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"Benefits, Challenges and Application of Industrial Internet of Things"

Dr. Sameer Narang[1], Dr. Satinder Kumar[2]

[2]Assistant Professor, SMS, Punjabi University, Patiala-147001(Punjab)

ABSTRACT

We have reached that stage of life where almost every individual is connected to the Internet. The advancement of Internet technology took a new shape where everything around the planet can be connecting among each other and that technology is named as IoT (Internet of Things). It is a huge concept which is evolving day by day and the opportunities in IoT is infinity. There are essential enabling technologies used in IIoT, the architectural layers of IIoT which are mentioned in this study. The study also puts forward Application of IIoT in various areas. The research paper gives an idea to the readers/audience about IIoT. Further the benefits and Challenges of IIoT have been brought forward. In my viewpoint I would like to state that it depends on the organization/industry how well it makes use of IIoT so that industry/organization can take maximum benefits from it while simultaneously delicately handling the Challenges involved.The nature of this study is qualitative and the author recommends there are many possible directions of research in IIoT which can be helpful for the development of society and the world.

Keywords: industry, internet, research, study,

INTRODUCTION TO IIOT

IoT technologies exist all round us – all those connected devices we utilize alike wearable technologies & virtual assistants are made probable by IoT. Industrial IoT, then, is taking the digital inter-connectivity we've come to rest on on & applying it to colossal industrial operations, where the jeopardies are higher, but the remuneration is greater.

According to TechTarget, IIoT can be formally well-defined as "the usage of smart sensors & actuators to improve manufacturing & business processes. Also known as the industrial internet or Industry 4.0, IIoT clouts the power of smart machines & real-time analytics to take benefit of the data that dumb machines have created in industrial settings for eons."

Industrial IoT competences necessitate extensive digitization of manufacturing operations. Organizations must comprise four prime pillars to be well-thought-out a fully IIoT-enabled operation:

- SMART machines armed with sensors & software that can trace & record data.
- Full-bodied cloud computer systems that can hoard & process the data. Radical data analytics systems that make sense of & leverage data gathered from systems, informing manufacturing enhancements & operations.
- Cherished employees, who put these visions to work & guarantee proper manufacturing function.

WHICH ARE ENABLING TECHNOLOGIES OF IIOT?

The spine of IIoT is established by allowing a outsized glut of technologies comprising IoT, cloud computing, big data analytics, AI, cyber-physical systems, augmented reality & virtual reality, Human-to-Machine (H2M), and M2M communiqué.

Internet of Things
Bearing in mind the associated factory scenario, IoT devices help in real-time data assortment & actuation. Being the prime element in IIoT, these devices trace the industrial unit possessions across the world. The entire procedure which is beginning from raw material & finishes with finish products is observed utilizing IoT devices in order to accomplish momentous lessening in labour cost & manual system management. The IoT devices in a fully associated IIoT system are installed across all the factory amenities ranging from storerooms to production

accommodations & distribution centers. However, the configuration, positioning, observing, & upkeep of these devices is a thought-provoking task & necessitate vastly trained technical employees.

Blockchain Technology

The blockchain is amongst the utmost vital technologies that will play a crucial role to bring the reverie of IIoT into reality. Presently, an exhaustive research is carried by academia & industry on blockchain technology in several arenas such as finance, health, supply chain, car insurance. The IoT facilitated devices utilized in smart industry produce a colossal expanse of data. The data produced by these IoT devices is versatile, the data is analyzed & treated for performance observing of devices, glitch detection, identification, extrapolative maintenance, asset observing, tracing of the comprehensive product lifecycle from raw material to finishing goods & supply to end users. However, division this imperative data with all things involved in the IIoT system in a safe and sound mode is a very perplexing task. The distinctive features of blockchain technology alike dispersed nature, traceability, survivability, reliance, fiddle resistance, safekeeping & innate data provenance make it appropriate for IIoT. Additional newly blockchain technology is used for IoT devices firmware updates & access control.

Cloud Computing

The gigantic progress of data in IIoT necessitates exceedingly disseminated high performance calculating systems in order to cope, procedure, analyze, & stockpile the data. Cloud calculating technologies deliver compute, network, & stowage services across all the amenities in an IIoT system. All linked devices & applications are straight interfaced with backend clouds. The cloud service models are designed as private (merely held & coped by IIoT staff), public (exclusively owned & managed by third-party cloud sellers), or hybrid (whereby a fusion of together service models is utilized).From the time when the founding of data centers & enrolment of technical staff necessitate great expenditure therefore private cloud service models are not a worthwhile choice for afresh entrants and/or small & medium level enterprises. However, big & well-established multinational companies fancy the positioning of private clouds in order to guarantee the shelter, security, & confidentiality & muddle through with industrial reconnaissance for competitive advantage.

Big Data Analytics

The things & systems in IIoT produce enormous quantity of data streams consequential the requisite of exceedingly refined high performance calculating systems for big data treating & analytics. However, it is pretty perplexing to stipulate when, how, & where to process & analyze the big data bearing in mind latency & real-timeliness in IIoT systems. In order to copiously orchestrate the big data analytics services, IIoT systems facilitate diverse technologies for big data assortment, stowage, management, treating, analyzing, & actuation. The data congregation technologies deliver connectors to a big glut of data sources comprising sensors, smart objects, on-board data collectors, web-empower data sources, & humane-machine activities in IIoT systems, to forename a few. Likewise big data stowage technologies expedite in on-board, on-premise, in network, & distant data stowage in cloud environs. The data management & treating technologies empower to grip big data nearby the sensors, in edge servers, & in cloud data centers. The data examination technologies deliver diverse apparatuses for data mining, machine & deep learning & statistical data examination at diverse layers in IIoT systems. The actucation technologies facilitate exchanges amongst IIoT devices & their ambient environs. In spite of intricacy, big data processing & analytics technologies play a prime role in next-generation IIoT systems.

Artificial Intelligence and Cyber-Physical Systems

AI technologies guarantee that IIoT system should ride independently & cerebrally to minimalize the humane interpolations & increase efficiency. The AI technologies create IIoT self-sufficient by utilizing multifarious AI technologies such as multi-agent systems & chatty AI. In addition, the astuteness is implanted at layers in IIoT systems from sensors to devices to edge servers & cloud data centers by facilitating diverse search, optimization,& extrapolation algorithms. In order to abate the human pains & interventions, IIoT systems endow diverse cyber-physical systems such as manufacturing systems & industrial robots. The core of CPS lies in on-board implanted IoT devices which facilitate diverse sensors & actuators to work in the industrial environs. These on-board implanted IoT devices also enable in intellectual data processing for self-sufficient operations & augment efficiency in IIoT systems. These proficiencies range from unalike working efficiencies in industrial environs to system-wide efficiencies in CPS & IIoT systems.

Augmented and Virtual Reality

The Augmented Reality (AR) technologies support in assisting the industrial employees throughout multifarious manoeuvres such as assembling/de-assembling the apparatuses, multifaceted business products, & mission critical systems. The AR technologies facilitate to observe the employees & machines throughout manoeuvres & instantaneously generate amends or announcements in order to minimalize the errors. The Virtual Reality (VR) technologies enable in envisaging the configurations & re-configurations of industrialized functions & segments before real executions in IIoT systems. The utilize of VR facilitates to condense the (re-)configuration times &

slashes off the shutdown time of industrialized plants & machines. The VR models are designed by bearing in mind open standards which are designed by in view of heterogeneity in CPS & IIoT systems.

ARCHITECTURE OF IOT

IIoT systems are commonly apprehended as a encrusted segmental architecture of digital technology. The device layer refers to the physical constituents: CPS, sensors or machines. The network layer contains of physical network buses, cloud computing & communiqué protocols that amassed & transference the data to the service layer, which comprises of applications that manipulate & pool data into info that can be demonstrated on the driver dashboard. The uppermost stratum of the stack is the content layer or the consumer interface.

Layered modular architecture IIoT	
Content layer	Consumer interface devices (For example computer screens, PoS stations, tablets, smart glasses, smart surfaces)
Service layer	Applications, software to scrutinize data & transmute it into actionable info
Network layer	Communications protocols, Wi-Fi, Bluetooth, LoRa, cellular
Device layer	Hardware: CPS, machines, sensors

Objective of Study

- The First objective of the study is to throw light on the IIoT and enabling technologies that are used in IIoT.
- The Second objective of the study is to know more about architectural layers of IIoT and Application of IIoT.
- The Third objective of the study is to give the audience an idea about IIoT and further the Benefits of IIoT as well as Challenges associated with IIoT and Suggesting a direction for future research in same.

METHODOLOGY OF STUDY

- The methodology of the research work is derived from the systematic and theoretical analysis of the methods to evaluate correct specific method for application. It constitutes qualitative techniques.
- This study is Qualitative in nature and is conducted based on the data collected from secondary sources of information such as published reports, journal articles, newspapers and magazines.

BENEFITS OF IIOT

1. **Increase efficiency**

The prime advantage of IIoT is that it provides constructors the capability to automate, & therefore improve their operational efficiency. Robotics & automatic machinery can slog extra proficiently & precisely, furthering throughput & assisting constructors rationalize their tasks. Furthermore, physical machines can be linked to software via sensors that observe performance on a continual basis. This facilitates constructors to have healthier insights into the operative performance of discrete pieces of apparatus as well as whole fleets.
IIoT-facilitated data systems endow constructors to advancement operational efficiencies by:

- Dodging manual jobs & functions & executing automated, digital ones
- Creation of data-driven decisions concerning all manufacturing tasks
- Observing performance from anyplace – on the manufacturing floor or from thousands of miles away

2. Reduce Errors

Industrial IoT endows constructors to digitize approximately each part of their business. By plummeting manual process & entries, constructors are capable to condense the prime risk linked with manual labor – human error.
This goes yonder just operative & manufacturing errors. IIoT solutions also can shrink the menace of virtual & data fissures instigated by human error. A Cyber Security Trend report quoted folks as the largest root of cyber security cracks, with human error being the offender 37% of the time. AI & machine learning-permitted programs & machines can do much of the mandatory calculating themselves, jettisoning the prospective for someone to make a meek gaffe, & put the manufacturer's data at risk.

3. Predictive Maintenance

Nothing deleteriously influences a manufacturing operation additional than machine downtime. Aberdeen Research Group gauges that the run-of-the-mill cost per hour of downtime across all manufacturing kinds equates to

$260,000. What could be bring about such dire matters that manufacturers cannot function? The solution is simple – lack of proper & prognostic conservation.
When upkeep in the manufacturing sphere is responsive rather than pre-emptive, manufacturers are wedged trying to detect what the matter is, how it can be refurbished, & what it will charge. With prophetic upkeep driven by industrial IoT resolutions, all of those concerns are assuaged.

When machines performance & task is observed consistently, manufacturers can make a reference line. This reference line & the matching data endow corporations with the info they necessity to see any concern before it befalls. They can then programme upkeep previous to downtime, which benefits them in that they:

- Have the parts requisite for the job
- Know the charge of the project ahead of time, & can financial plan for it
- Transfer production to one more zone of the facility, so the product shares are unaffected
- Confirm that machinery is working at full proficiency

4. Improve Safety
All of the data & sensors prerequisite of a effusively working IIoT manufacturing operation are also assisting to shore up workroom safety. "Smart manufacturing" is turning into "smart security" when all of the IIoT sensors labour together to observe workroom & employee safety.

Cohesive safety systems are shielding workforces on the floor, on the line, & in distribution. If an mishap transpires, every Tom, Dick, and Harry in the facility can be forewarned, operations can terminate, & business headship can interfere & create sure the mishap & episode is fixed. This occurrence can also produce treasured data that can help preclude a recap occurrence in the imminent.

A new-fangled choice some manufacturers are using is the usage of wearable technology amongst their staffs. Wearables have been chunk of IoT since its embryonic stage, & it are just now being used in industrial IoT operations.

Wearables aid headship keep checks on things like employee pose & the contiguous noise levels, & they can then advance work state of affairs & possibly improve performance. They can also vigilant employees when they aren't succeeding proper workroom safety processes, so they can accurate their activities & stay innocuous on the job.

5. Reduce Costs
Knowledge is power, & the knowledge delivered to manufacturers through IIoT solutions is giving them the apparatuses they necessity to condense outlays & produce more income. Data-driven visions into operations, construction, advertising, sales, & more can coxswain businesses in a lucrative direction.

All of the above-mentioned paybacks of IIoT – prognostic maintenance, rarer errors, enhanced quality control, & make the most of proficiencies – will all lift profits for a manufacturer. Industrial IoT also bids debatably the utmost treasured tool for front-runners of a manufacturing company – visions from anywhere, anytime.

Remote observing of manufacturing operations is at the present probable 365 days a year, 24/7, from anyplace in the world. This 360-degree sight into the whole manufacturing process, & the continuation service delivered to patrons in their purchasing journey, is an priceless asset.

APPLICATION OF IIOT

1.Smart Factories– IIoT enabled equipment can sense the environment and transmit data to managers or field engineers, which enable them to remotely manage their factory units and take advantages of process automation. IIoT devices can also transmit data regarding production, losses and inventory to their managers so they can take timely necessary actions.

2.Maintenance Management- IIoT sensor enables condition-based maintenance by monitoring critical machines and alerting managers when they deviate from specified parameters like temperature or vibration ranges. This functionality reduces breakdown time, cost and increase operational efficiency of the plant.

3.Process Management- IIoT in manufacturing industries enables monitoring of refining process of raw material to packaging of the final product. This nearly real-time monitoring enables production managers to adjust plant parameters so production targets can be met with quality and cost.

4.Inventory Management- IIoT permits monitoring of each and every supply chain events from material arrival to material dispatch; any deviation from the plan can be captured by managers in real time, so they can act upon accordingly. IoT device RFID and barcodes are used in stores for material management which reduce a significant amount of time and energy consumed by human-based inventory management system.
5.Quality Control- Uses of IIoT in the production line can improve the overall quality of the final product as they can monitor process and equipment on real-time and maintain plant parameter like temperature, pH, acidity, impurity, densities etc. in a range which results in a quality product. They can also monitor third party raw material quality and can capture customer reviews on final product which can be later analyzed for quality issues.

6.Safety and Security- IIoT devices can work in a hazardous environment like in acid plant or in confined space, thus reducing or eliminating human life intervention. IIoT devices themselves can take immediate actions based on their area of application viz. stopping furnace if the temperature goes beyond the specified limit, honk a siren if the boiler is going to explode or a stack is going to fall etc. Overall workers safety can be enhanced by using big data and IoT technology.

7.Logistic Management- IIoT can provide nearly real-time tracking information of raw material, the final product, plant equipment and their spare parts. This information will help managers to predict issues and their resolutions in time. GPS enabled vehicle monitoring system can help manufacturers to track raw material availability and final product's delivery in time.

8. Challenges associated with IIoT

- Proficient Data Management Schemes
- Alliances amongst Heterogeneous IIoT Systems
- Full-bodied & Malleable Big Data Analytic Technologies
- Dependence on IIoT systems
- Co-occurrence of Wireless Technologies & Protocols in IIoT
- Facilitating Decentralization on the Brink
- Arrival of IoT Specific Operating Systems
- Public Well-being in IIoT

CONCLUSIONS AND FUTURE SCOPE

This research introduces IIoT, enabling technologies that are used in IIoT, architectural layers of IoT and discusses Application of IoT in various areas. Further the research paper gives an idea about IIoT , its benefits and challenges associated with the same. This research paper is theoretical in nature and data was collected from secondary sources such as Thesis, research papers, magazines, reports etc. The research concludes that IIoT has definitely revolutionized how Internet technologies are applied these days across the Globe in various application areas which include manufacturing or the industrial sector. There are Challenges for IIoT mentioned in this study. In my viewpoint I would like to state that it depends on the organization/industry how well it makes use of IIoT so that organization can take maximum benefit while simultaneously delicately handling the challenges involved. The research approach followed in this research paper is qualitative. Further scope of research is also there where the theoretical framework can be proposed and tested by statistical tools and techniques.

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