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Need of IIOT Monitoring and Cloud Computing in Modern Manufacturing

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Abstract: ***The focus of this paper was to analyze the need for IIOT & cloud computing in the manufacturing industry and evaluate the impact in Increasing productivity, uptime, improving process efficiencies, accelerating innovation, reducing asset downtime, enhancing operational efficiency, creating end - to - end operational visibility, improving product quality, and reducing operating costs. This study will also determine how IIoT can help manufacturing optimize production processes and minimize downtime. In addition, this will also support exploring how IIOT & cloud computing can help to create new business models that allow them to stay competitive.***

Keywords: IIOT, cloud computing, manufacturing, productivity, operational efficiency

1. Introduction

IoT refers to a complex system of devices (e. g., sensors, cameras, GPS trackers) connected to the cloud and provides real - time data that enables optimization of the car manufacturing process and more efficient transport management. IoT solutions turn vehicles into smart means of transportation that leverage predictive maintenance, direct car - to - car interaction, AI - powered driving assistance, and other advanced features to offer enhanced road safety and driving efficiency to individuals and businesses alike. Car manufacturers also use IoT to automate production processes, reduce the likelihood of human error, and enhance quality control.

Some of the key challenges faced by Manufacturing Industry that IoT promises to solve include -

- Inability to provide intuitive and differentiated customer experience.
- Keep the growth engine always firing.
- Low availability and under - utilization of assets and resources
- Longer time to market new products.
- Soaring costs, regardless of implementing cost reduction initiatives.

Businesses (irrespective of the industry or domain) now consider IoT to be one of their key strategic technology initiatives that can help them in a range of scenarios including improving customer experience, physical asset tracking, optimizing processes, and providing better visibility into operations, among others. The growth potential of IoT - related products and services is immense in today's market scenario and future as well. IoT product and service providers are expected to generate an estimated incremental revenue of $300+ billion by 20201 and the worldwide market for IoT solutions will grow from $1.9 trillion in 2013 to $7.1 trillion by 20202. Furthermore, the installed base of IoT devices will grow at a CAGR of 17.5% to 28.1 billion during the same period.

Bottom line: The shift toward Industry 4.0 is evident in the manufacturing industry. Manufacturers are eager to embrace smart manufacturing, moving toward a new level of interconnected and intelligent manufacturing systems.

This study determines the need for IIOT Monitoring and cloud computing in the Manufacturing Industry.

2. Research Problem

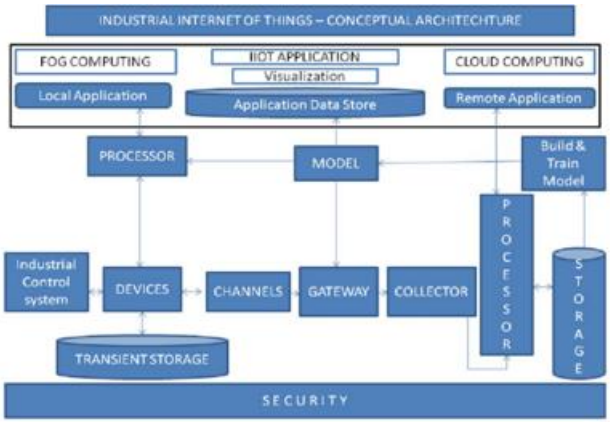
IIOT monitoring and cloud computing in manufacturing. IIOT monitoring and cloud computing share some of the common datasets. Implementing these systems is expensive and time - consuming. There are challenges like investment costs, Secure Data Storage & Management, Connectivity Outages, Blending Legacy, and IIOT Infrastructure. The Internet of Things (IoT) has emerged as a potential solution to these challenges. As a network of physical objects embedded with sensors that collect and exchange data, the IoT helps manufacturers optimize production processes and reduce downtime. In addition, the IoT can help manufacturers create new revenue streams and business models that allow them to stay competitive. A Deloitte survey shows, "More than 86% of survey respondents believe smart factory initiatives will be the main driver of manufacturing competitiveness in the next five years, though only 51% are making/have made investments. "

Today, many businesses across various sectors house their software and databases on the cloud. It provides full - service security, flexibility for growth, enhanced quality control, and advanced loss prevention and disaster recovery capabilities. The cloud provider must manage the costs of infrastructure, maintenance, and day - to - day running of the server equipment, while the company that is conducting cloud computing on those servers must pay only for the server time or space that they use. Cloud computing is an optimized, efficient way to run the technological backend of any type of company, and the use of cloud computing in manufacturing is becoming increasingly widespread. Cloud - based manufacturing means that a company runs its manufacturing software systems and databases on the cloud, accessed via the Internet. This way, the company's information, and software systems are not tied physically to any network server – everything is available to be accessed from anywhere, anytime, if there is an internet connection. This is certainly an added convenience for managers of a manufacturing facility, who can also control permissions and access to the systems on the cloud.

Furthermore, a cloud manufacturing platform is designed to handle the ‘big data’ associated with manufacturing operations, as well as complex computational capacities in a secure, protected environment. In addition, when different systems are running on the cloud, they can be synced to communicate automatically with each other, streamlining the overall business management and operations. Like other
To overcome these challenges Organizations must have the right implementation strategy for IIOT monitoring & Cloud Computing manufacturing sector is under constant pressure to increase efficiency and productivity while reducing costs.

3. Literature Review

IIOT Architecture: IIOT brings the concept of the Internet of Things to the enterprise level. Every enterprise has its unique clusters of devices with limited interfaces. Now considering the challenges, there is no single solution that solves all the problems. Key Components:



Industrial Control System: Industrial Control System is a general term used to define software and hardware integration to control critical infrastructure. They are generally developed using distributed control system (DCS), programmable logic control (PLC), supervisory control and data acquisition (SCADA) system, remote terminal units (RTU), control servers, human - machine interface (HMI), intelligent electronic device (IED) and many other industry - specific systems [1].

Devices: Sensors, Interpreters, and Translators These are some industry - specific devices that interface with ICS, Transient Data Stores, Channels, and Processors to provide data to the application user end. They provide machine - to - machine interaction, human - to - machine interaction, and vice - versa capabilities to the Industrial Control System [2].

Transient Store: The Transient Data Store is a slave component to the master architecture where the transient representation of the data objects is stored temporarily ensuring durability during failure of the operation and system failure including networks.

Local Processors: They are low latency data processing systems providing fast processing of data. And which can be integrated with the device itself for data processing. This processor can be classified into data filters, event managers, data processors, rule - based engines, signal detectors, algorithms, routers, etc. [3]

Application: These provide insight into the field operations in real - time, these applications help staff to manage the devices, interact with other systems, to manipulate the data. Notification, alerts, and visualization help them to make effective and calculated decisions [4]. Ø Channels: These are data exchange mediums between the system and the application. It includes network protocol, satellite communications, API, routers, etc.

Gateways: Gateways provide a connection across various networks and protocols enabling data transfers between different IIOT devices. It includes intelligent signal routers, information transfer protocols, etc.

Collectors: Collectors gather data from gateways using standard protocols. It can be custom - made; these kinds of devices vary from industry to industry depending upon the needs.

Processors: Processors are the heart of any kind of IIOT solution. Their primary functions involve data transformations, signal detection, analytical models, complex event processing, etc.

Permanent Data Store: These are long - time data storage systems connected to the IIOT system. They work as a historian for the devices along with data from different sources feeding data to the processors for advanced analytical processing and preparing models. It includes a massive amount of parallel processing data stores, cloud storage, data repositories, RDBMS, open - source data, etc. [5]

Models: There are two types of models in any IIOT solution one is the Analytical Model, and another is the Data Model. The data models provide a structure to the data while the analytical models are custom - built to meet industry - specific needs. Models play a crucial role in any IIOT solutions, they are generally built by leveraging the data in permanent data stores, human experiences, and industry standards. The analytical models are trained using a historical data set or using advanced machine learning. For example: clustering, regressions, mathematical, statistical, etc. Some examples of data models are semantic models, entity relationship mapping, JSON, XML/XSD, etc. [6].

Security: This is an important aspect of the IIOT - based system. It runs through the pipelines from the source to consumption. It includes data authorization, encryption, authentication, user management, firewalls, masking, etc. [7].

Computing Environments: The mentioned environment varies from industry to industry depending upon the business need and its landscape.

Fog Computing: Brings the analytics near to the source.

Cloud Computing: Scaling analytics globally across the industry.
Hybrid Computing: Mix of fog and cloud computing optimizing operations tailored for specific field needs [27].
Fig 1: Conceptual architecture of IIOT
Fig 1

4. Significance and Benefits

IoT can be used in the Manufacturing industry for various purposes, such as machine automation, capacity planning, and predictive maintenance. It allows manufacturers to observe and understand machine data, configure them automatically based on collected data, predict necessary maintenance activities ahead of time, and schedule them accordingly.

IIoT technologies allow manufacturers to improve productivity by automating processes, optimizing capacity planning, and implementing predictive maintenance activities.
- Several reasons drive the need for IoT in Manufacturing:
- The industry faces a shortage of skilled workers, sending costs soaring and leading to drops in production numbers.
- Competition from emerging markets such as China has put pressure on high - cost manufacturers to cut costs and find ways to automate processes.
- There is a need to enhance the customer experience.

IoT enables manufacturers to enhance their capabilities by implementing any of the following applications –
- Predictive Maintenance: This allows manufacturers to predict problems and failures before they happen to avoid untimely disruptions.
- Productivity Optimization: IoT enhances a manufacturer's productivity by allowing them to monitor machine performance data, configure machines automatically based on collected data, collect relevant data from sensors that are then processed by production analytics software, and configure machines remotely through cloud technology.
- Capacity Planning: IoT in Manufacturing is used for capacity planning to determine future customers' needs effectively.
- Product Tracking: This allows manufacturers to track all their products throughout their lifecycle.
- Supply Chain Management: IoT technologies gather data from various sensors collected at the production source. As a result, this information is then transmitted to management software for further processing.

IoT uses new technologies such as sensors, machine learning, and wireless. These technologies help manufacturers to create various products and improve their production processes by measuring the speed they take to produce them. Cloud computing enables manufacturers to be more agile in their approach. This is enabled through continuous data collection on the shop floors and on - demand processing and availability of data through expanded analytical capabilities. This, in turn, enables A Manufacturing Industry to make decisions in real - time and detect and solve issues in the production environment before they have a chance to turn into problems and cause work stoppage and productivity losses.

Since cloud - based solutions do not involve expensive upfront investments in hardware or software, the total cost of ownership is much lower than traditional solutions.

With cloud services, developers can effectively hand over the burden of managing IT infrastructure or data centers and simply focus on developing and managing applications for better business results. This, in turn, results in a markedly improved focus on innovation and result - oriented application development.

With most businesses targeting a global presence in current market scenarios, Cloud services have a unique potential for Manufacturing businesses to reach customers irrespective of geography and also to implement digital transformation strategies across their global footprint of different facilities.

5. Conclusion

IIOT Monitoring and Cloud system implementation in manufacturing with connected devices (can sense, communicate, and store information) gain competitive advantage in Manufacturing.

The Real - time Monitoring, asset /resource optimization, and remote diagnosis of IIOT Monitoring and Cloud Computing provide better Predictive maintenance in Manufacturing equipment especially through environmental sensors. Although implementing a Cloud system with IIOT reduces IT costs, however, the technology is still evolving and the cost advantages, security, and flexibility of IIOT & cloud computing in Manufacturing depend on various system strategies.

IIOT & Cloud Computing are still a very challenging platform because of what is demanded from them. The cost of sensors is continuously reducing and therefore enabling more automation. However, the greatest difficulty is acquiring the substantial expertise required in cloud manufacturing to implement a virtual and physical system in parallel.

High - level management must invest in time and provide finance through a phased roadmap, it is up to individual companies to analyze their manufacturing and find the area for phased implementation for the best payback.

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