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REVIEW ON INDUSTRY 4.0

Ms. J.Aiswarya[1],M.Sc., (Ph.D), Vignesh S[2], and Raja P[3],

Research Scholar, Department of Computer Applications, Sri Krishna Arts and Science College, Coimbatore

[2], [3]Student of III BCA-B

Research Scholar, Department of Computer Applications, Sri Krishna Arts and Science College, Coimbatore

Abstract:

This literature review is about Industrial Revolution 4.0(IR 4.0). With technological advancements, industrial and manufacturing Sector also advancing. This review talks about some of the main technologies used in industries. They are Artificial Intelligence (AI), Internet of Things (IOT), Virtual Reality (VR), blockchain, big data and cybersecurity. Also, the benefits and downsides of the fourth industrial revolution are discussed in the Literature review

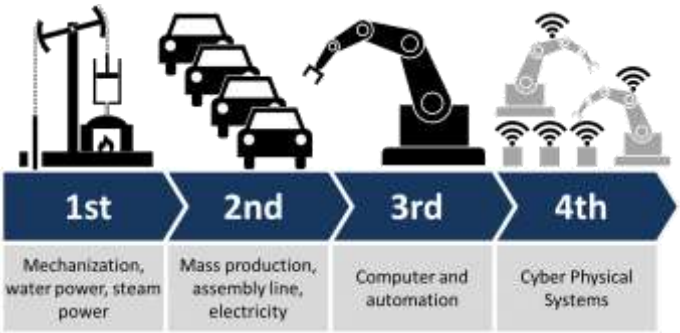

Fig.1(Industrial revaluation)

Introduction to Industrial Revolution

Over the course of history, mankind has perfected its industry by not only relying on technical evolution but also by reinventing it as new resources have created new technical means.

1) Industrial Revolution 1.0 (From 1784)

Steam power and mechanization was the driving factor during the start of industrial revolution.

2)Industrial Revolution 2.0 (From 1870)

With railroads, electricity, telegraph andmoving assembly line there was 5 times Increase in production.

3)Industrial Revolution 3.0 (From 1969)

With the invention of computer automation was introduced in manufacturing industries.

4)The Fourth Industrial Revolution (Since 2011)

Al can contribute to poverty reduction, infrastructure development, and achieving sustainable development goals (SDGs).Al includes various applications, including security, automatic configuration, planning, control and monitoring, prediction and diagnosis, and decision-making based on information and algorithms to achieve industrial goals, such as reproducing product processes and monitoring factory performance.

The global industry 4.0 market has several major players including Cisco Systems Inc., DENSO Corporation, Fanuc Corporation, Hewlett Packard Enterprise Company, Intel Corporation, International Business Machines Corporation, Nvidia Corporation, Robert Bosch GmbH, SAP SE, Schneider Electric SE, Stratasys Ltd., Swisslog Holding AG (Kuka AG) and Techman Robot Inc. (Quanta Storage Inc.).

Industrial Analysis

The results of a survey conducted by Vanson Bourne in July 2017, with 260 respondents, showed that the main obstacles to the implementation of AI are a lack of IT infrastructure and a shortage of talent. The development of mature AI infrastructure is likely as the world moves towards IoT, smart cities, and cloud systems. The shortage of talent in the field of AI can be addressed through the creation of graduate certificates and programs focused on AI and machine learning offered by universities. A survey by McKinsey Global Institute found that AI implementation outside of the tech sector is still in its early stages. Only 20% of 3,000 executives from ten countries and 14 industries reported using AI technology in a significant or central aspect of their business. Many companies are uncertain about the potential benefits and return on investment from AI.

The study analysed over 160 use cases and found that only 12% of these employed AI commercially illustrates how companies are implementing AI.

A survey of Michigan-based small and medium-sized manufacturing executives conducted by Automation Alley in 2019 showed that only 22% of the companies were currently using AI, 37% were planning to implement it in the next year, and 4% had no plans to use AI .The adoption of AI is expected to drive growth and improve revenue for companies that implement it it, while those that don't adopt it risk falling behind.

The latest 2022 Industry 4.0 adoption survey now shows that companies have even further advanced. Companies that are not executing against an Industry 4.0 strategy are in the minority. A staggering 72% of the survey respondents report that they are in the process of implementing their

Industry 4.0/Smart Factory with many initiatives in progress and some already completed.

The annual funding of start-ups that are active in Industry 4.0 has increased by +319% from 2011 to 2021.

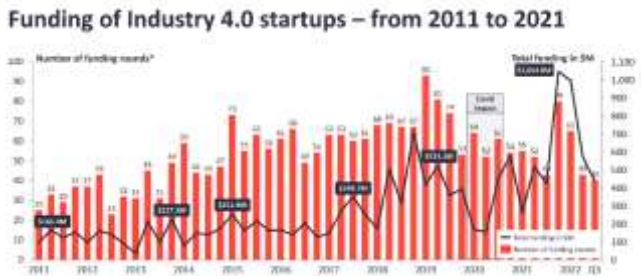

Fig.2(funding of industry 4.0 startups)

Study Approach

Literature review on industry 4.0 in manufacturing primarily focused on three sources, namely, academic literature, blog posts, and industry reports. In this review, we prioritized academic literature, and used other sources for specific use-case illustrations. The main takeaway from each technical article is summarized and categorized by manufacturing application and AI technique. The review also incorporated differing perspectives on certain applications of the concept of industry 4.0 in manufacturing to provide additional context for the challenges and benefits it has in manufacturing.

Technologies in industry 4.0

Many industry sectors have been pursuing the adoption of Industry 4.0 ideas and technologies. This shift is driven by technological advances, including Artificial Intelligence (AI) and machine learning, sensor networks and Internet of Things technologies, cloud computing, additive manufacturing, and the availability of large amounts of data that can be exploited by these technologies.

Artificial Intelligence and smart sensors:

The integration of AI in smart sensors and devices has enabled the development of more intelligent and automated systems that can make decisions based on real-time data.

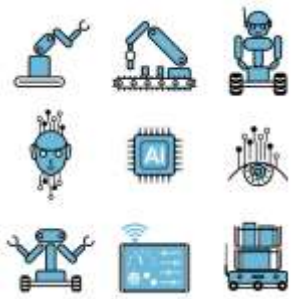

Fig.3(application of AI)

Types of Sensors

A&G:

The recent advancements in sensor fusion algorithms, which Combine data from multiple sensors, have improved the accuracy and stability of AI systems that use accelerometers and gyroscopes.

Proximity Sensors: Proximity sensors are sensors that detect the presence of Nearby objects without physical contact. They are used in AI applications

that Require object detection and tracking, such as robots, drones, and security systems.

The recent advancements in lidar and radar Technologies, which use light and radio waves to detect objects, have improved the Accuracy and range of AI systems that use proximity sensors.

AI Applications of Sensors and Devices:

Robotics: Robotics is one of the most significant applications of AI that uses Sensors and devices. Robots use various sensors and devices, such as cameras, Proximity sensors, accelerometers, and gyroscopes, to perceive and interact with The environment. These sensors and devices enable robots to perform tasks that are Dangerous, difficult, or impossible for humans, such as manufacturing, exploration, And rescue operations. The recent advancements in robotics technology, such as Soft robotics and swarm robotics, have expanded the scope and complexity of AI Systems that use robots.

Autonomous Vehicles: Autonomous vehicles are another significant Application of AI that uses sensors and devices.

Smart Buildings : Smart buildings are AI Applications that use sensors and devices to monitor and control various systems, Such as lighting, heating, cooling, and security. These sensors and devices enable Smart systems to optimize energy consumption, improve comfort, and enhance Security. The recent advancements in smart technology, such as IoT and cloud Computing, have made it possible to connect and control multiple sensors and Devices in real-time.

Industrial Automation: Industrial automation is another significant Application of AI that uses sensors and devices. Industrial sensors and devices, Such as pressure sensors, temperature sensors, and flow meters, enable Manufacturers to monitor and control various processes, such as production, Quality control, and inventory management. The recent advancements in industrial Technology, such as Industry 4.0 and digital twins, have improved the flexibility And productivity of industrial automation .

Internet of things:

Fig.4(Internet of Things)

The Internet of Things (IoT) paradigm has important applications in industrial environments. The Industrial Internet of Things (IIoT), also known as Industry 4.0, is an emerging technology that can revolutionize manufacturing and production by using a significant number of networked embedded sensing devices

and integrating cutting-edge computing technologies.

As a result, they invented the first smart vending machine, which tracked its contents.

With the use of IIOT technology, it is possible to combine all of this data, including sensor output, user input, service provider information, and more, to deliver precise and efficient real-time responses, all of which have consequences and call for research into strategic planning. Moreover, RFID, geolocation, and sensor networks are all emerging technologies that are likely to expand further (according to reports, by 2025, there will be more than 25 billion linked devices, including houses, phones, automobiles, and factories) The IIoT provides the required tools and a framework for worldwide Internet Protocol (IP) interconnection. They can communicate with other devices on their network using the same architecture and protocols. Machine learning and big data technology can be supported by IIOT, as well as programmable logic controllers (PLCs) and supervisory control and data acquisition (SCADA).

It is impossible to determine the exact number of sensors used in industry worldwide. However, it is estimated that there are billions of sensors in use across all industries.

Cloud Computing:

In several ways, cloud computing benefits collaborative supply chains in industries. Multiple partners along the supply chain may view centralized information in real time, enabling management to adopt a more proactive stance. Cloud computing infrastructure and other Industry 4.0 technologies, such as location monitoring, simplify fleet management. This enables retailers and manufacturers to control the whole supply chain in real time while tracking individual objects using location tracking. The capacity of manufacturers to work together may be significantly enhanced by using the Cloud for data storage. Cloud computing creates an atmosphere that is more favorable to cooperation across users in different locations or departments by consolidating data centers into a single place that is accessible to all workers.

Virtual Reality:

Fig.5(VR)

Virtual reality is one of the most fascinating technologies, with many advantages. Industry 4.0 uses virtual reality to produce lifelike, incredibly realistic simulations of goods and procedures that provide experience, learning, and insights. One of the most critical uses of virtual reality in the global adoption of Industry 4.0 is the delivery of improvements in human capabilities. VR is utilized in the planning and building of industrial facilities, the visualization of complicated data, the

improvement of operations and maintenance staff competency and training,

Augmented Reality:

Fig.6(AR)

Augmented reality represents a view or content where a computer-generated view or content is superimposed or added over the real physical view or content in real time. The resulting view or content is thus augmented with additional information from devices and sensors such as imaging devices (camera) global positioning system (GPS) data or audio devices (microphones). The real and virtual view or content is aligned in such a way that a user perceives the entire content as real. Augmented reality differs from virtual reality because in virtual reality the entire real-world environment is replaced by a virtual environment

The Benefits of Industry 4.0 :

Competitive Advantages: Industry 4.0 smart solutions and services offer a wide range of competitive advantages for organizations that are able to successfully launch these new strategies and technologies.

Increase in Operational Efficiency: The hope for Industry 4.0 is that the next generation of industrial revolution will drive even greater profitability for organizations, as they are able to squeeze greater output from the same resource input.

Better Products and Services: Whether it be product quality, safety, or customer experiences, Industry 4.0 will drive greater visibility and throughput for operations, allowing them to continue driving value for customers to retain business.

Growth of Markets and New Markets: With any technological revolution, new services, products, and software will be needed to support the transformation of organizations. This will create entirely new product categories, new jobs, and more.

Improving Lives Overall: With new technologies, higher profitability, and growth in economies, peoples' lives as a whole generally get better, with income rising, better health solutions, and overall a higher quality of life.

The Downsides of the Fourth Industrial Revolution (4IR) :

High Costs: Not only is technology a major cost to consider, but the expertise in enabling the technology to be implemented. Having the know-how in newer fields like IoT, Augmented Reality, and AI can lead to major budget constraints, not to mention a lack of understanding among all parties involved

High Rate of Failure: The difficulty in launching Industry 4.0 initiatives is that there is often a lack of direction when it comes to establishing objectives. They are often cross-functional projects with many stakeholders, which can mean projects can become mired in conflicting goals, and may simply sputter out.

Cybersecurity: People, products, and equipment is, and will increasingly be, connected to the internet. Although this gives us greater access to data via the cloud, it opens up opportunities for hackers to access networks.

Need for Highly Skilled Labor: Manufacturing, and industry as a whole, continues to rely on humans to enable production. However, with the move to digitally connected systems, there is a greater need for highly skilled labor, which may unintentionally reduce the need for low-skill labor.

Industry and Market Disruption: With new technologies available, existing solutions will eventually be phased out. Similar to the Blockbusters of the world, certain industries will be unable to survive what Industry 4.0 brings to market.

Upcoming Industrial Revolutions:

IR 5.0:

It is based harmonious human-machine Collaboration. But there are several limitations and it still needs to gain more traction in order to flourish.

Industrial Revolution 6.0:

IR 6.0 is a concept of developing computing to next level with quantum computing and the development of nano technology. While predicting the exact timing of Industry 6.0 is uncertain, it's estimated that technology will achieve pure autonomy by 2050.

Industrial Revolution 7.0:

According to our findings, the seventh industrial revolution is poised to center around the Natural Organic Artificial Intelligence Systems (NOAI-Systems). This innovative paradigm relies on the intricate interplay of sensors, microchips, neural artificial networks, mega-computers, complex intelligent auto-sustainable software systems, and practical applications grounded in the utilization of robust programming languages.

Conclusion:

The benefits of Industry 4.0 are clear: increased efficiency, safety, precision and even decreased costs. But most companies have not achieved full "smart factory" status yet. Around the world still many MSME's (micro, small and medium enterprises) use the concept of industry 3.0.It will take more time to globally accept the concept of industry 4.0. Cut costs, boost profit, and increase growth is the main task of all the industrial Revolution. It took around 6 million years for

humans to evolve from ape like beings into homo sapiens. But last 250 years saw a rapid Increase in growth of human civilization. It is because of the development of industries. Every technologies invented and every industrial revolution are for one purpose. The advancement of human civilization and well being of the human society.

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