Implementation of Industrial Quality Management System using Internet of Things (IoT)

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Abstract :

Today's industry needs the digitization and intelligentization of manufacturing processes. Mass production is giving way to personalized production in the manufacturing industry. Increased productivity is aided by rapid advances in production technology and applications in the industries. The fourth industrial revolution, also known as Industry 4.0, is characterized as a new level of organization and control over the entire value chain of a product's life cycle, oriented toward increasingly individualized consumer requirements. Industry 4.0, which includes Internet of Things, Industrial Internet, Smart Manufacturing, and Cloud-based Manufacturing, is still a futuristic yet practical term. Industry 4.0 refers to the strict incorporation of humans into the production process in order to achieve quality improvement, an emphasis on value-added operations, and the elimination of waste. In order to eliminate quality errors, sectors such as quality control, quality inspections, and quality assurance have adopted quality management. Quality management ensures that a company, product, or service is reliable. Quality preparation, quality assurance, quality management, and quality development are the four main components. Quality control is concerned not only with the quality of the product and service, but also with the methods used to accomplish it. To achieve more consistent consistency, quality management employs quality assurance and monitoring of procedures as well as goods.

Keywords: Quality management, IOT, Internet of Things, Quality assurance.

1. INTRODUCTION

The Internet of Things (IoT) is a network of interconnected computing devices, mechanical and digital machines that have unique identifiers (UIDs) and can transmit data over a network without requiring human-to-human or human-to-computer interaction. Because of the integration of various technologies, real-time analytics, machine learning, commodity sensors, and embedded devices, the concept of the Internet of Things has expanded. The Internet of Things is enabled by conventional fields such as embedded systems, wireless sensor networks, automation (including home and building automation), and others. **IoT technology is most closely associated with items related to the idea of the "smart home," which includes devices and appliances (such as lighting fixtures, thermostats, home monitoring systems and cameras, and other home appliances) that support one or more common ecosystems and can be operated by devices associated with that ecosystem, such as smartphones and smart speakers.** The Industrial Internet of Things (IloT) is a term that describes interconnected sensors, instruments, and other devices that are networked with industrial applications such as manufacturing and energy management. Data collection, exchange, and analysis are all possible with this connectivity, which could lead to increased productivity and efficiency, as well as other economic benefits. The Internet of Things (I.o.T.) is an evolution of a distributed control system (DCS) that uses cloud computing to refine and optimize process controls, allowing for a higher degree of automation.

2. CHARACTERISTICS OF INTERNET OF THINGS

Cybersecurity, cloud computing, edge computing, mobile technologies, machine-to-machine communication, 3D printing, advanced robotics, big data, internet of things, RFID technology, and cognitive computing are some of the technologies that allow the IloT. The following are five of the most critical ones:

Cyber -physical systems (CPS): The basic technology framework for IoT and HoT, and thus the primary enabler for connecting previously disconnected physical machines. CPS combines physical process dynamics with software and communication dynamics, offering abstractions as well as modelling, design, and analysis techniques.

Cloud computing: Instead of connecting directly to a computer, cloud computing enables IT services and resources to be uploaded and accessed over the Internet. Rather than storing files on local storage devices, files can be kept on cloud-based storage systems.

Edge computing: Distributed computing is a computing model tat pushes computer data storage closer to where it’s needed. Edge computing, in contrast to cloud computing, refers to decentralized data processing at the network’s edge. In order to transform productivity, products, and services in the industrial world, the Industrial Internet needs and edge-plus-cloud architecture rather than a strictly centralized cloud architecture.

Big data analytics: The process of analyzing broad and complex data sets, or big data, is known as big data analytics.

Artificial intelligence and machine learning: Artificial intelligence (Al) is a branch of computer science in which intelligent machines that function and respond similarly to humans are produced. Machine learning is a key component of Al, allowing software to predict outcomes more accurately without being specifically programmed.

The main objective of our project is detailed below

1. To reduce and identification of error in the component during real time manufacturing of the product.
2. To reduce the wastage of machine, man power, money due to error in the product.
3. To increase the profit and productivity through reduced time of quality inspection.

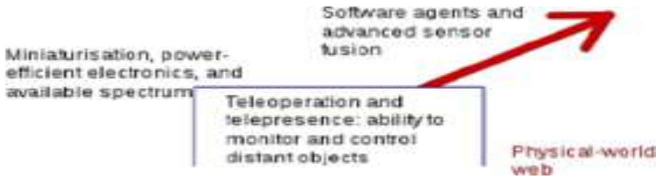

Fig I The development of IoT with year on year

The exponential growth of devices linked to and powered by the internet has been a big IoT trend in recent years. Because of the broad variety of applications for loT technology, the details can vary greatly from one system to the next, but there are some commonalities among them. The Internet of Things allows for a more direct integration of the physical world into computer-based systems, resulting in increased efficiency, cost savings, and reduced human effort. The number of IoT devices has risen by 31% year on year. The global market value of IoT is expected to hit $7 billion by 2020. IoT is a global infrastructure for information that connects physical and virtual things using existing and emerging information and communication technologies to enable advanced services. The Internet of Things (IoT) is a catch-all word that encompasses many domains.

The Internet of Things (IoT) is about to transform our world. Smart Vehicles, Smart Houses, and Smart Cities with the aid of the Internet of Things, everything around us can be turned into a smart computer. The Internet of Things (IoT) brings a cool aspect to technology.

- Sensors and Actuators
- Internet Gateway Layer and Data Acquisition Systems
- Edge CT
- Cloud Analytics
- Data visualization and management

SENSORS AND ACTUATORS:

The physical layer, which is made up of sensors that can detect and collect data from the environment, is the first layer. Its responsibilities include detecting physical parameters and recognizing other smart items. Then there are the Actuators, which can cause changes in the environment. For example, if a sensor senses that the temperatures have changed and that the light is low, meaning that it is dusk, an actuator will turn on the street lights automatically.

INTERNET GATEWAY LAYERS AND DATA ACQUISITION SYSTEMS:

Data from the sensors must be prepped in the Internet Gateway Layer before it can proceed to the processing stage. Essentially, data obtained in analogue form must be aggregated and transformed to digital form, which this layer accomplishes with the aid of an Internet gateway that routes the data over WLANs or other networks for further processing. Both of the above layers are close together, allowing for real-time pre-processing of the collected data.

The information that is obtained provides added value to companies via IoT. IoT systems go through five steps in their lifecycle: To begin, establish a process in which devices or sensors collect data from the physical environment.

Smart connected device data can be used to create insights that favor companies, consumers, and partners. second, the communicate process, in which the produced data and events are transmitted over the network to the desired destination; third, the aggregate process, in which the collected data is aggregated by the devices themselves; fourth, the analyze step, in which the aggregated data can be used to produce simple trends, monitor, and optimize processes through more sophisticated analytics and Finally, the act process occurs, during which appropriate steps are taken based on the information/gathered.

1. **INTELLIGENCE:**

   IoT is intelligent because it combines algorithms and computation, software and hardware. Ambient intelligence increases the capabilities of IoT devices, enabling them to respond intelligently to a given situation and assisting them in completing specific tasks. Despite the popularity of smart technology, knowledge in the Internet of Things is only concerned with computer interaction, while user and device interaction is accomplished by traditional input methods and graphical user interfaces.

2. **CONNECTIVITY:**

   The Internet of Things is made possible by connectivity, which connects everyday objects. Since simple object-level interactions lead to collective knowledge in the IoT network, connectivity of these objects is critical. It allows objects to connect to the internet and communicate with each other. The networking of smart things and apps will generate new business opportunities for the Internet of things with this connectivity.

3. **DYNAMIC NATURE:**

   The Internet of Things' primary function is to gather data from its surroundings, which is accomplished by the complex changes that occur around the devices. The state of these devices changes dynamically all the time, such as when they are sleeping or waking up, whether they are connected or disconnected, and the context of the devices, such as temperature, location, and speed. The number of devices changes dynamically with a person, location, and time, in addition to the state of the system.

4. **ENORMOUS SCALE:**

The number of devices that need to be handled and communicate with one another would be much greater than the number of devices currently connected to the Internet. The management and analysis of data created by these devices for application purposes becomes increasingly important. In the estimated study, Gartner (20 I 5) confirms the immense size of IoT, reporting that 5.5 million new objects will be connected every day and 6.4 billion connected things will be in use worldwide in 20 I 6, up 30% from 20 I 5. By 2020, the number of connected devices is projected to exceed 20.8 billion, according to the study.

5. **SENSING:**

Sensors that detect or quantify changes in the environment to produce data that can report on their status or even communicate with the environment are necessary for IoT to function. Sensing technologies enable us to develop capabilities that represent a true understanding of the physical world and the people who live in it. While sensing data is simply analogue input from the physical world, it can provide a deep understanding of our complicated world.

6. **HETEROGENEITY:**

One of the main characteristics of the Internet of Things is heterogeneity. Devices in the Internet of Things are based on various hardware platforms and networks, and they can communicate with other devices or service platforms through various networks. Direct network access between heterogeneous networks should be supported by IoT architecture. Scalability, modularity, extensibility, and interoperability are the core design criteria for heterogeneous things and their environments in the Internet of Things.

7. **SECURITY:**

IoT systems are inherently vulnerable to cyber-attacks. It would be a mistake to ignore the security risks associated with the IoT as we obtain efficiencies, innovative experiences, and other benefits from it. With IoT, there is a high degree of accountability and privacy concerns. It is critical to protect endpoints, networks, and the data that is transferred through all of them, which necessitates the development of a security paradigm. There are a wide range of technologies associated with the Internet of Things that aid in its successful operation. The above-mentioned characteristics of IoT technologies add value and help human activities; They contribute to the IoT network's capabilities by cooperating and being a part of the overall structure.

3. EXPERIMENTAL SETUP:

The components used in this project are listed below

1. Arduino Board AT mega 350
2. U.S.B port cable
3. Digital Vernier Caliper
4. NPN 537 Transistor
5. 10K ohm resistor
6. Bread Board

3.1 ARDUINO BOARD:

Arduino Uno is an 8-bit ATmega328P microcontroller-based microcontroller board. Along the way Other components that support the ATmega328P microcontroller include a crystal oscillator, serial communication, voltage regulator, and so on. The Arduino Uno has 14 digital in/out ut ins (six of which can be used as PWM out uts), a USB connection, a Power barrel jack, an ICSP header, and a reset button.

Fig. 2 contains Arduino Uno Microcontroller Board

3.2 DIGITAL VERNIER CALIPER:

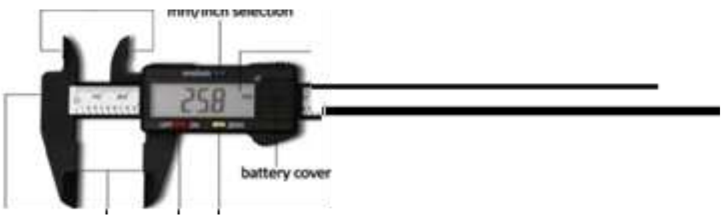

Fig. 3 contains Digital Vernier Caliper

A caliper (or, in the pluraletantum sense, a pair of calipers) is a mechanism that is used to calculate the distance between two opposing sides of an object. A ruled scale, a dial, or a digital monitor are all choices for reading measurements with calipers. A caliper, on the other hand, may be as plain as a compass with inward or outward-pointing lines. The caliper's tips are calibrated to fit around the points to be measured, then the caliper is removed and the distance measured between the tips with a measuring instrument like a ruler.

The Digital Caliper is a precision instrument for measuring internal and external distances with extreme precision. The distances/measurements are read from an LCD monitor in the illustration below, which is a digital caliper. The most important sections have been numbered. Earlier models of this type of measuring instrument had to be read by carefully looking at the imperial or metric scale, and reading the tiny sliding scale required very good eyesight. Manually operated vernier calipers are still available and popular since they are much less costly than digital vernier calipers. In addition, the digital version needs a small battery, while the manual version does not.

There is no need for a power source. The on/off button is used to turn on the light. The external jaws should then be brought together until they meet on the y axis, and the zero button is pressed. The distances can then be calculated using the optical caliper. When turning on the show for the first time, always follow this protocol. Digital calipers are easier to use because the measurement is clearly displayed, and the distance can be read in metric or imperial units by clicking the inch/mm button.

4. RESULTS AND DISCUSSION:

The traditional method of well-logging to analogue type, where data processing and manipulation is time-consuming, if not impossible. The ability to process digital data on a computer is a significant benefit. It's simple to manipulate, right, and so on. Using analogue data would be a time-consuming process since such a large volume of data would have to be manually manipulated. The method used here had calculation data entered in a book and then manually copied to a PC, resulting in manual errors. The rejection data and other factors that were expected from the data being calculated could not be determined using the current methodology.

4.1 PROCESS FLOW MODEL:

- When the caliper is switched on, data is transmitted in a continuous data stream.
- Each complete dataset consists of a series of 24 bits
- The calliper uses a 1.5V logic voltage, which means we'll have to amplify the signal to make it Arduino SV compliant.
- When the clock line transitions from HIGH to LOW, the logic level of the data line must be read.
- There is a longer period of time between each sequence of 24 bits when CLK remains HIGH.
- The first bit is always high and has no discernible value.
- Beginning with the least significant bit, the next bits encode the value of the calliper reading (LSB)
- The resulting value in mm-mode is equal to the calliper calculation multiplied by 100. 1,5mm, for example, would result in a readout of 150.
- Bit 21 is the sign bit: if bit 21 is HIGH, the value is negative

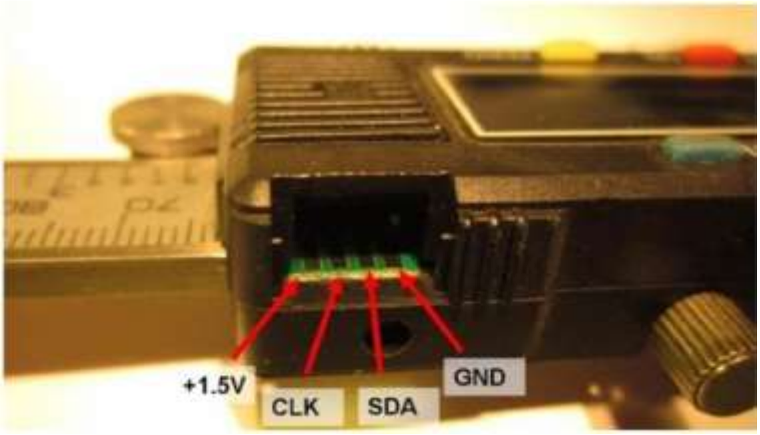

Fig. 4 configuration of Vernier caliper

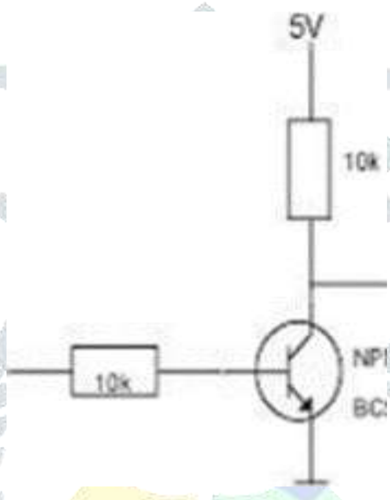

Fig. 5 Circuit diagram of the project

4.2 OUTPUT:
The following serial monitor displays the on-time value of Vernier Caliper measurements

Fig, 6 Output from the Vernier Caliper

4.3 ADVANTAGES OF USING IOT:

1. Better and consistent control of major business processes
2. A deeper understanding of the needs of customers
3. Regulation of successful working practices
4. Improved risk management
5. Increased customer satisfaction
6. Improved participation of employees
7. Better internal communication
8. A higher degree of continuity in product and service quality
9. Differentiation of your business from its competitors
10. Increased profits
11. Reduction of costly errors
12. Managing growth more effectively
13. an embedded culture of quality

LIMITATIONS:

1. cost of getting and keeping the certification
2. The time involved
3. Resistance to change from within the business

You can tailor the norm to your company's needs and resources, but you will need the assistance of a consultant, which can be costly.

V. CONCLUSION:

The data acquisition system developed resulted in a reduction in inspection time as well as a reduction in manual errors that occurred prior to the project's implementation. Due to the reduction in inspection time, the number of parts supervised (which was originally two per shift) has increased to five per shift, resulting in improved dimensional accuracy and efficiency.

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