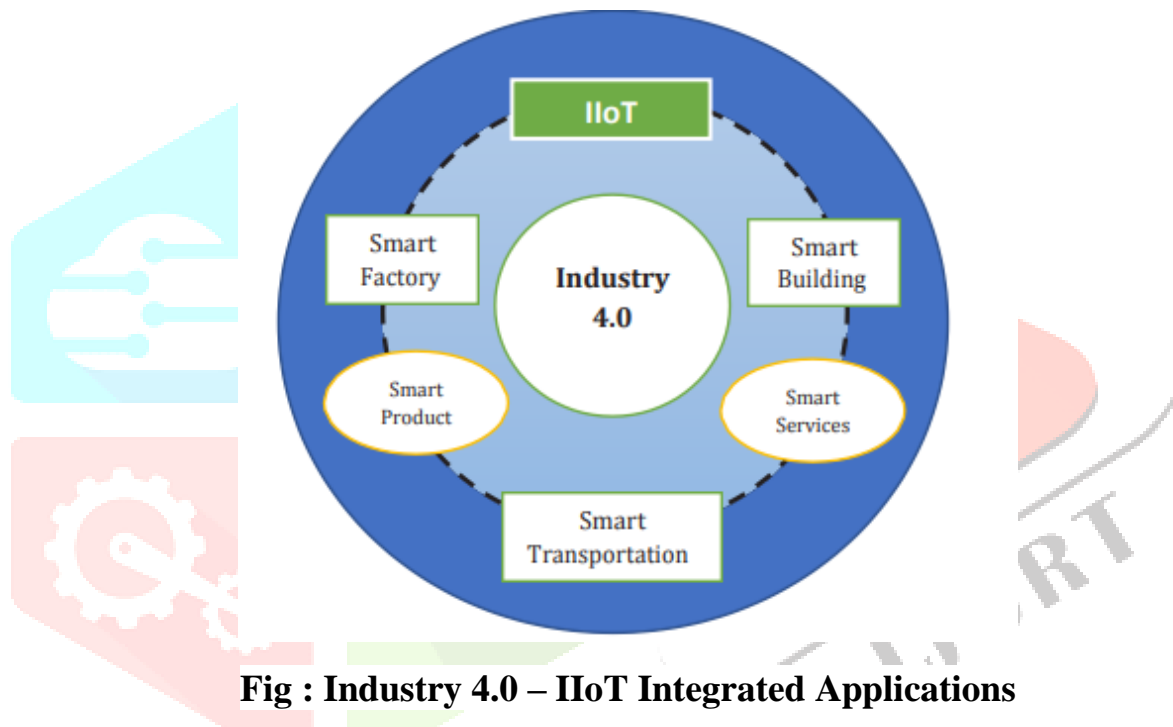


Fig : Industry 4.0 – IIoT Integrated Applications

v. The Industrial Internet of Things (IIoT) and Industry 4.0 Together

Industry 4.0 and the Industrial Internet of things (IIoT) are two different concepts but they are two sides of the same coin. Industry 4.0 and IIoT work together and cannot exist without each other to be effective for business processes. The existence of industry 4.0 depends upon the IIoT and IIoT effectiveness depends on industry 4.0 as they both focus on improving the manufacturing process in every industry.

Both IIoT and industry 4.0 is required for sustainability in the business processes which should be long-term. Industry 4.0 uses IIoT for analytics, on the other hand, IIoT uses internet-enabled devices for a fast and real-time flow of communication. The IIoT is the ideology of industry 4.0 which drives it through the industry of manufacturing and production.

Industry 4.0 and IIoT focus on the continuous improvement of the manufacturing process, making it fully automated and competitive. This objective is the only key to the success of any manufacturing systems.

Generation 1 : The era of mechanization, water power, steam power

The era between the 1700s and early 1800s is named as the first generation. This time period referred to the period of manufacturing using manpower with the help of water, steam engines, and machines.

Generation 2 : The era of mass production, assembly line, electricity

The second industrial revolution started in the early years of the 2000s. In this phase, the focus was shifted to the use of steel and electricity for the manufacturing process. The use of electricity increases efficiency in production and machines were more mobile. This phase bought the concept of mass production to practice a competitive advantage.

Generation 3 : The era of Computer and Automation

Starting in late 1950s, this era started with the use of electronic technology in the production process. More focus was laid on digital technology and automation rather than analog and mechanical.

Generation 4 : The new phase – Automated Systems

The fourth generation, Industry 4.0 emerged in the past few decades which laid emphasis on digital technology through the introduction of automated systems such as robotics, automatic pilots, smart grids etc.

Critical Discussions

Year	Author	Purpose/ Objective	Data/ Methodology	Conclusion
2014	Xu <i>et al.</i> , Lu and Ning	Industry 4.0	NA	4 th industrial revolution, the creation of new products with improved technology and logistics
2020	Javaid and Haleem	Industry 4.0	NA	Focused on smart manufacturing using smart devices and technology
2014 & 2017	Shrouf <i>et al.</i> , Kim	Industrial Internet of Things (IIoT)	NA	Adoption of IIoT in industries depends upon the series & variability of technology
2016 & 2017	Xu and Kim	Industrial Internet of Things (IIoT)	NA	Capturing of real-time data and information, use of virtual management system; helpful in errors alerts in ongoing production

2020	Priyanka et al.	Industrial Internet of Things (IIoT)	NA	Prediction of upcoming situation through IIoT capabilities, helpful in appropriate decision making
2015 & 2017	Zhou <i>et al.</i> , Barreto <i>et al.</i> , Pereira <i>et al.</i> ,	Internet of Things (IoT)	NA	Helpful in cost effective productions, handling of processes, maintains product quality with proper supervision
2017, 2018 & 2020	Trappey <i>et al.</i> , Pereira <i>et al.</i> , Nagy <i>et al.</i> , Javaid <i>et al.</i> ,	Internet of Things (IoT)	NA	IoT uses various technologies which are innovative for the manufacturing process, and focuses on taking advantage of these technologies using IIoT.
2017 & 2018	Wollschlaeger <i>et al.</i> , Griffiths and Ooi	Industrial Internet of Things (IIoT)	NA	IIoT devices leads to improvement, design accuracy and multi control of industry 4.0

i. Applicability of IIoT

The entire world is being changed by introducing revolution in the field of manufacturing, making it a smart and automated place. It focuses on devices used in business processes that are highly innovative. It includes software, hardware, machines and tools, servers and applications that are posted at every stage of the manufacturing process.

The devices used in this technology helps in extracting real-time data and information which is useful for analysis and working. Large data are kept on the devices with secure network using smart applications.

Applications of IIoT in automation of Industry

1. Accessing machines remotely :

Accessing the machines remotely helps different stakeholders to access the machines from their locations conveniently, saving time and efforts.

2. New functions on machines :

Many new functions can be added to the machines as per the needs and requirements of the different situations. Thus adding functions to the machines helps in customization of products as per the customer demands.

3. Maintenance of machines based on predictive analysis :

Cloud computing is used to collect, store and analyze the data and information required for the maintenance and upkeep of the machine. Notifications are sent to the required person for the early maintenance of the machines.

4. Industrial Robots :

Industrial robots are used to perform the repetitive tasks. Features of IIoT such as remote access helps the required person to work with industrial robots perfectly, adding or deleting programs as and when required as per the needs.

5. Data Automation :

IIoT helps in monitoring and controlling various data from different remote locations. In this process, the data in the real time is transferred on the central application known as cloud, with the use of communication networks.

6. Supply Chain :

There are many positive implications of IIoT which includes providing accurate real-time data, forecasting and helping in inventory management, recording point-of-sales inventory levels. With the help of IIoT technologies, the model make-on-order becomes practical from the model make-to-stock.

7. Customer Service :

The analytics help improving the customer services by understanding their needs and requirements. The real time data and information helps getting the customer information about their satisfaction/dissatisfaction levels, thus helping the industry in providing appropriate solutions for the customers.

ii. Future of IIoT

The focus of IIoT is on improving the process of production by providing real-time data and information. With better and advanced computing devices, research and development processes can be improved. The implementation of this technology helps the industries in meeting the customized requirements of the customers by creating smart factory.

IIoT uses robots & internet enabled services for fully automated production and logistics management. The implementation of this technology leads to production & operational efficiency. In future, IIoT will facilitate the digital manufacturing system that will help in collecting the detailed data and information required for efficient manufacturing environment. Use of smart sensing devices by IIoT will make industry smart and improving the production line.

The technology of IIoT can be used to keep track of the working machines, inventory and conveyance that will help in reducing the waste thereby enhancing the manufacturing productivity. The future of manufacturing industries lies with the use of IIoT technologies.

Conclusion

The working and success of industry 4.0 largely depends upon the use of IIoT technologies where the use of internet enabled devices leads to advanced industrial operations.

IIoT deals with the real-time data and information which leads to advanced industrial operations and automation of industry 4.0. This reduces the human error and improves overall efficiency in manufacturing process. With this, there is less requirement of human workforce and the manufacturing unit works independently as IIoT technologies has the characteristics of adequate control and monitoring for efficient utilization of resources. It helps in meeting the customized demand of the customers.

IIoT technology also helps in tracking of inventory in real time situation, monitoring supply chain, keeping check on resources available, utilization of machines and tools. IIoT serves as a life blood for the manufacturing industries with their complete automation.

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