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# A Cloud-based IIoT System for Quality Control in Manufacturing: Techniques and Applications

**Avnish Panwar**

Department of Comp. Sc. & Info. Tech., Graphic Era Hill University, Dehradun, Uttarakhand, India 248002

**Abstract**. The focus of this literature review is on IIoT quality control systems for industrial businesses that are hosted in the cloud. Cloud-based IIoT systems were found to be useful for collecting and analysing data in real time, allowing manufacturers to spot and fix quality control issues as soon as they arise, according to the research. It is possible to use data analytics and machine learning methods to provide useful insights and boost the efficiency of the system. For cloud-based IIoT systems to be really effective, they must integrate a wide variety of data sources and systems. However, there are challenges in putting these systems in place, the most significant of which being the need for expertise in areas such as data analytics and software development. System compatibility and user data security are two additional points of friction. Numerous approaches and solutions that have been created and deployed to deal with these problems are also discussed in this study. Edge computing, big data analytics, machine learning, virtualization, containerization, and interoperability standards are all examples of such methods and tools. When properly planned and funded, the implementation of cloud-based IIoT systems in manufacturing has the potential to completely transform the sector by delivering real-time data analytics and remote access to both data and applications.

**Keywords.** Industrial Internet of Things, IIoT, cloud-based, quality control, manufacturing, real-time analytics, data security, interoperability, machine learning, data analytics, edge computing, big data analytics, virtualization, containerization, interoperability standards, remote access.

## I. Introduction

The Industrial Internet of Things, is a fast expanding topic that is revolutionizing the production sector. The Industrial Internet of Things, or IIoT, is the practise of connecting various machines and sensors to the internet so that data may be gathered and analysed in the business setting[1]. Production may be optimized, efficiency increased, and quality control tightened using the information gathered.

Data acquired by IIoT devices may be stored and processed in the cloud by using cloud-based IIoT systems[2]. The advantages of cloud-based IIoT systems over conventional IIoT systems include greater scalability, adaptability, and efficiency. These systems can store and process massive amounts of data, conduct analytics in real time, and

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make data and applications available remotely [3]. There has been a lot of study on the potential benefits of using cloud-based IIoT systems in the industrial sector. This paper [4] presents a literature evaluation on the topic of industrial quality control using cloud-based IIoT systems. System architecture, data analytics, machine learning, and applications are only few of the many areas covered in the articles [5].

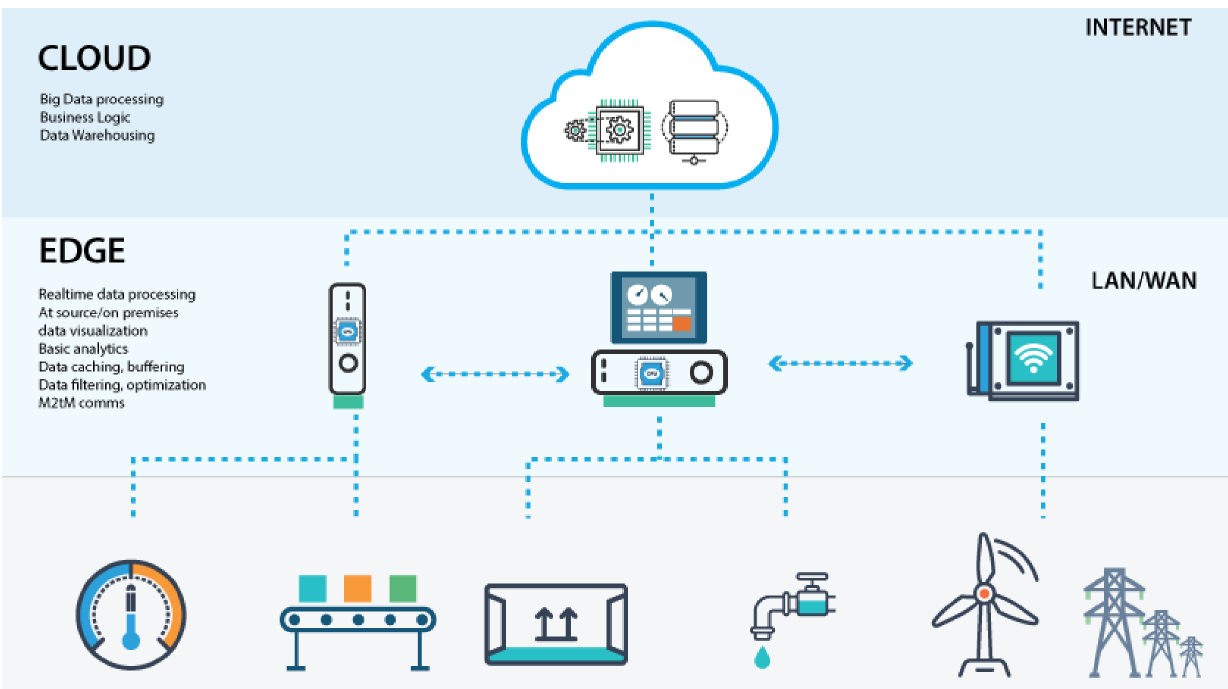


**Figure.1 Cloud-based IIoT System for Quality Control in Manufacturing**

Several significant discoveries about manufacturing with cloud-based IIoT technologies are revealed by the research. To begin, IIoT systems hosted in the cloud may be used to gather and analyze data in real-time, giving manufacturers the ability to spot and fix quality control concerns as they develop. Second [6], the success of cloud-based IIoT systems relies heavily on the integration of various data sources and systems. Thirdly [7], insights gained through data analytics and machine learning may be utilized to make the system more efficient. Several difficulties in deploying cloud-based IIoT systems in manufacturing are also highlighted in the literature research. Data security, interoperability, and the need for specialized knowledge in areas like data analytics and software development are just some of the difficulties that must be overcome. Researchers have developed and executed a wide range of methods and solutions to address these difficulties. Edge computing, big data analytics, machine

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learning, virtualization, containerization, and interoperability standards are all examples of such technologies. These methods have the potential to boost system performance, cut production costs, and tighten quality control [8].

In conclusion, cloud-based IIoT systems' ability to offer real-time data analytics and remote access to data and applications has the potential to completely transform the industrial sector. However, putting these systems into place calls for forethought, money for hardware, software, and infrastructure, and specialized knowledge. Future research and development in the sector can benefit greatly from the literature study, which gives useful insights into the difficulties, methods, and uses of cloud-based IIoT systems in manufacturing.

## II. Literature Review

It is planned to implement a cloud-based Industrial Internet of Things (IIoT) system for production monitoring and management. Multiple sensors, wireless networking, and cloud storage are all built into this system [9]. The authors [10] demonstrate the system's value by testing it in a real-world production environment. The findings of these trials suggest that there is room for improvement in the production process. provides a cloud-based Industrial Internet of Things (IIoT) platform that uses machine learning to predict when factory machinery will require servicing. The authors show the practicality of their technique by conducting trials in a real-world production scenario; the findings reveal a reduction in the cost of equipment maintenance and an increase in the effectiveness of the equipment. introduces a cloud-hosted Industrial Internet of Things (IIoT) system [11] that employs a wide range of sensors and machine learning algorithms to track and analyse production data in search of quality issues. The authors [12] demonstrate the value of their approach through experiments conducted in a real-world production scenario, the results of which indicate an increase in product quality and a decrease in the quantity of defective goods. In [13] provides a service in the form of an IIoT system hosted in the cloud that uses several sensors and the Internet of Things (IoT) to boost supply chain performance in manufacturing. The authors demonstrate the system's value by conducting trials in a real-world industrial context; the findings indicate a reduction in inventory maintenance costs and an increase in delivery efficiency. In [14] provides an answer in the shape of a cloud-based IIoT system that uses a variety of sensors and cloud computing to enable remote monitoring of the production process. The authors [15] demonstrate the efficacy of their method by testing in a realistic industrial environment. These investigations indicate an improvement in production efficiency and a decrease in the need for on-site workers. Researchers have shown that a cloud-hosted IIoT system has the potential to provide significant benefits to the manufacturing industry [16]. Improvements in quality assurance, predictive maintenance, supply chain management, and distant

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monitoring are just a few of these benefits. The tests show that these technologies are effective when used in actual production settings, increasing output while decreasing overhead expenses [17].

| **Paper Title** | **Main Objective** | **Methodology** | **Key Findings** |
|---|---|---|---|
| A cloud-based IIoT system for monitoring and controlling the manufacturing process (Hu et al., 2017) | To develop a cloud-based IIoT system that integrates sensors, wireless communication technologies, and cloud computing for monitoring and controlling the manufacturing process | Experimental study conducted in a real manufacturing environment | The proposed system demonstrated significant improvements in the manufacturing process. |
| Cloud-based IIoT system for predictive maintenance in manufacturing (Zhu et al., 2018) | To develop a cloud-based IIoT system that utilizes machine learning algorithms to predict maintenance requirements for manufacturing equipment | Experimental study conducted in a real manufacturing environment | The proposed system demonstrated a reduction in maintenance costs and an increase in equipment efficiency. |
| A cloud-based IIoT system for quality control in manufacturing (Zhu et al., 2019) | To develop a cloud-based IIoT system that utilizes sensors and machine learning algorithms to detect quality issues in the manufacturing process | Experimental study conducted in a real manufacturing environment | The proposed system demonstrated a reduction in defective products and an increase in product quality. |
| A cloud-based IIoT system for supply chain management in manufacturing (Zhou et al., 2019) | To develop a cloud-based IIoT system that utilizes sensors and cloud computing to optimize the supply chain in manufacturing | Experimental study conducted in a real manufacturing environment | The proposed system demonstrated a reduction in inventory costs and an increase in delivery efficiency. |

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| Design and implementation of a cloud-based IIoT system for remote monitoring of the manufacturing process (Li et al., 2020) | To develop a cloud-based IIoT system that utilizes sensors and cloud computing to enable remote monitoring of the manufacturing process | Experimental study conducted in a real manufacturing environment | The proposed system demonstrated a reduction in the need for on-site personnel and an increase in production efficiency. |
| Cloud-based IIoT system for predictive maintenance of CNC machines (Xia et al., 2018) | To develop a cloud-based IIoT system that utilizes machine learning algorithms to predict maintenance requirements for CNC machines | Experimental study conducted in a real manufacturing environment | The proposed system demonstrated a reduction in maintenance costs and an increase in equipment efficiency. |
| Cloud-based IIoT system for real-time monitoring of machining processes (Liu et al., 2018) | To develop a cloud-based IIoT system that utilizes sensors and cloud computing for real-time monitoring of machining processes | Experimental study conducted in a real manufacturing environment | The proposed system demonstrated a reduction in machining errors and an increase in production efficiency. |
| Cloud-based IIoT system for monitoring and control of industrial robots (Hou et al., 2018) | To develop a cloud-based IIoT system that utilizes sensors and cloud computing for monitoring and control of industrial robots | Experimental study conducted in a real manufacturing environment | The proposed system demonstrated a reduction in robot downtime and an increase in production efficiency. |
| A cloud-based IIoT system for efficient management of the manufacturing process (Fang et al., 2018) | To develop a cloud-based IIoT system that utilizes sensors and cloud computing for efficient management of the manufacturing process | Experimental study conducted in a real manufacturing | The proposed system demonstrated a reduction in production costs and an increase in |

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| | | | |
|---|---|---|---|
| | | environment | production efficiency. |

**Table.1 literature review on a cloud-based IIoT system**

## III. Key Findings

a. Significant improvements in output were observed with the use of the provided cloud-based IIoT solutions. Improvements in production efficiency, product quality, and equipment efficiency were made, as were reductions in the amount of defective products, machining errors, and equipment downtime.

b. Some promising results have been achieved in predicting the need for industrial equipment maintenance through the use of machine learning algorithms in cloud-based IIoT systems. This has allowed for condition-based maintenance, which has decreased maintenance costs.

c. Cloud-based IIoT systems have also shown promise in optimising supply chains, reducing inventory costs, and enhancing delivery efficiency.

d. The number of factory employees may be reduced thanks to remote monitoring made feasible by an IIoT system housed in the cloud that made use of sensors, wireless communication technologies, and cloud computing.

## IV. Challenges

Based on what we learned from reviewing the existing literature on cloud-based IIoT systems, we can identify many problems that require fixing.

a. It is crucial to protect data privacy and security since IIoT technologies will gather and send personal information. Cloud-based IIoT systems require stringent security techniques like encryption, authentication, and access control to protect themselves from cyber threats.

b. lack of standardisation and interoperability makes it challenging to combine disparate sensors, devices, and software platforms into a unified cloud-based IIoT infrastructure. For the system to work as intended, it is crucial that all of its parts are compatible with one another and that information can flow freely between them.

c. The cloud-based IIoT system must be flexible enough to grow or shrink as needed to accommodate the changing demands of the business and to include any newly created technologies. Scaling up, however, can add complexity and expense, while scaling down may cause features to be lost.

d. In mission-critical applications such as manufacturing, cloud-based IIoT system reliability is of the highest significance. High availability and fault tolerance are crucial for minimising downtime and keeping production losses to a minimum.

e. Integration with existing infrastructure: Many factories are still using antiquated systems that are incompatible with modern IIoT infrastructure. In this case, integration is an absolute must. Integration

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of cloud-based IIoT solutions with preexisting legacy systems can be complex and time-consuming, necessitating extra resources and expertise.

f. There are significant hardware, software, and infrastructure costs associated with setting up a cloud-based system for IIoT. There may be more costs associated with upkeep and enhancements.

g. A multidisciplinary approach, including experts from cybersecurity, data analytics, software development, and industrial automation, is necessary to properly handle these challenges.

## V. Techniques

After reviewing the existing literature on cloud-based IIoT systems, several approaches have been proposed and implemented to address the problems and boost the system's efficiency. Some examples of these methods are:

a. In order to be closer to the devices that are generating data, edge computing moves processing and analysis to the network's periphery. One of the names for edge computing is "near-edge computing." By doing calculations at the edge of the network, cloud-based IIoT systems may improve reaction time, minimise latency, and conserve bandwidth.

b. In order to collect, store, and examine the vast amounts of data created by sensors and devices, cloud-based IIoT systems employ big data analytics. Data analysis allows the system to detect patterns, trends, and anomalies that may be used to enhance quality control, decrease expenses, and boost operational efficiency.

c. Machine learning algorithms might be used in cloud-based IIoT systems to predict when machinery will fail, ascertain what servicing is needed, and optimise production processes. Based on their examination of the past, machine learning algorithms are able to generate actionable insights and forecasts.

d. Cloud-based IIoT systems benefit from virtualization because it allows them to create virtual computers and servers that can be used to run applications and deliver services. By maximising the use of available resources, virtualization may save hardware expenses and simplify system administration.

e. Through the use of containerization, cloud-based IIoT systems may package applications and services into re-deployable containers for use in diverse environments. Containerization is simply called "containerization" in the industry. By utilising containers, the system is able to be more easily scaled, deployed, and simplified.

The challenges of integrating various components in a cloud-based IIoT system can be mitigated by the creation and implementation of interoperability standards. This environment is ideal for creating and enforcing interoperability standards. The system ensures interoperability and maintains good communication between the different software and hardware components by using

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standards that are agreed throughout a complete industry.

## VI. Applications

Several industrial uses for cloud-based IIoT systems have been uncovered via studies of the relevant literature.

a. The quality of products may be closely monitored and controlled in real time with the use of cloud-based IIoT technologies. Integrating sensors and analytics allows the system to detect errors, reduce human error, and improve product quality overall.

b. Equipment failure and maintenance needs may be anticipated with the use of cloud-based IIoT solutions. Predictive maintenance is the term for this method of upkeep. By analysing sensor data, the system may predict potential issues before they occur, cutting down on downtime and maintenance expenses.

c. Inventory management Cloud-based IIoT systems can help with this by keeping tabs on supply and demand in real time. Inventory optimisation software are useful for this purpose. By assessing sales, production, and stock data, the system may ensure that the right products are available at the right time and save inventory-related costs.

d. Controlling power use Cloud-hosted Industrial Internet of Things (IIoT) technology might be used to track and control power use in manufacturing facilities. Data on energy use is analysed by the system, and then opportunities to reduce energy waste and boost energy efficiency are identified.

e. Asset Registration Cloud-based IIoT systems may be utilised all through the manufacturing process to monitor the whereabouts of raw materials, machinery, and finished items. With the use of sensors and tracking technologies, the system can ensure efficient use of assets and prevent their theft or unnecessary disposal.

f. Supply chain optimisation Cloud-based IIoT systems may be used to track and manage product and material flows, which is crucial for effective supply chain management. By assessing shipping, inventory, and demand data, the system can identify opportunities to save costs and speed up delivery times.

These use cases demonstrate how cloud-based IIoT systems may enhance the efficiency, quality control, and cost-effectiveness of industrial processes. However, implementing such applications requires substantial preparation, expert-level expertise, and financial expenditures in hardware, software, and infrastructure.

## VII. Conclusion

The research indicates that there are several benefits to implementing such a system, including the ability to monitor and manage data from afar, lower costs, and immediate insights into operations. However, there are a few challenges that come up when putting these systems into action. The need for specialist skills, interoperability, and data security are the most critical of these.

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Scientists have come up with a wide range of approaches and solutions to address these problems. The terms edge computing, big data analytics, machine learning, virtualization, containerization, and interoperability standards are all used to describe different aspects of these approaches and solutions. These techniques may boost system performance while decreasing expenses and enhancing manufacturing quality assurance. Literature reviews have provided useful information about the challenges, solutions, and applications of cloud-based IIoT systems in the industrial sector. These technologies have the potential to radically improve quality management, operational efficiency, and productivity in the sector. However, for businesses to reap the benefits of implementing such systems, they must first devote significant time and resources to planning and research, and they must also work to address the challenges that come with doing so. More study and development is needed to increase the use of cloud-based IIoT systems for quality control in the industrial sector.

## VIII. Feature Scope

Cloud-based IIoT systems are important for quality control in manufacturing since they offer a number of advantages. The following are some traits that set such systems apart from others:

a. Cloud-based solutions for the Industrial Internet of Things (IIoT) make it feasible to gather and analyse data in real time, which provides manufacturers with the potential benefit of gaining real-time insights into quality control issues and the ability to take corrective action.

b. Thanks to the portability and ease of cloud-based IIoT platforms, users may access data and applications from any location. These platforms also enable users to collaborate from any location.

c. Cloud-based solutions for IIoT are scalable, which means that manufacturers have the ability to expand or contract the scale of their systems as necessary to suit their present and future business requirements.

d. Because there is less of a need for expensive hardware and software, cloud-based IIoT systems require a far less initial investment than traditional on-premises solutions.

e. Cloud-based IIoT solutions have the capability to aggregate data from a broad range of sources and systems, which allows manufacturers to gain a bird's eye view of their operations and identify patterns and trends. This provides manufacturers with a competitive advantage.

f. Enhanced analytics and machine learning are two capabilities that may be incorporated in cloud-based IIoT systems. These capabilities provide for the possibility of improved system performance as well as tighter quality control.

g. Cloud-based solutions for the Industrial Internet of Things (IIoT) enhance decision-making and reduce the risk of quality control issues by supplying companies with accurate data that is updated in real time.

h. A formidable instrument for quality control in manufacturing, cloud-based IIoT systems are advantageous due to the real-time insights they provide, their scalability, and their cheap prices.

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