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Intelligent Manufacturing System Using Industrial IoT

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ABSTRACT: Intelligent manufacturing system is emerging concept for the betterment of manufacturing processes which includes all sectors of industry. It is a digital transformation of industry and cultivating a new processes through it. With the help of several technologies and tools it will reduce the gap between digital transformation and traditional manufacturing industry. This system gives a wide introduction to improve or modernise the process according to current transformations. It will enable end to end integrations without any global limitations and resources. This system uses technologies like Artificial intelligence, Internet of Things, Cloud computing, Data analysis and embedded systems. It will be useful to monitor, control, track the manufacturing processes in various sectors. It will be a latest transformation in industry with strong support of latest technologies. Intelligent Manufacturing System is a combination of technologies and will help to make smooth, reliable, error less system as well as it will reduce wastage and increase the production rate with good quality and tracking of each process start from design to dispatch.

KEYWORDS: Industry 4.0, Manufacturing, Transformation, Cloud computing, Embedded systems

I. INTRODUCTION

Intelligent Manufacturing will reach most businesses in phases, and the first step is the move to an integrated manufacturing environment. Simply collecting data and making it available to a wide audience within a plant and across the business will lead to almost immediate returns. Industrial data generated by sensors embedded within assets is growing twice as fast as any other sector. intelligent system that spans edge, on-premises, and cloud; supports a variety of deployment options based on available hardware resources; integrated together or used independently to optimize workload execution. Based on this concept these systems can control and monitor ongoing processes with some service integrations. The physical systems designed to manufacture products can communicate with each other, as well as interact and cooperate with humans. This interaction increases the efficiency of your production process and improves your decision making process. Stream data from the factory floor to measure the performance and health of your equipment based on different predefined or custom metrics, and get up-to-date production status information. This application lets you locate your factories and machines, and monitor their health and utilization. It gives you real-time visibility into your production process and helps you diagnose and predict production issues so that you can increase the uptime of your factories. It also helps you schedule maintenance so that you can minimize the disruption to your daily operations.

A. Key Features

Monitor the performance of your factories at different levels, starting from a global perspective to then drill down to the health of specific machines:

Shop floor Level: Monitor all your production lines real time as they appear on shop floor, and select a specific production line for getting more details and analysis.

Production Level: Monitor and refract the progress of products, view real time images with product routing, and identify bottlenecks and detect anomalies.

Machine Level: Monitor machine availability statistics, associated sensor data to identify problem areas, preactive maintenance alerts and notifications as well as issues that affect production output.

1. Digital Manufacturing: Digital simulations are made of the factory layout, product design, use of machinery, and labor in order to formulate the best value chain that reduces cost, enhances product quality, and achieves optimal use of resources. Since all of the processes are digital, it reduces the manufacturing time of products specific to consumer requirements.

2. Digital-Networked Manufacturing: The networking technology allows collaborative R&D among different enterprises, connects enterprises in the same industry, connects enterprises operating on different levels of the production process within the same industry, and connects users to enterprises. User interaction is the first step to transform the production process into a user-centric one.

3. New-Generation Intelligent Manufacturing: Artificial Intelligence gives new-generation intelligent manufacturing the power to engage in R&D and formulate new processes, designs, products, and business models without human intervention. Since machines are intelligent and fast than human being, AI will reduce the time of manufacturing, production as well as innovation and designing.

The idea of design this project, is to initiate the implementation of advance technologies for the betterment of the manufacturing industry, to increase digital skill sets in infrastructure and among the employees. Motivation to transform the traditional methods into digital technologies and transformation of traditional business and processes. Access cloud computing technologies and methodologies for better manufacturing in various sectors. Current advanced manufacturing is including several intermediate processes to create the various components for a finished item, with some manufacturers using the term fabrication. Manufacturing has close connections to the engineering and industrial process design sectors.

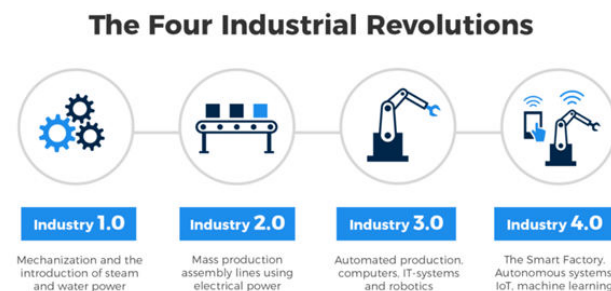


Figure 1. Industrial Transformation

Important characteristics of intelligent manufacturing system are categorized with respect to processes and formats.

- Interconnection**: The ability of machines, devices, sensors, and people to connect and communicate with each other via the Internet of things, or the internet of people (IoP)
- Information transparency**: The transparency delivered by Industry 4.0 technology provides facilities to operators with decisive information to conclude it.
- Technical assistance**: The technological facility of systems to assist humans in decision-making and problem-solving, and the ability to help humans with difficult or unsafe tasks
- Decentralized decisions**: The capability of cyber security devices to take decisions on their own and to perform tasks autonomously.

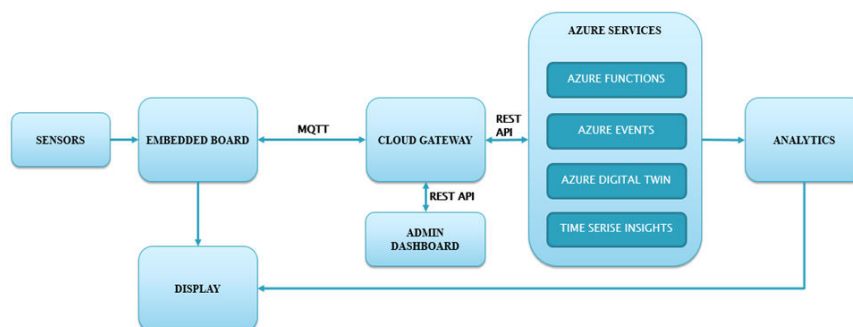


Figure 2. Architecture of Intelligent Manufacturing System

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The above architecture denotes the importance of intelligent management systems where it has several inputs from multiple data sources and sensors. These sensors are integrated with embedded devices which are may be edge devices to perform better and efficient work during several operations. These devices are itself capable to handle multiple operations like interfacing, cloud communication and data backup. These are self-protected and self-healed devices which can detect anomalies and can repair by their own. These devices are connected to cloud gateway which is initial configuration step towards cloud operations and communication. Cloud gateway can communicate with several services through communication protocols which can interact with device and cloud services simultaneously. After fetching data, it needs to analyse and set accordingly

for further analytics. These analytics services are connected with administrator dashboard where the admin have the rights to innovate and transform the representation as well as data requirements. Then administrator can approve data and display it on the dashboards which are also cloud based so dependency of geographical region is reduces with the minimum efforts of handling multiple devices. It has a facility to attach multiple devices across any region and monitor the system globally without any interruption of access and on premise dependency as well as tradition methods which occurs human errors. It will be end to end packed system which binds with device id, user access and security measures.

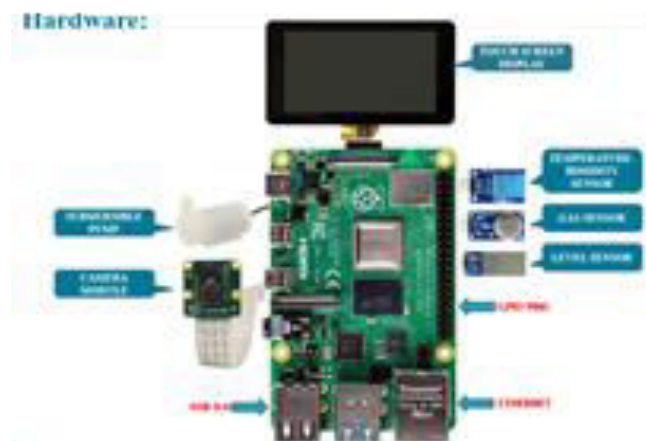


Figure 3. Conceptual system

It includes multiple technologies like Artificial Intelligence, IoT, Cloud computing which are binding together with the help of several tools and platforms. OCR [1] is one of the evolved technology which is very useful to identify and process documents. It is an intelligent way to train a system to identify the document and store it in digital format with identification tags. Due to this system it resolves traditional method of documentation and storage pattern of the same. Then it will modify the storage pattern by guessing a document type like invoices, BOM [2], designs and drawings etc. It is using the concept of computer vision where it's a smart recognition system.

II. OVERVIEW OF INTELLIGENT MANUFACTURING SYSTEMS

The key feature for the successful establishment of Industry 4.0 is to integrate various domains in the supply chains. This integration of domains can be horizontal or vertical or end-to-end integration. Horizontal integration involves the integration of two firms that are in the same stage and produces same or similar product/output in the supply chain. Through this integration communication between same stages of the supply chains within the firm or with other firms is possible. Vertical integration involves the integration of two firms that are at the different stages in the supply chain. This integration helps us to have better communication through all the domains in all the hierarchical flow. Vertical integration can either be forward or backward integration. When a company in the initial stage of supply chain controls or owns

An Overview of Industry 4.0 Technologies and Benefits

a company in the farther stages along the supply chain, then it is called forward integration. In contrast, when a company in the farther stage of the supply chain owns or controls a company in the beginning stage of the supply chain, then it is called as backward integration. The combination of the horizontal and vertical integration results in the formation of end-to-end integration that has the benefits of both types of integration. As the name indicates, this technological bundle involves the interaction between the Humans and machines. Though the whole concept of

Industry 4.0 is to completely automate the manufacturing process via self- optimization, there are few challenges that are to be met. To overcome these challenges, human interaction with the machines is required now and then. HMI technology is usually preferred in the firms where flexibility is a key characteristic. Here, the operator is the flexible factor in the factory set-up who interacts with the machine manually. As they will be the primary problem-solvers and decision-makers, they must be provided with suffice data and information through devices such as mobiles and context sensitive devices. Through Industry 4.0, it is believed that the concept of automation brings us to a point called “mixed automation” where both humans and machine (robots) work together in the factory environment without any partition between them. Various robot manufacturing firms have pointed out that collaborative robots have the capacity to interact and guide the operators rather than just to stop when the operators get close to them.

A. TECHNOLOGIES INVOLVED IN INTELLIGENT MANUFACTURING SYSTEM



Figure 4. Technologies in Intelligent manufacturing system

1. Industrial Internet of Things (IIoT)

IIoT is when interconnectivity and collaboration of data, machines, and people in the world of manufacturing. Essentially, it takes IoT sensors, machines, and data all connected and interfacing seamlessly and applies it to manufacturing. Every aspect of the manufacturing operation can be connected to the IIoT, and the data it creates can be leveraged into optimizing efficiencies across the manufacturing operation.

2. Automation

The ultimate goal of a connected factory is to maximize efficiency, therefore maximizing profits. To achieve that, automation must be adopted into some or all of the manufacturing processes. Automation, via robotics or AI, is made possible by the interconnectivity and communication that occurs across an Industry 4.0 optimized facility.

3. Artificial Intelligence

Artificial Intelligence and its subset of machine learning are practically a requirement for an Industry 4.0-enabled smart factory. The whole premise around this new industrial revolution is to take out manual processing, and AI is the primary tool to use in its place. AI can use the data generated from a connected factory to optimize machinery, reprogram workflows, and identify overall improvements that can be made to drive efficiencies and ultimately revenue.

4. Big Data & Analytics

Because every function of the manufacturing operation is being monitored and generating data, there are tons of data to sift through. However, big data analytics systems can utilize machine learning and AI technologies to quickly process data and give decision-makers the information they need to make improvements across an entire manufacturing operation.

5. The Cloud

Manufacturers don't have or want to use the massive amount of space required to physically store vast volumes of data created in an Industry 4.0 operation. This is what makes cloud storage and computing an absolute necessity and key cog in a connected factory. Cloud usage also allows for a single source of truth and data sharing across the company, at lightning speed. Lastly, cloud storage also allows for remote access and monitoring of all data and machine operating systems, giving great visibility into operations and efficiencies.

6. Cybersecurity

Because every touchpoint in the manufacturing operation is connected and digitized in Industry 4.0, there is an extra need for robust cybersecurity. Manufacturing machinery, computer systems, data analytics, the cloud, and any other system connected via IoT should be protected.

7. Simulations

Having the ability to forecast outcomes is one of the biggest game-changers in the age of Industry 4.0 and manufacturing. Before the digitization of the factory, changing over a product line and optimizing its speed and production was somewhat guesswork and always imperfect. With today's advanced simulation models powered by IoT data and AI, manufacturing operations can optimize machinery for their next product run, thereby saving time and money.

B. ADVANTAGES OF INDUSTRIAL MANUFACTURING SYSTEM

a. Optimized Processes- All of the Industry 4.0 connectivity sensors, IoT, AI, etc. services one primary purpose: optimizing manufacturing processes.

b. Greater Asset Utilization- Industry 4.0 allows for greater flexibility across the manufacturing operation, which translates to better asset utilization and therefore a potential for revenue increases.

c. Higher Labour Productivity- Industry 4.0 is also expanding the skills repertoire of many manufacturing workers. As new technologies come into the operation, workers are learning new skills that improve operational efficiency and their skillset.

d. Supply Chain and Inventory- IoT enables sensors and data analytics give manufacturers insight into the entire supply chain and production process

e. After-Sales Services- The predictive analytics, virtual reality, and remote monitoring that are pillars of Industry 4.0 also translate to the consumer space after manufacturing. While this doesn't directly impact a manufacturer

C. ABBREVIATIONS AND ACRONYMS

[1] OCR- Optical character recognition

[2] BOM- Bill of material

III. CONCLUSION

This system is implementing under a new revolution in industry. Where industry 4.0 will impact on current practices and trends in manufacturing system. This system will give real time health of system, production efficiency, monitoring of real time processes and help to reduce wastage of it during storage and supply chain. It is making a good scenario in manufacturing industries to update and modify traditional methods and processes. Intelligent manufacturing system is the latest revolution in industry in multiple aspect which will change the dimension of industry. This is very important transformation because digitally skilled resources are the powerful asset of such industrial transformation. Intelligent manufacturing system is powerful and conversional system which will enhance production efficiency, reduce manual errors, express new ways for reporting and documentation part will be reduce to cloud computing. Data handling and management process will become easy using access control and other security norms.

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