Industrial Engineering Journal
ISSN: 0970-2555
Volume: 52, Issue 8, No. 3, August: 2023

A REVIEW ON INDUSTRY 4.0 INDUSTRIAL INTERNET OF THINGS

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Abstract
The core component of Industry 4.0, which is extensively covered in this article, is the Industrial Internet of Things (IIOT). To create intelligent, networked factories, the fourth industrial revolution, often known as "Industry 4.0," mixes traditional production with digital technologies. The Industrial Internet of Things, which also provides real-time monitoring, preventative maintenance, improved automation, and seamless data exchange between equipment and systems, is what allows for this paradigm shift. The IIOT has made a substantial contribution to Industry 4.0, and this abstract provides a concise review of that contribution, highlighting its potential to increase productivity, competitiveness, and efficiency across a variety of industrial sectors.90% of the employment in the logistics sector between 2010 and 2014 was attributable to goods transport and storage services, according to Census and Statistics Department data. Hong Kong's conventional warehousing practices involve a lot of manual labor and little automation. As the number of transactions across several channels has been rapidly expanding, the preference for the availability of next-day delivery services has grown. Third-party logistics companies as a result have understood the value of operational effectiveness. With the emergence of Industry 4.0 technology like the Industrial Internet of Things (IIOT), Cloud, and Autonomous Robots. A smart robotic warehouse management system is suggested since it redefines the concept of the warehouse's picking and put-away processes, which switch between man-to-goods and goods-to-man mobile, autonomous robots.

Keywords: IIOT, digital technologies, the fourth industrial revolution, efficiency.

I. Introduction

A brand-new paradigm known as the Industrial Internet of Things (IIOT) emphasizes automation, innovation, data, cyber-physical systems, processes, and people. It frequently refers to the worldwide industrial revolution known as Industry 4.0, which focuses on data, automation, innovation, and cyber-physical systems. For intelligent industrial operations, the Internet of Things (IoT) consists of machines, robotics, cognitive technologies, and computers. It collects significant amounts of data for predictive maintenance, time management, and cost control. Cyber and physical systems that monitor and manage the physical environment are part of Industry 4.0. IoT is a significant source of big data and calls for contemporary solutions to handle massive amounts of structured or unstructured data. The Internet of Things (IoT) is a brand-new paradigm that aims to enable a wide range of objects (such as automobiles, appliances, thermostats, microwaves, mobile devices, machines, animals, and humans) to communicate with one another. Displays technologies related to the Internet of Things. Radiofrequency identification (RFID) is one of them. IoT application software, middleware, cloud computing, and wireless sensor networks (WSN) are some examples of these technologies. The design, development, training, and testing of a machine learning model depends on the choice of machine learning frameworks. The open frameworks for the machine learning model development in an industrial environment. IIOT is regarded as a significant source of big data and as such needs the contemporary technologies to handle enormous amounts of structured or unstructured data. The MCU transfers the sensing data/control orders back and forth with the cloud/fog computing platform to realize Cyber-Physical Systems through the Industrial Internet of Things. All
production processes will become more digitalized and networked as a result of the fourth industrial revolution, and industries will shift from service-oriented to product-oriented.

II. Literature

Matthew. N. O. Sadiki et al [1] The industrial Internet of Things (IIOT) can be defined as advanced data analytics used by machines, computers, and people to enable intelligent industrial operations. It is a network of apps, platforms, systems, and objects that can converse and exchange intelligence. It is the largest and most significant component of the Internet of Things as a whole. It is bringing about a world in which intelligent, linked embedded items and systems work as a component of bigger systems. A large number of networked industrial systems that are interacting, exchanging data, and enhancing industrial performance for the benefit of society are referred to as the "Industrial Internet of Things. A sub-paradigm of the IIOT has recently arisen, focusing primarily on safety-critical applications in sectors like aircraft, energy, and healthcare. Companies should adopt the IIOT as soon as feasible if they want to remain competitive.

Yuan Zia et al [2] Manufacturing businesses may increase production efficiency, cut costs, and achieve intelligent industrial production with the support of the Industrial Internet of Things (IIOT). Based on realistic measurement data gathered in auto manufacturing, we seek to characterize electromagnetic noise for IIOT systems. We can determine the frequency occupation and power amplitude information of electromagnetic noise in the 300MHz–3GHz band by taking into account the measurements that were made in the time and frequency domain. Then, the frequency spectrum of wide-band electromagnetic noise is described using an enhanced bell-shaped spectrum. Here, we give a description of the measurement system and the surrounding area. The electromagnetic noise measurement findings are provided. Frequency-domain measurements are used to determine the factory wireless environment's spectrum occupancy in the 300MHz–3GHz range. We report time-domain APD observations from three measurement sites at 315MHz, 433MHz, and 916MHz. We can conclude that an enhanced bell-shaped spectrum can be employed to represent the electromagnetic noise spectrum in light of the experimental results.

A Sharul Islam Khan et al [3] The demand for artificial intelligence and machine learning approaches has been felt by all industries, large and small, to process the terabytes of data produced by sensors, actuators, industrial management systems, and online applications. These data have the qualities of volume (terabytes) and variety (image, audio, video, graphics), hence specialized modeling and management strategies are needed. Industrial Data Analysts must choose machine learning frameworks that are both affordable and simple to use to meet their needs and expectations. Industries including consumer demand prediction in the energy sector, supply chain modifications, predictive maintenance, quality control, and increased production throughput all stand to gain significantly from the machine learning implementation on Industrial Internet of Things data. Future work will use TensorFlow to construct a predictive maintenance model based on deep learning and industrial Internet of Things data from the oil and gas industry.

Yu–JuLina et al [4] In Industry 4.0, a cyber-physical system has components from the cyber and physical worlds networked together. However, the interconnection depends on the equipment, sensors, and controllers' ability to communicate via a variety of data and communication standards. The Industrial Micro Control Unit (MCU) is used as the interface between the equipment, actuators, and data sources. Therefore, a choice of preventive or predictive action can be made online and subsequently put into practice offline. This paper presents a CPS Architecture based on many MCUs coupled with various technologies. Each MCU with a wireless module was integrated into each edge node to transport data from the sensors to the fog and cloud on the platform. By mounting wireless sensors on the device to collect real-time condition data. The cyber-world can identify situations and issues by applying data analytics and reasoning for the industrial knowledge ontology in the cloud platform.

Michael Riegler et al [5] Machines and devices are connecting more and more in the age of Industry 4.0 and the Internet of Things. These connections come with possible security flaws and dangers for these devices. The widespread usage of legacy systems in industrial automation and control systems, particularly in mass production, results in downtime when updates are installed. System integrators and asset owners can therefore actively defend themselves by moving to a mode with restricted attack surfaces and, consequently, with constrained assault ranges. The networked industrial control and automation systems will be more secure and resilient to cyberattacks thanks to a multi-modal architecture and mode switching. System integrators or asset owners will, on the one hand, be able to lower the attack surface on their own without any changes, create a prototypical implementation for future assessment, and show how effectively mode switching increases security.

T. Ch. Anil Kumara et al [6] Artificial intelligence (AI) and an Industrialized Internet of Things (IIOT) have revived Industrial Revolution.4.0 detecting approaches to avert significant economic losses imposed on by issues in rolling element bearings. A rainy technique is used by the researchers to develop a soft real-time fault diagnosis tool that adapts to the domain. Deep Learning (DL) patterns create concepts without regard to the survey's input dimension. According to experimental findings, our suggested approach, which uses a short-term memory system, delivers the most precise bearing-detecting results in an IIOT ecosystem. This study demonstrated the creation of a dependable and affordable bearing defect detection system using a Raspberry Pi, an accelerometer with the name ADXL345, and a three-phase induction motor. The LSTM approach was employed for the real-time bearing defect assessment. The outcome demonstrates that the machine learning models were outperformed by the LSTM. Additionally, the system was remotely observed utilizing IoT technology from Thing Speak, enabling secure data monitoring and real-time visualizations.

V S Magomadov et al [7] One of the most significant technologies made available by the fourth industrial revolution is the Industrial Internet of Things (IIOT). This study focuses on this component of the fourth industrial revolution and makes an effort to define it and describe how businesses use it. The report also outlines the contrasts between the IIOT and the Internet of Things, noting that while they share many characteristics, they also have some key distinctions. In conclusion, the Internet of Things has significantly impacted a variety of facets of our lives and is likely to continue to do so in the future. It will become more crucial in many aspects of our lives, including healthcare, traffic control, entertainment, and many others. Even very successful businesses can considerably raise their performance by incorporating IIOT into their workflows. Many industry experts concur that as time passes and the IIOT realizes its full potential, output levels will undoubtedly rise.

F. Zezulkael et al [8] The paper examines the issue of a unified architecture to comply with the principles of Industry 4.0 as applied to enterprises of the future, a necessity for further development of the Industrial Internet of Things (IIOT) and Industry 4.0 concepts, and discusses the fundamentals of communication systems for open, safe, secure, near real-time, standardized communication interfaces. The Open Platform Communication -Unified Architecture (OPC UA) is presented in the first section of the analysis. According to the article, the fundamentals of Time Sensitive Networks (TSN) are described and contrasted with the capabilities of common public networks (the Internet) in light of the coming of the fourth industrial revolution. The contribution focuses on the concepts and methods governing data and command transmission for IIOT as well as for transmission in the I4.0 factories of the future. The authors outline I4.0 requirements and look for technologies and methodologies that can satisfy them. As a result, there are OPC UA specifications that are suggested as an open SW interface and communication protocol for the I4.0 applications' information and automation subsystems. Authors take a little diversion into one antecedent to modern communication standards that were addressed in the 6thFPthe integrated effort known as VAN.

T.Cerquitelli et al [9] Manufacturing systems have been gradually evolving into smart factories over the past few years. In this situation, more and more information and communication technologies are being used in businesses to streamline management, production, and control procedures. Insight into the manufacturing process and its assets can be gained through the timely gathering and analysis of collected data. This article describes the predictive analytics methodology built into the SERENA platform, which can streamline the prognostics of industrial components characterize the health status of the monitored equipment, produce an early warning about the equipment's condition; and forecast the progression of the degradation of the monitored equipment in the future. A lightweight micro-services architecture is used to design and execute a prototype IIOT platform, making it scalable and independent of technologies. The RPCA, an innovative certification mechanism, is added to the platform. The results for the studied use case are highly encouraging, especially considering the high degree of class imbalance and the scarcity of data. In conclusion, future work will concentrate on integrating extra functionalities to the predictive analytics services for smart manufacturing.

Daniel Lee Andersen et al [10] Big data analytics has emerged as it plays a significant role in the IoT sector as data is increasing at a great depth and size, but there is still a lot of confusion about how enterprises must use big data analytics for the capitalization of the IoT. Because big data analytics and the Internet of Things always seem to be connected from an economic and technological standpoint, the research study makes the case that it is crucial to give a more precise interpretation of their relationship. The Internet of Things (IoT) has been recognized as a highly complex, multi-scale, technical, and multi-level data infrastructure with a propensity for uncertainty and emergent behavior. This study has concentrated on the multiscale, technological, emergent, and unpredictable aspects of the IoT sector. The IoT is created through technologically structured ideas, not by technologies themselves. By using a "malleable" IoT framing rather than a single notion that emphasizes a distinct picture, IoT is acknowledged as a multifaceted factual reality.

Barbara Mayra et al [11] The FH JOANNEUM's Smart Production Lab (Lab) in Kapfenberg, Austria, is a cross-disciplinary learning and research facility with a focus on vertical and horizontal IT integration. By utilizing the most recent digital technologies, it seeks to increase transparency and productivity. Modern use cases employ commercially available technologies for ready-to-use solutions and educational purposes. In the area of IIOT, this study presents the concept of case-based education. IoT nodes were attached to the lab's equipment on the operational technology (OT) layer for this purpose, and they collected and provided data for the IoT middleware layer based on the Open Platform Communication Unified Architecture (OPC UA). It gives pupils a thorough understanding of the advantages and restrictions of IIOT. Industrial organizations face special technology and personnel qualification challenges as a result of digital transformation. With IIOT as a fundamental technology, new, intricate multidisciplinary roles, and duties are created. An interesting idea for applying case-based scenarios in an industrial setting close to manufacturing is digital learning factories. To tackle an interdisciplinary challenge, students in this study offer an IIOT case-based paradigm where they model and execute a real-time data flow. To equip the workers of tomorrow with the necessary skills to implement such IIOT use cases themselves in industry, this case-based teaching concept is based on the introduced IIOT architecture developed in the Lab. This architecture enables research-oriented teaching of a very young field of industrial research.

Bajic Eddy et al [12] Interaction between (IoT) applications is primarily restricted by issues with interoperability, security, and secrecy. Due to the increase of connected objects, these problems frequently involve specific application types. The Social Internet of Things (SIOT) is a brand-new method for managing interactions with IoT devices. It seeks to establish connections between things derived from social human behavior. This Social Internet of Things (SIOT) paradigm offers a fresh perspective on how IoT-connected things interact with one another. The SIOT idea and the features of human social interaction can be facilitated by commercial communicative devices. The SIOT idea provides novel interaction that can help with energy conservation and the externalization of industrial object services.

Sylwia Godrej et al [13] This article's goal is to help businesses grow by using Industrial Internet of Things technology. The suggested idea was created to aid established businesses in making the switch to the digital market. The analysis was focused on the effects that the Industrial Internet of Things has on business models and the economy. There is no idea of a business model the company is passing on the digital market, but this phenomenon will help not only the expansion of manufacturing but also the evolution of a new path of economic development. When the idea of an outcome-based business model was introduced, the company changed the way it entered the digital market.

Onur Çimen et al [14] Wet wipe machines are designed to produce large volumes of material quickly. For manufacturers, even brief machine downtimes in the manufacturing area result in significant losses. A sensor and actuator-based application has been built to prevent failures to prevent unintended stoppages. Our wet wipe machines have been modified to the industry as a consequence of the research done. In this study, a significant portion of the predictive maintenance methods were achieved by the machine automation system. Companies aim to employ predictive maintenance methods to prevent unplanned downtime.
Saurabh Vaidya et al [15] a higher level of control and organization across the product life cycle. It is designed to meet the needs of increasingly personalized customers. This essay's goal is to give a general introduction to Industry 4.0 while also pointing out its implementation's difficulties. With the aid of more powerful computers, cleverer machinery, smaller sensors, and less expensive data storage. By exchanging information with one another and learning from one another, transmission might make things and machines smarter. Industry 5.0 refers to the coming fourth industrial revolution.
Selim Erola et, al., [16] Technology advancement is necessary for Industry 4.0, but its swift adoption into industrial practice is hampered by its perceived complexity. The so-called Fourth Industrial Revolution is driven by the Industrial Internet, Cloud-based Manufacturing, and Smart Manufacturing. We recommend a scenario-based industry to alleviate these difficulties. The idea is based on an Industry 4.0 model for problem-based instruction in future production engineering. Industry 4.0 Pilot Factory will serve as the basic infrastructure for the execution of this concept, even though it is still in the planning stages. As a result, we will need to further develop our "problem-competency cube" and the training scenarios.
ndrej Simonovi et, al., [17] The most recent advancements based on digital technology must be incorporated. The main tasks are how to automate the process and how can Industry 4.0 help a person, who is in the agricultural industry, to make effective decisions based on objective data. In addition to the electronics, using sensors and drones, FOR data collection of several agriculture. aspects, such as weather, animals, geography, etc. The purpose of the article is to examine how Industry 4.0 impacts the agriculture sector concerning new technology, new equipment, automated procedures, etc. The 4.0 revolution offers a fantastic chance to think about the agri-food production chain, even in agriculture. In addition to new technologies and ongoing agricultural equipment upgrades, excellent supply chain management. Farmers require extra investment in technology training and standards to assure equipment compatibility. The growth of communication infrastructure is occurring in rural areas as IoT adoption for agriculture.
Ludmila Fridri chová et, al., [18] Today, 3D printing is accessible not just for business and semi-pro use, but also for educational and recreational purposes. As a result, students employ 3D printing for the Management topic. They discuss a variety of subjects, including the usage of 3D printing to produce textiles. The 3D printers we use in our classrooms are Czech-made, thus the subject of 3D printing is also pertinent to us in the Czech Republic. This year marks the company PRUSA's tenth anniversary. The founding of a business is comparable to the American Dream. After that, in May 2012, the Prusa Mendel i3 3D printer was created.
CKM Lee et, al., [19] 90% of the employment in the logistics industry between 2010 and 2014 was attributable to goods transport and storage services, according to Census and Statistics Department statistics. Hong Kong's conventional warehousing practices include a lot of manual labor and little automation. As the number of transactions across several channels has been rapidly expanding, the desire for the availability of next-day delivery services has grown. Third-party logistics companies as a result have understood the value of operational effectiveness. With the emergence of Industry 4.0 technology like the Industrial Internet of Things (IIoT), Cloud, and Autonomous Robots. A smart robotic warehouse management system is suggested since it redefines the concept of the warehouse's picking and put-away processes, which switch from man-to-goods and goods-to-man mobile, autonomous robots. An IIoT-based smart grid is developed and implemented in this article. Peter Juhas et al(2020). [20] Future wireless data transfer between devices is a key component of smart modern

production systems' modern communication technologies. We are referring to the Internet of Things (IoT), which is the connectivity of different devices as a result of the usage of smart gadgets that interact through a network.
M. Abul Hasan et, al., [20] Through the integration of contemporary technology, traditional industries are being converted into smart industries during the fourth industrial revolution (Industry 4.0). Industry 4.0 enables the blending of physical and virtual processes, resulting in smart factories and digital infrastructure. operating settings. The IoT is a technical advancement that has made a substantial contribution to the industry 4.0 adoption. Biomedical waste (BMW) generated daily in our nation includes. There are many hazardous and pathogenic substances. Employees must comprehend and plan their disposal scientifically and efficiently only to comprehend the dangers posed by biomedical waste in an office setting. Biomedical waste is acknowledged under a lot of words, such as hospital garbage and national healthcare waste produced as a result of both short-term and long-term therapy. The principal and leading provider.
Wen Sun et, al., [21] The Industrial Internet of Things (IoT) enables distributed intelligent services that can adapt to the dynamic and real-time industrial environment to achieve Industry 4.0 benefits. In this paper, we consider a new architecture of digital twin-empowered Industrial IoT where digital twins capture the characteristics of industrial devices to support federated learning. The proposed scheme can adaptively adjust the aggregation frequency according to the channel state thanks to the DT that can sensitively capture the dynamic changes of the network. Additionally, an asynchronous federated learning architecture based on node clustering has been designed to eliminate the straggler effect, which is more pronounced when learning occurs asynchronously.
Ons Aoued et, al., [22] Due to several new cyber-security concerns, security has become a crucial problem for Industry 4.0. Recently, a lot of Deep Learning (DL) methods have emphasized incursion detection. However, these methods frequently call for transferring data. to the main body. This in turn prompts worries about privacy. delay and effectiveness. Despite the enormous volume of data produced Industry 4.0's Internet of Things (IoT) gadgets make this possible. obtaining labeled data is challenging since it is expensive and time-consuming. This presents several difficulties for various DL techniques that need data with labels. To address New strategies, need to be used to address these problems. This essay introduces a new federated semi-supervised learning technique. use federated data that are both labeled and beway.
Enrique Ruiz zúñiga et, al., [23] Globalization, product customization, and automation are all having a significant impact on the manufacturing sector's progress in the currently transforming industrialized world. Currently, the creative ideas of The objectives of Industry 4.0, the Internet of Things, and the Factory of Things revolutionize the method by which technology can enhance global manufacturing. While these ideas are being thoroughly examined in several global businesses They are beginning to be adopted, even in big and middle-sized firms is obvious they may benefit society in numerous ways, yet doubt and Managers and stakeholders are still experiencing uncertainty. This document includes the modern and upcoming technologies, as well as the Factory's implementation Some instances of the current use of the Internet of Things concept in international manufacturers.
Gregor Grambow et, al., [24] In the framework of Industry 4.0, smart factories provide a new level of highly customized and effective manufacturing, powered by the linked industrial internet of things and highly automated operations. (IIoT) gadgets. Nevertheless, the operational context of the IIoT process in processes as they are now modeled, and process enactment cannot be easily described. Despite advancements in automation, manual work is still done Complex jobs performed by people (such as maintenance) continue to exist. are still weakly integrated into global manufacturing processes, even though they may be aided by Augmented Reality (AR) devices. in a seamless BPMN-CARX, a Context and Augmented Reality extension is a contribution made in this work to connect process automation, IoT context, and AR. Business Process Model and Notation) and the CARX Framework, which enables integration of the IIoT with AR, and current Business Procedures.

Parimala M et, al., [25] Smart factories and machines today use machine learning/deep learning-based models for incurring intelligence; however, storing and communicating the data to the cloud and end device leads to issues in preserving privacy. To address this issue, federated learning (FL) technology is implemented in IIoT by the Reinvent consortium. The examination of the new paradigm of integrating FL on IIoT data and the introduction of many ways and techniques related to it. Particularly, we emphasized the traits and advantages of IIoT in terms of FL and distributed learning. The rationale for integrating the IIoT with Also mentioned is FL. Following that, various privacy-protecting Blockchain and ML/DL models used in FL and IIoT are presented. Next, survey methods for handling heterogeneous Data are condensed. researchers' contributions to the field of Following FL with data and resource management, various There is the discussion of problems and remedies. reviewing vehicles Innovative applications for IIoT in healthcare with FL would give the researchers the to comprehend the key elements of clever IoT gadgets. We also found several difficulties and alternatives.
Kesavan Gunasekaran et, al., [26] People and machines may now communicate and make choices together thanks to intelligent machine-machine (M2M) interactions made possible by the Internet of Things (IoT). Additionally, during the preceding two years, these systems' importance in the commercial and industrial sectors has increased for decades. A smart system made up of engineering tools called the Industrial Internet of Things (IIoT) may communicate with one another to enhance production processes. The difficulty of this task would increase. If the energy consumption and the quantity of network traffic produced by the IoT ecosystems accelerated significantly. As a result, decision-making during communication is crucial for IoT infrastructure which is essential to autonomous interaction. Utilizing communication technologies, smart factories monitor and collect data in real time to improve production and efficacy.
Hansong Xu et, al., [27] Industry 4.0, sometimes referred to as Industrial Internet-of-Things (IIoT), is the process of integrating Internet of Things (IoT) technologies into the industrial manufacturing system. factories and plants' intelligence, connectedness, and efficiency can be made better. From the standpoint of a cyber-physical system (CPS), several systems (such as control, networking, and computing technologies) are dynamically combined into IIoT systems to attain the purposes of the operator's design. The interplay between various systems has a significant impact on the architecture of the IIoT. and specifications, particularly under dynamic conditions, such as the automation of industrial processes. In this article, we use reinforcement. learning methods to program the control automatically and systems networking in a dynamic industrial setting. We based on the traits of industrial systems, create three new rules to allow reinforcement learning.
P. Senthilkumar et, al.,[28] A possible development platform for Industry 4.0 and its associated applications, particularly in cyber-physical systems, is the Industrial Internet of Things (IIoT). Such a fresh development in the manufacturing industries provides an additional opportunity to enhance operations, realize business models, and cut expenses. Such accomplishments might also result in challenging and difficult responsibilities, so Reference Architecture Model Industry 4.0 (RAMI 4.0) is created to address these concerns. building Industry 4.0. The standardized framework is referred to as RAMI 4.0 and its interaction with Software Platform Embedded Systems (SPES), an IoT application. Model-Based Engineering (MBE) integration calls for a thorough understanding of the framework. The Recurrent Neural Network (RNN) learning algorithm. RNN-MBE, which improves the whole process.
Xin Jiana et, al.,[29] Cooperative multi-access edge computing, one of the foundational components of 5G wireless communication technology, enables a single device to simultaneously associate multiple edge nodes, or "multi-association," which can deliver scalable communication services with high reliability, massive connectivity, and low latency for Industrial Internet of Things (IIoT) is promising. The need is the effective association between edge nodes and devices. for delivering top-notch communication services in widely deployed IIoT networks. most cutting-edge studies concentrate on the single-association scenario's user association problem. Rarely are there no solutions

offered for the multi-association user association difficulty? User association and power allocation in this study Under the multi-association framework, edge node deployment are jointly taken into consideration for load balance and energy efficiency.
Ipseeta Nanda et, al.,[30] A centralized approach in the IIoT (Industrial Internet of Things) field developed for comprehending agriculture, which comes before the setup of low-power devices The monitoring method developed in this research improves farm security against animal assaults and climate change conditions. Smart farming usually makes use of IIoT advancements to highlight the grade of agriculture. It includes many controls and sensors. WSN is represented by the ARM Cortex-A The primary component of the process is a board that uses 3W. various sensors, including HC-SR04 Ultrasonic, PIR Sensor, LDR Sensor, and DHT 11 Humidity & Temperature Sensor the ARM Cortex-A board is fitted with a sensor and camera. When the PIR notices, it increases. When there is movement inside the camera's field of view, the recording begins, and the data is saved.
Carlos Mendes da Costa et, al., [31] The Internet-of-Things (IoT) and 5G developments' predicted ubiquity has sparked research on wireless solutions for vital applications, particularly Industrial IoT (IIoT). However, there is little to no investigation into a uniform design approach for the IIoT that addresses the divergent wireless system performances of Power, Reliability, and Latency (PLR). Getting such a foundation is important. crucial for enabling future progress and allowing for fair comparison of upcoming IIoT designs. This paper so proposes a fresh idea. design process for dealing with PLR trade-off in IIoT Wireless IIoT-WS systems. To build a complete PLR RF system using this new technique, a meet-in-the-middle system approach is used. as well as a personalized Multiple-Criteria Decision Analysis (MCDA) to assist in choosing the optimal design elements for a certain situation that are both resource-efficient and PLR-balanced.
Yingmo Jie et, al.,[32] A company's efforts to guarantee excellent data quality may be complicated by the sizeable amount, diversity, and velocity of data collected from the numerous Industrial Internet of Things (IIoT) sensors and other systems in a cloud-based or fog-based environment. Experience level for data users (DUs). For instance, how can We equitably and effectively distribute resources throughout cloud data centers? (FSPs), cloud computing (CCs), and DUs? In the IIoT context, such as for those in urgent situations sections of the infrastructure, such as electricity, and dams. Consequently, in this post, we provide a good resource allocation plan. For an IoT ecosystem based on fog. We present fog service-providing nodes (or FSPs) that are in competition with one another for the DUs that utilize CC resources. increase resource utilization.
Kosmas Alexopoulos et, al.,[33] Context-aware intelligent service systems can be utilized in a manufacturing shop floor to offer information services to shop floor staff by their circumstances. An industrial Internet of Things (IIoT) context-aware information system that supports decision-making is presented in this article. For managers and operators, whether mobile or stationary. The system successfully incorporates fundamental IIoT ideas such as service-oriented architecture with several layers that combine various systems, such as sensor data acquisition in conjunction with ideas for creating context-aware systems, including context modeling and information delivery with context. The suggested remedy applies to several manufacturing environments. However, in dynamic, semi-structured industrial settings where the employees are mobile and the workstations fluctuate over time rather than being fixed, At a few predetermined workstations, the static.
Montdher alabadi et, al.,[34] The digital transformation of manufacturing and other industries, including retail, distribution, oil and gas, and infrastructure, is referred to as "Industry 4.0." While this is going on, the Industrial Internet of Things (IIoT) is a technical development that accelerates the adoption of Industry 4.0 productivity and financial effects of the sector. The capacity to offer international communication between components spread out in different places. Implementing IIoT in the industrial industry has presented several challenges, mostly as a result of IIoT features. This study provides a comprehensive analysis of Industry 4.0 and IIoT, where This is primarily being done to introduce the most recent developments in Industry 4.0 and IIoT, as well as to deal with the current constraints. First, this study provides a brand-new IIoT taxonomy. issues that contain difficulties.

JUDE OKWUIBE et, al., [35] Industrial IoT (IIoT) solutions that are effective and durable begin with short-term gains and then subsequently grow with new capabilities and value. Due to the diverse nature of IoT devices and services, resource needs may likely fluctuate often depending on the services, applications, and use cases. Resource orchestration might be difficult with such uncertainty, even in simple use cases. And in some very dynamic usage situations, virtually hard to handle. In this essay, we suggest SDRM; a resource management system with SDN support. Using this innovative orchestration technique automatically determines the best resource distribution for various IIoT network architectures and dynamically modifies allocated To guarantee Service Level Agreement (SLA), allocate resources based on predetermined restrictions. The suggested strategy for the best resource allocation is based on the Constraint Satisfaction Problem (CSP), which models resource allocation Treatment.
Mohammed Zaki Hasan et, al.,[36] To better understand the ideal sensor deployment pattern, a bio-inspired metaheuristics canonical particle multi-swarm optimization (CPMSO) method is proposed. the Industrial Internet of Things (IIoT) connection. The suggested method constructs a linked network to tolerate failure while maintaining quality, ensuring a successful deployment. measuring quality of service (QoS) in terms of energy use, latency, and throughput. We demonstrate the CPMSO algorithm's efficacy by implementing multi-topologies that meet the QoS and outcomes. are contrasted with the standard canonical particle swarm Fully particle multi-swarm optimization (FPMO) and CPSO algorithms for (FPMSO). Evidence suggests that CPMSO and FPMSO increase the throughput by around 95.23 percent while reducing the energy use by 87.5% and the delay by compared to CPSO, 95.00%.
Dequan Kong et, al.,[37] The sensors are the main issue in the industrial Internet of Things (IIoT), which involves hundreds of different instruments, controllers, and pieces of hardware. The IIoT relies heavily on sensor-based detection, which has a direct impact on the system's control indications and detection accuracy. But when a significant amount of real-time data from IIoT devices is sent to cloud computing facilities, large-scale data will certainly bring computing load, which will slow down cloud computing centers' processing speed and raise the data centers for cloud computing. These elements directly contribute to instability and lag in real-time sensor data collection within the IIoT. This research proposes an edge calculation-based sensor outlier identification technique.
Kesavan Gunasekaran et, al., [38] People and machines may now communicate and make choices together thanks to intelligent machine-machine (M2M) interactions made possible by the Internet of Things (IoT). Additionally, during the preceding two years, these systems' importance in the commercial and industrial sectors has increased for decades. A smart system made up of engineering tools called the Industrial Internet of Things (IIoT) may communicate with one another to enhance production processes. The difficulty of this task would increase. If the energy consumption and the quantity of network traffic produced by the IoT ecosystems accelerated significantly. As a result, decision-making during communication is crucial for IoT infrastructure which is essential to autonomous interaction. Utilizing communication technologies, smart factories monitor and collect data in real time to improve production, and efficacy.
Liqun Hou et, al., [39] Wireless sensor networks (WSNs), which serve as the foundation of the industrial Internet of Things (IIoT), are often powered by batteries that have a finite amount of energy, which limits their ability to operate continuously. Energy harvesting has promise as a remedy for this issue. Industries have a lot of hot One of the crucial elements to be monitored in industrial settings is temperature, whether it be in pipelines or walls. processes. This study created a brand-new WSN node that harvests thermal energy for temperature monitoring. IoT. The proposed self-powered WSN node's viability is experimentally confirmed for a variety of the device's several sleep intervals. These findings show that the planned boost circuit has an energy-efficient design. The suggested thermal energy harvester has an approximate 27% conversion rate and can provide endless power.
MOHAMMED-AMINE KOULALI et, al., [40] Industrial Internet of Things (IIoT) advancements recently have greatly benefited predictive health management for industrial systems. The IIoT's

cognitive and communication characteristics enable their integration into the industrial systems maintenance workflow to facilitate the move towards4.0 industry. In this research, we investigate an IIoT-based CBM for industrial facilities using a mean-field stochastic game. Designed to encourage coordinated maintenance for cost-saving. We offer a critical evaluation of the Mean-field equilibrium (MFE) is a suggested game to describe its operating point for equilibrium. We create a learning method that uses both a local adjustment of the maintenance rate and a global adjustment of the MFE distribution of the monitored components' health status. A numerical analysis supports the suggested game. This guarantees that a high.

III. Conclusion

The Industrial Internet of Things (IIoT) plays a central role in this revolution, connecting machines, devices, and systems to facilitate data exchange and automation. In conclusion, Industry 4.0 and IIoT have revolutionized the industrial landscape by enhancing efficiency, productivity, and innovation. The seamless integration of cyber-physical systems has enabled real-time data analysis, predictive maintenance, and smart decision-making, leading to reduced downtime and optimized operations. Embracing these technologies is essential for companies to stay competitive in a rapidly evolving global market. As this revolution continues, collaboration between industries and governments will be crucial to addressing challenges such as cybersecurity and workforce upskilling, ensuring a sustainable and prosperous future for all stakeholders.

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