

A SCOPE OF INDUSTRIAL ROBOTIC AUTOMATION IN THE FOURTH INDUSTRIAL REVOLUTION

Mr. chandra sekhar Sunnapu
Mechanical engineering
Prakasam engineering college
Kandukur, prakasam dist
Andrapradesh, India
chandu.pec@gmail.com

Dr. Ravi kumar Chadalavada
Electronics communication engineering
Prakasam engineering college
Kandukur, prakasam-DT,
Andrapradesh, India
kumarec0@gmail.com

Mrs. Mastan Rupa Patapati
Electrical and electronics engineering
Prakasam engineering college
Kandukur, prakasam-DT,
Andrapradesh, India
rupa2b8@gmail.com

Dr. Venkata Ramlinga Reddy Devireddy
Department of Mathematics
Prakasam engineering college
Kandukur, prakasam dist Andrapradesh, India
chandu.pec@gmail.com

Abstract— Digitization of assembling process is the requirement for the present industry. Industry 4.0 is the fourth modern transformation that was first presented in Germany. This paper shows a survey on the advances of mechanical and computerization innovation in accomplishing industry 4.0. Numerous organizations, look into focuses, and colleges recognize that apply autonomy and computerization innovation is the premise of modern assembling and a significant driver for Industry 4.0. The assembling ventures are as of now changing from large scale manufacturing to redid creation. The goal of this paper is to give an outline on the headway in the advancement of assembling process by nonstop upgrade in the mechanical innovation and control robotization in Industry 4.0 for accomplishing best outcomes for any assembling procedure. Ideally, from this report, designing understudies would be presented to new innovations of innovation transformation just as to make the business mind for a superior future.

Keywords— Industry 4.0; robotics and automation; Internet of Things (IoT) power; smart factories and smart production,

I. INTRODUCTION

The mechanical segment is imperative to each nation's economy and remains the driver of development and work. Industry, which in this setting centers around assembling, gives included an incentive through the change of materials into items [1]. The expression "Business 4.0" turned out to be freely known in 2011, when an activity called "Industry 4.0" where a relationship of delegates from business, legislative issues, and the scholarly community advance the thought as a way to deal with fortify the seriousness of German assembling industry [2]. Germany has one of the most serious assembling ventures on the planet and is a worldwide innovator in the assembling gear division [3]. Since the German government declared Industry 4.0 as one of the key activities of its cutting edge technique in 2011, the theme of Industry 4.0 has gotten popular among numerous organizations, examine focuses, and colleges.

Various scholarly distributions, handy articles, and gatherings have examined this theme [2]. The German Federal Government presents Industry 4.0 as a new, emerging structure in which manufacturing and logistics systems in the form of Cyber-Physical Production Systems (CPPS) intensively use the globally available information and communications network for an extensively automated exchange of information and in which production and business processes are matched [4]. As the term "Industry 4.0" is not well-known outside the German-speaking area [2], it is worth looking at comparable ideas from a global perspective. Some commentator promotes a similar idea under the name of cyber physical systems, smart factory, smart production, machine-to-machine, advanced manufacturing, internet of things, internet of everything or industrial internet [5]. Industry 4.0 or fourth industrial revolution also refers to the next phase in a digitization of the manufacturing sector where the Internet of Things (IoT) looks to play a huge role that have the potential to feed information into it and add value to manufacturing industry to realize a low-volume, high-mix production in a cost-efficient way [1]. It also involves the management and organization of the entire value chain process of the manufacturing industry. Various organizations have been advocating Industrial Internet of Things and Industry 4.0 concepts to create smarter factories [3]. Meanwhile, according to [6], the idea of Industry 4.0 includes a wide variety of devices, from smart phones, gadgets, televisions and watches to household appliances, which are becoming ever more flexible and intelligent. The devices are increasingly able to communicate with one another or to data sources via the Internet. According to forecasts of analysts at Gartner [7], 26 billion "things" will be connected to the Internet in the year 2020. Thus, based on the wide literature on the topic robotic Industry 4.0, the goal is mainly to develop a smart factory in which products are able to find their own way through production and establish alternatives in case of disturbances, as a technological basis serving cyber-physical systems and the "Internet of Things and Services".

II. HISTORY OF INDUSTRIAL REVOLUTION

The first mechanical loom from the year 1784 until now which is exactly 232 years ago; there are four stages in the ongoing process called the Industrial Revolution. The first revolution occurred towards the end of the 18th century which was mechanical production on the basis of water and steam.

The second Industrial Revolution at the beginning of the 20th century happens during the introduction of conveyor belts and mass production, to which the names of icons such as Henry Ford and Frederick Taylor are linked. The third revolution takes place in the digital automation of production by means of electronics and information technology (IT) system. Today, the industrial landscape is again being transformed to the fourth stage with the rise of autonomous robots, contemporary automation, cyber- physical systems, the internet of things, the internet of services, and so on. Industrial robots, which are one of the

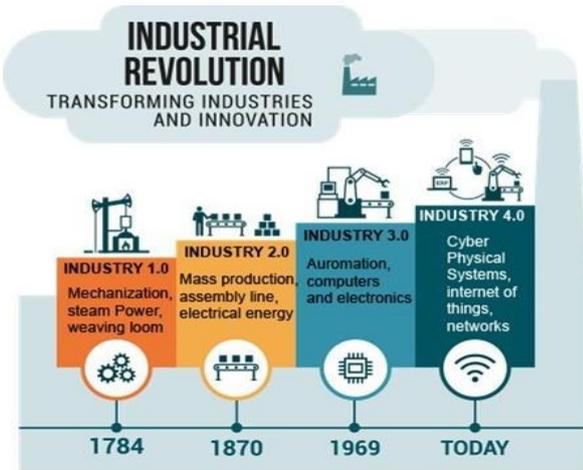


Fig 1

key drivers in Industry 4.0, have evolved considerably since the last decades of the 20th century. They are becoming more productive, flexible, versatile, safer, and collaborative and are thus creating an unprecedented level of value in the entire ecosystem. Smart factories, which will be at the heart of Industry 4.0, will take on board information and communication technology for an evolution in the supply chain and production that brings a much higher level of both automation and digitization. It means machines using self-optimization, self-configuration and even artificial intelligence to complete complex tasks in order to deliver vastly superior cost efficiencies and better quality goods or

III. TECHNOLOGY OF INDUSTRY 4.0

Over the past two decades, the Internet has changed the social life. Today, the Internet and the gradual integration of the three major industry revolutions, making manufacturing areas will have the collection, transmission and processing of large data advanced capabilities. Industry 4.0 [1] was proposed by the German, its essence is "Internet + Manufacturing".

Industry 4.0 described the future of manufacturing will be established on the Internet and information technology based interactive platform, it integrates increasingly factors of

production scientifically and becomes more automated, networking, intellectuality. Moreover manufacturing personalized, customized will become the new norm. Industry 4.0 incorporates information technology and manufacturing, it is the fourth industrial revolution dominated by intelligent manufacturing. The industrial manufacturing life cycle becomes orientated towards the increasing individualism of customer requirements and encompasses: the idea and the order for development and production, the distribution of products plus recycling, and furthermore including all related Services. The interconnection of human beings, objects and systems leads to dynamic, real time optimized and self-organized inter-company value creation systems which are evaluated and optimized using criteria such as costs, availability and resource efficiency. Industry 4.0 emphasizes the idea of consistent digitization and linking of all productive units in an economy. There are several technological areas that underpin Industry 4.0, which are horizontal and vertical system integration, the internet of things, cybersecurity, the cloud, big data analytics, simulation, additive manufacturing (3d printing), augmented reality, and robot [8]. The figure below shows the technologies related to Industry 4.0 In Industry 4.0, the horizontal and vertical system integration among companies, departments, functions, and capabilities will become much more cohesive, as cross-company, universal data-integration networks evolve and enable truly automated value chains. The Industrial Internet of Things will also enrich more devices with embedded computing and will be interconnected using standard technologies. This allows field devices to communicate and interact both with one another and with a more centralized controller, as necessary. It also decentralizes analytics and decision making, enabling real-time responses.

Reliable communications as well as sophisticated identity and access management of machines and users is important for industry 4.0 to address the issue of cyber security threats

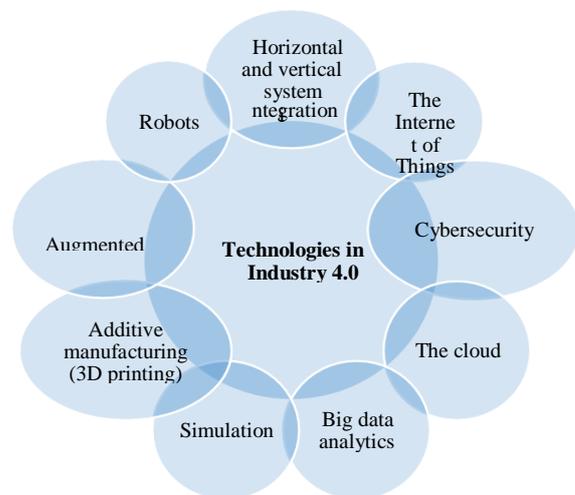


Fig 2

which increases dramatically with the increased connectivity

and use of standard communication protocols.

As the performance of technologies improves, machine data and functionality will increasingly be deployed to the cloud, enabling more data-driven services for production system. More production- related undertakings in Industry 4.0 will

require increased data sharing across sites and company boundaries.

Big data and analytics enables the collection and comprehensive evaluation of data from many different sources and customer to support real-time decision making, optimizes production quality, saves energy, and improves equipment service.

Simulations will leverage real-time data to mirror the physical world in a virtual model, which can include machines, products, and humans. This allows operators to test and optimize the machine settings for the next product in the virtual world before the physical changeover, thereby driving down machine setup times and increasing quality.

Additive manufacturing methods will also be widely used in Industry 4.0 to produce small batches of customized products that offer construction advantages, such as complex, lightweight designs. High-performance, decentralized additive manufacturing systems will reduce transport distances and stock on hand. Though the systems are still in infancy, companies will make much broader use of it towards industry 4.0.

Augmented-reality-based systems can support a variety of services, such as selecting parts in a warehouse and sending repair instructions over mobile devices.

Robots are becoming more autonomous, flexible, and cooperative. Eventually, they will interact with one another and work safely side by side with humans and learn from them. These robots will cost less and have a greater range of capabilities than those used in manufacturing today.

IV. ROBOT IN INDUSTRY 4.0

Robots play an important role in modern manufacturing industry. The number of multipurpose industrial robots developed by players in the Industry 4.0 in Europe alone has almost doubled since 2004 [9]. An essential face of Industry 4.0 is autonomous production methods powered by robots that can complete tasks intelligently, with the focus on safety, flexibility, versatility, and collaborative. Without the need to isolate its working area, its integration into human workspaces becomes more economical and productive, and opens up many possible applications in industries. More industrial robots are evolving with the latest technological innovation to facilitate the industrial revolution. Smart robots will not only replace humans in simply structured workflows within closed areas. In Industry 4.0, robots and humans will work hand in hand, so to speak, on interlinking tasks and using smart sensor human-machine interfaces. The use of robots is widening to include various functions: production, logistics, and office management (to distribute documents) and they can be controlled remotely. If a problem occurs, the worker will receive a message on his mobile phone, which is linked to a webcam, so he can see the problems and give instructions to let the production continue until he comes back the next day. Thus, the plant is operating 24 hours/day while workers are only there during the day [9]. Several robots have been introduced with the latest technology to be the pioneer in Industry 4.0. Kuka LBR iiwa is a lightweight robot for industrial

applications that is designed for safe close cooperation between human and robot on highly sensitive tasks. Iiwa which stands for intelligent industrial work assistant can learn from its human colleagues and can independently check, optimize, and document the results of its own work while connected to the cloud [10]. Bosch also introduces the APAS family robot system which includes APAS assistant, APAS inspector, and APAS base for an agile and flexible production concepts based on quickly and easily retooled production systems [11]. The robot features mobile, intrinsically safe, networked and configurable process modules which can be adjusted to new tasks by using the dialog-controlled user interface. The advanced collision avoidance system makes it safe for working together with humans. Nextage robots from Kawada Industries are an evolution from mere equipment to becoming a partner in parts assembly s. Its overall design includes a "head" with two cameras, a torso, two 6-axis arms, and a mobile base, a flexible software GUI. Its advance stereo vision with image recognition system allows it to ascertain object distance and attain 3D coordinates with high precision. The accompanying open source software provides superb visibility and usability, making the operation and instruction of Nextage easy and flexible. There are two versions of the robot, one for the industry and the other for research. The dual-arm YuMi robot is the first collaborative robot from ABB. It features an advanced vision system, flexible hands, parts feeding systems, sensitive force control feedback, and state-of-the-art robot control software that allows for programming through teaching. Along with the built-in Safety function, it is designed to work side-by-side with humans. Several other robot models developed by various companies in keeping up with the trend is listed in Table 1 below.

Table 1The organizations that interest in revolution industry 4.0

No	Model	Company	Description
1	Baxter	Rethink Robotics	Baxter, the world's first interactive production robot, is particularly well-suited for a wide range of packaging applications
2	Sawyer	Rethink Robotics	The revolutionary new high performance collaborative robot designed to execute machine tending, circuit board testing and other precise tasks that are impractical to automate with conventional robots
3	Roberta	Gomtec	Roberta is a light, adaptable, and inexpensive 6-Axis industrial Robot. It was specifically developed for small and medium-size enterprises which are focused on flexible and efficient automation

4	UR series	Universal Robots	UR- 5 is a highly flexible robot arm and ideal to optimize low-weight collaborative processes, such as: picking, placing and testing
5	CR-35iA	Fanuc	The CR-35iA robot seems to target integration with automotive assembly s, machine tending applications, metalworking and packaging
6	BioRob Arm	Bionic Robotics	The lightweight BioRob robot has been certified safe for use in close proximity with humans without requiring further protective measures to be undertaken
7	P-Rob	F&P Personal Robotics	F&P provides all-in-one robotic solutions leveraging expertise in arm and effector technologies as well as artificial intelligence
8	Speedy-10	Mabi Robotic	The "flexible manufacturing" often publicized today is the rationale for this development and it is based on a lightweight design with excellent damping characteristics
9	PF400	Precise Automation	PF400 used by customers with little automation experience, yet powerful and fast enough to support light duty assembly operations

1	Institute for Management Cybernetics, RWTH Aachen University	This institute explore and develop solutions for economic and technological questions in interdisciplinary teams. The Industry 4.0 project which is ProSense is to achieve production control on the basis of cybernetic support systems and sensors, in order to support decision-makers within production planning and control .
2	Platform Industry 4.0	The main objective of the Platform is the development of technologies, standards, business and organizational models and their practical implementation
3	Industrial Internet Consortium (IIC)	The goal of the IIC is to accelerate the adoption and deployment of Industrial Internet applications through technology test-beds, use cases and requirements development [12]
4.	Siemens	Siemens produces custom Programmable Logic Controls (PLCs) in a state-of-the-art 'smart factory' where product management, manufacturing and automation systems are integrated [13]
5.	W3C	The World Wide Web Consortium (W3C) is an international community that develops open standards to ensure the long-term growth of the Web. W3C Standards as a Basis for the Project of the Future Industry 4.0
6.	OPC Foundation	The mission of the OPC Foundation is to manage a global organization in which users, vendors and consortia collaborate to create data transfer standards for multi-vendor, multi- platform, secure and reliable interoperability in industrial automation
7.	Fraunhofer IAO	The Fraunhofer IAO* has been helping shape the INDUSTRIE 4.0 project since as early as 2011 as part of activities carried out by the Industry-ScienceResearch Alliance [1].

V. INTERNATIONAL ROBOTIC ORGANIZATIONS IN INDUSTRY 4.0

Different associations and key players have significant research divisions which bolster item advancement and mechanization of assembling forms, while likewise advertising their expertise to other mechanical undertakings or giving stages to 'brilliant' administrations for outsiders. This can additionally animate the execution of Industry 4.0. The table underneath shows the associations that are keen on the mechanical business of Industry 4.0.

Table 2The organizations that interest in revolution industry 4.0

NO	Industry	Description
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8. Google Google Glass as a new concept for machine operation which were primarily developed for the consumer sector, integrate among other things a head-up display for information plus a digital camera. Google Glass also be used in the industrial environment as a supplement for operation and observation in production.

VI. INDUSTRIAL ROBOTIC POTENTIAL IN MALAYSIA

Under the Eleventh Malaysia Plan, which is a five-year comprehensive blueprint prepared by the Economic Planning Unit (EPU) of Malaysia, the government aims to raise productivity and reduce dependency on inputs from capital and labor. One of the important solutions is to raise industrial productivity, where there will be greater adoption of automation and upgrading of skills. The role of industrial associations will also be further strengthened to deal with global competition through smart partnerships with other industrial associations in target export markets [14]. Automation and robotic industry in Malaysia has been implemented since 1983 by ex-prime minister Tun Dato' Seri Dr Mahathir bin Mohamad when he introduced the national car manufacturer, Proton, that was first established as the sole national car company until the advent of Perodua in 1993. Despite the long involvement of automation and robotic in manufacturing, the idea of Industry 4.0 in Malaysia is mostly influenced by foreign companies such as KUKA and ABB. Very large manufacturing companies and multinational groups already consider this topic as very important. Small and medium enterprises (SME) do not yet appear to consider industry 4.0 to be of great relevance to them, although these companies are most likely to be the big winners from the shift. SME companies are often able to implement the digital transformation more rapidly because they can develop and implement new IT structure from scratch more easily. Very large manufacturing companies and multinational groups, by contrast, have more complexity to deal with in terms of their existing, organically grown structures.

Malaysian government offices have concocted a few activities to energize the selection of most recent innovation to nearby industry. The Malaysian Industry-Government Group for High Technology (MIGHT) is acquainted with address the nation's needs because of the impacts of globalization and exchange progression on future financial development through the quickened utilization of high innovation. Under this activity, projects and exercises will incorporate structure strategic partnerships and coalitions, innovation procurement and sustaining, limit working just as reinforcing the development of these segments through approach intercessions and lead programs. Malaysia plans to be at the cutting edge of the up and coming age of advances in science and innovation through the recently set-up Global Malaysia-Korea Robotics Collaboration and Development Program where the two gatherings have

consented to trade robot human capital improvement programs, to embrace robot institutionalization participation, to dispatch robot presentation and universal participation [15]. MIMOS, which is Malaysia's national R&D focus in ICT, are doing collaboration with China on research and improvement on keen assembling innovation [16]. In this manner, the advancement of robotization and automated industry can possibly lead Malaysia towards industry 4.0 through key activities by government and industry player the same.

VI. IMPACT OF ROBOTIC INDUSTRY 4.0

The conceptual Industry 4.0 have a high impact and wide range of change to manufacturing processes, outcomes and business models. It allows mass customization, increase of productivity, flexibility and speed of production and improvement on quality product. This mass customization will allow the production of small lots even as small as single unique items due to the ability of rapidly configure machines to adapt to customer-supplied specifications and additive manufacturing. This flexibility also encourages innovation, since prototypes or new products can be produced quickly without complicated re-tooling or setup of new production s. Thus it can produce one product and many variants, with a decrease in inventory by using Industry 4.0 technologies [8]. The speed with which a product can be produced also improved where digital designs and virtual modelling of manufacturing process reduce the time between the design of a product and its delivery. In Germany, data-driven supply chains can speed up the manufacturing process by an estimated 120% in terms of time needed to deliver orders and by 70% for the time to get products to market [17]. Integrating product development with digital and physical production has been associated with large improvements in product quality and significantly reduced error rates. Data from sensors can be used to monitor every piece produced rather than using sampling to detect errors, and error-correcting machinery can adjust production processes in real time. This data can also be collected and analyzed using 'big data' techniques to identify and solve small ongoing problems. The rise in quality plays an important role in reducing costs and hence increasing competitiveness. According to [18], the top 100 European manufacturers could save the costs of scrapping or reworking defective products if they could eliminate all defects. Productivity can also increase through various Industry 4.0 effects. By using advanced analytics in predictive maintenance programs, manufacturing companies can avoid machine failures on the factory floor and results in downtime cut and increase production. Some companies will be able to set up 'lights out' factories where automated robots continue production without light or heat after the staff has gone home. Human workers can be used more effectively, for those tasks which are really important. It is easier to make money today with fewer workers rather than a quarter of a century ago. In a book on the Fourth Industrial Revolution handed to each of the delegates at World Economic Forum [13], Schwab compares Detroit in 1990 with Silicon Valley in 2014. In 1990 the three biggest companies in Detroit had a market capitalization of \$36 billion, revenues of \$250 billion and 1.2 million employees. In 2014, the three biggest companies in Silicon Valley had a considerably higher

market capitalization (\$1.09 trillion) generated roughly the same revenues (\$247 billion) but with about 10 times fewer employees (137,000). Robotic in Industrial application has substantial economic impact where increasing of productivity can drive economic growth. A recent study estimates that these benefits will have contributed as much as 78 billion Euros to the German GDP by the year 2025 [2].

VIII. CONCLUSION

This paper audits the idea pattern of automated innovation in Industry 4.0 or a comparable thought. Since the coming of Information and correspondence advancements (ICT), economies of nations around the globe increments significantly as organizations can contend on a worldwide scale to get the open door that presents. German expects to turn into the main market for Industry 4.0 arrangements stand out 4.0 insurgency since 2011 to appear its innovative vision with the goal that huge numbers of the organization, association and analyst accept this open door to propel their insight and innovation.

The fourth mechanical Revolution will be founded on digital physical frameworks, the Internet of Things and Internet of Service. More organizations and countries are getting the development together with various methodology in order to be serious so as to profit by the profitability and financial increases it gives. In spite of the fact that industry 4.0 spreads a wide application zone in the assembling business, the pattern is immediately appeared with the development of new mechanical and robotization item advancement that is custom fitted for modern transformation.

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