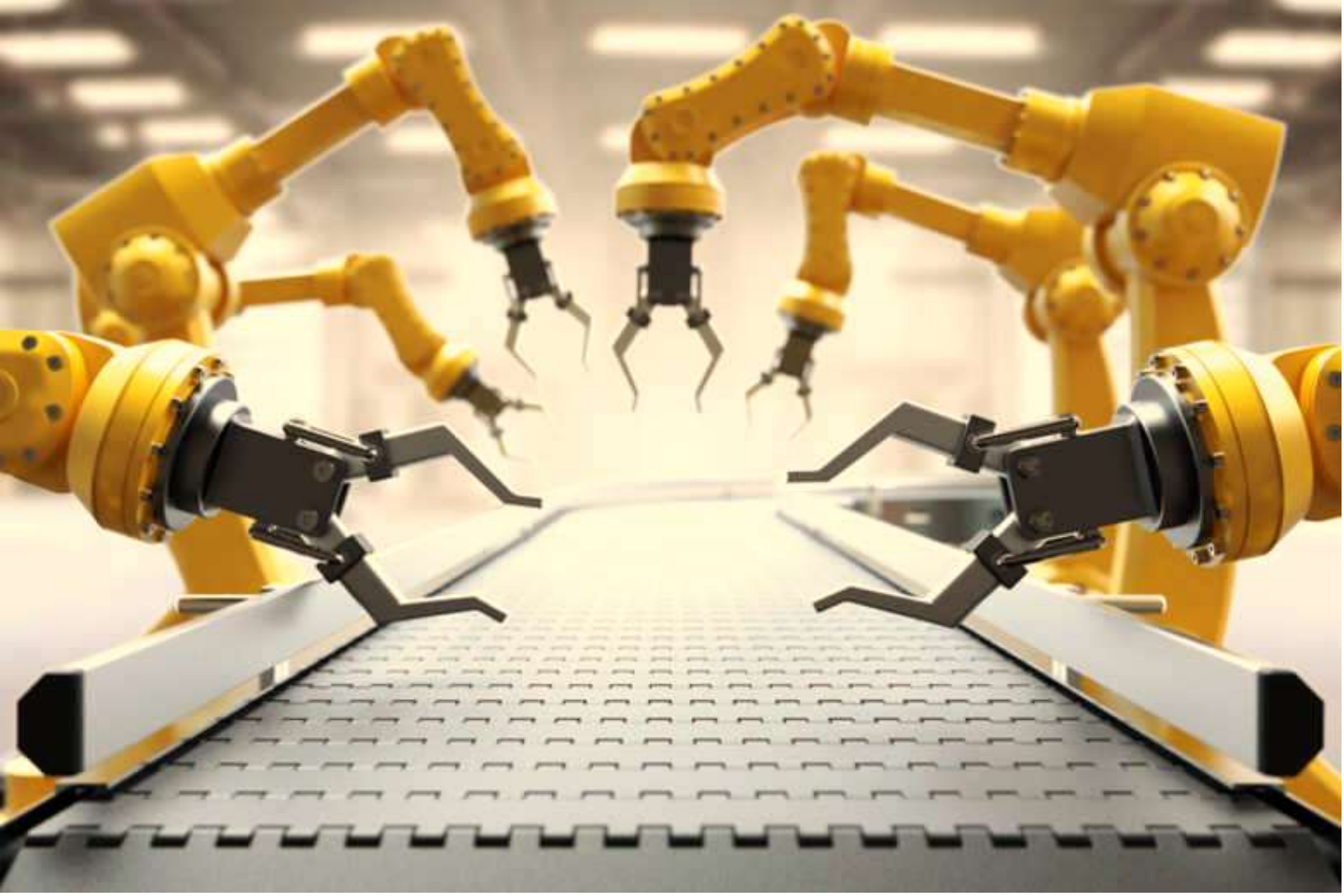

Convergence of Robotics and AI –

The Disruptions behind the Fourth Industrial Revolution

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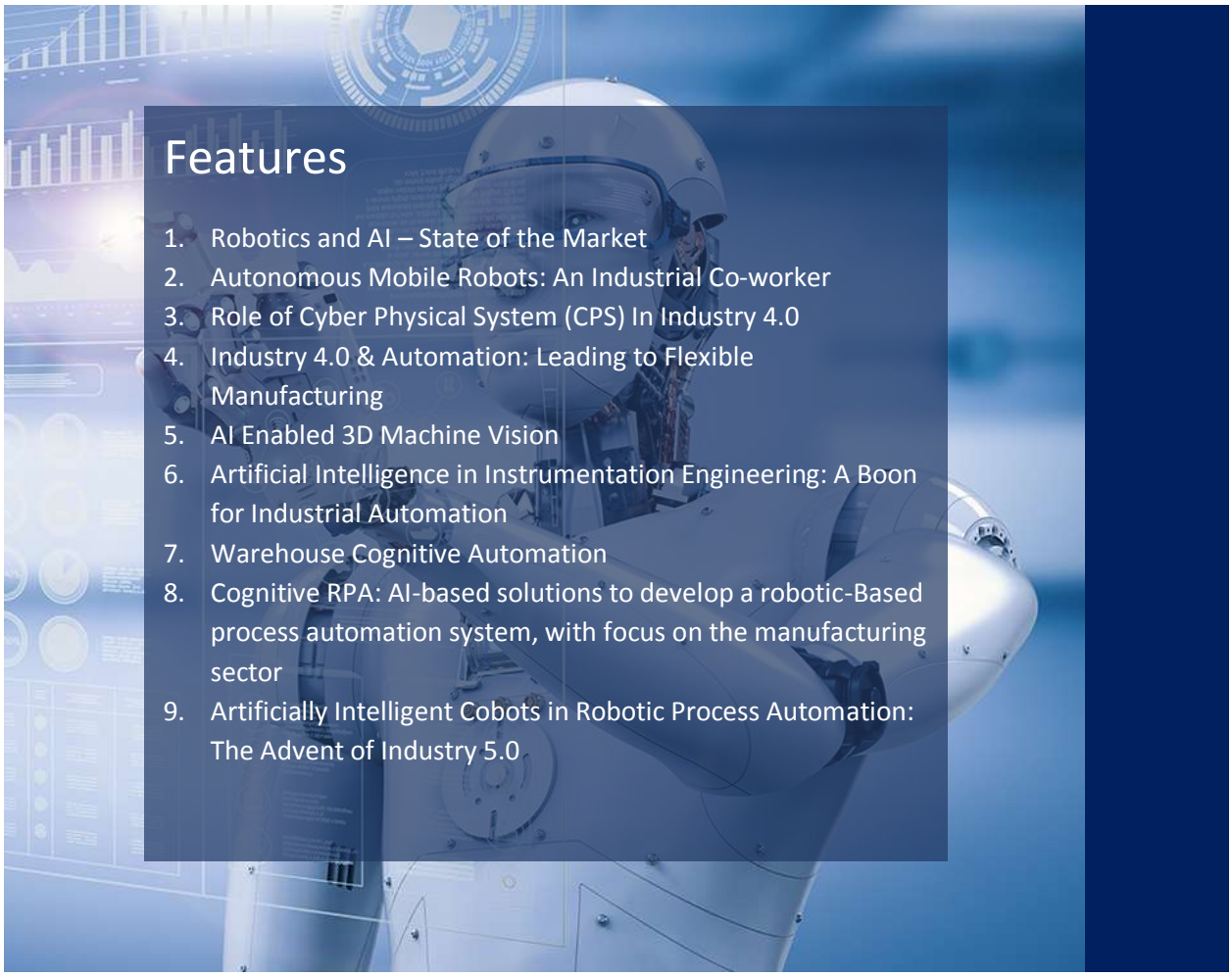
Preface

With the advent of Industry 4.0, the manufacturing segment is shifting to an increasingly technological dependent state. Robotics and AI are at the forefront of this technological revolution driving forward the industrial sector. Robotics are being utilized for everything from simple tasks such as pick and place and material handling through to complex customized functions. This dawn of the robotic revolution has led to the establishment of a significant number of startups geared around driving this upheaval. This magazine will explore the major technological disruptions taking place around the Convergence of Robotics and AI which is set to drive the Fourth Industrial Revolution.



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Robotics and AI –

State of the Market

Made in China 2025 – Starting a Robotics Revolution

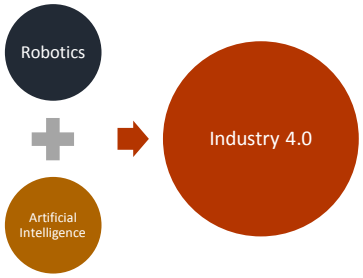
With the recent launch of 'Made in China 2025', China has taken a forward step to transform robotics and propel the implementation of Industry 4.0. With the country's plan to ensure that 70% of the industrial robots are manufactured by Chinese firms, the race for a robotics revolution has begun globally. This transformation has focused not just on robotics but also on related artificial intelligence (AI) as well as data gathering modules (sensors and systems). This convergence of the robotics and AI spheres will be a major driver for the execution of the fourth industrial revolution – Industry 4.0

The Convergence of Robotics and AI

As manufacturers across the world look to implement Industry 4.0 solutions in the current industrial market, the development of robotics and AI in recent years has gained major impetus. The major focus of Industry 4.0 has been to develop machines that operate in a decentralized manner, where the underlying machinery can communicate with increased efficiency. Industry 4.0 is focused on improving efficiency and flexibility of manufacturing through deployment of cyber physical systems, cognification, and IoT technology, at the base of which is Artificial Intelligence.

This has led to the World Economic Forum (WEF) labeling the emergence of Robotics and AI as the fourth wave of industrial revolution.

Convergence of Robotics and AI

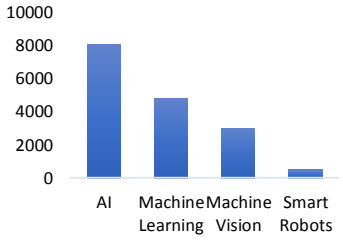


As the improved efficiency of AI and robotics implementation through smart factories is understood, there has been an increase in implementation of these technologies in the manufacturing sector. Thus, the increased technological improvements in AI and robotics have been the major focus areas of companies operating in this market in recent years. These developments are being forged by leading OEMs operating in the market — from Google and Microsoft to Siemens, Toyota and Intel. These companies have invested in over 80 startups in the heavy industry and manufacturing sector related to Robotics as well as over 120 related to AI during the 2012–2018 period according to CB Insights. Majority of these startups are focused on combating the major issues with robotics in the current state.

Current Challenges of Industrial Robotics

In the current market, there are two main issues underlying robotics: vision (identification and navigation) and dexterity (robotic gripping and mechanical capabilities). The pattern recognition capabilities of machine learning (including deep learning) have been touted as the basis for significant leaps of improvement in robotics — robotic vision in particular. According to McKinsey, approximately $8 billion has been invested into AI in 2018, with around 60% focused on machine learning. Smart Robots and Machine Vision also witnessed significant investment with $500m and $3 billion respectively. In Machine Vision, 3D and 360 Vision technologies in particular have witnessed increased investment. These investments will be the driving factors for companies to overcome the current challenges of robotics.

Investment into Manufacturing, By Field, 2018, ($m)



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Although in the current market, AI is focused on very narrow tasks, the future abounds with possibilities of cross task applications as well as broadening adoption of these narrow tasks. As manufacturers have increasingly focused on improving efficiency, AI has been increasingly adopted in this field. Machine learning, in particular, can be used to enhance predictive maintenance, thereby reducing maintenance wait times and improving operational efficiency. The offering of enhanced data collection in smart factories will also be a major factor behind the widespread adoption of AI. Monitoring and controlling robots and the industrial process in general have also been made increasingly possible using deep learning techniques. As the requirement for digital factories rises, manufacturers will find robotics to be the perfect foil to apply cognitive functionality to their automation process. From warehouses to the factory floor, advanced robotics offer a way for manufacturers to bridge the smart factory / digitization gap they currently face and implement Industry 4.0 through Cognitive Robotic Process Automation and Autonomous Robots.

Cognitive Robotic Process Automation – The Next Step

In recent years, most research in the field has concentrated on the development of cognitive robotics, wherein natural language processing, machine learning and other AI based tools have been used to implement robotic platforms that can automate perception based tasks. However, in the industrial sector, robotics has been limited to rule based automation; in recent years, there has been a push to develop intelligent robotics that can understand unstructured data without any rules. Cognitive automation is at the helm of this process, wherein robots can learn from previous processes to enhance their capability. As the cognitive capabilities of robotics improve, manufacturers will receive additional benefits.

Benefits of RPA

Accuracy
- Improved Decision Making Capabilities

Consistency
- Can replicate the process or task without variation

Flexibility
- Manufacturing can be ramped up or down based on demand

Compliance
- Ability to maintan accurate logs for compliance checks

Productivity
- Human resources can be freed up and retained for value-added tasks rather than assembly line tasks

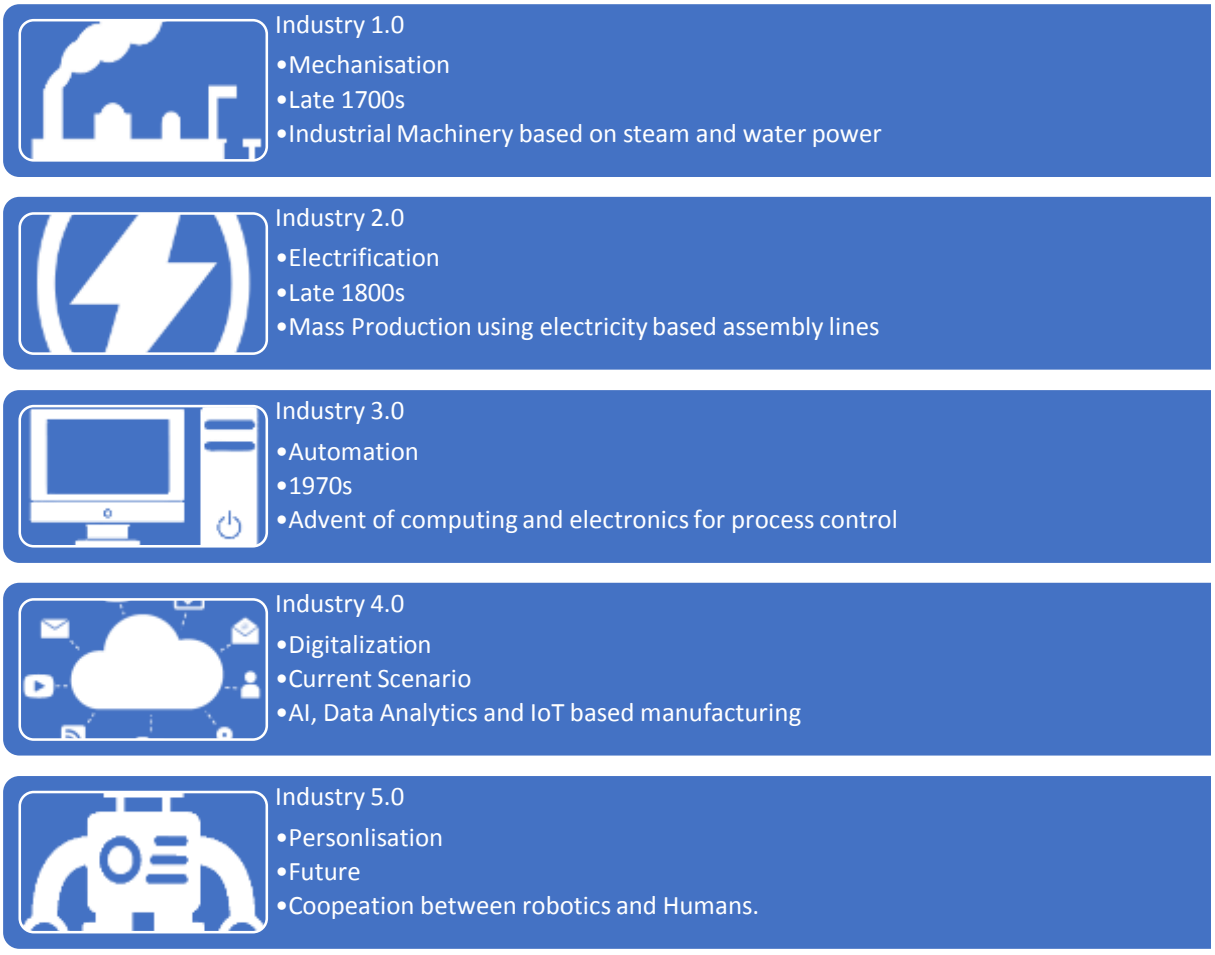
Reliability
- Improved predictive maintenance capabilities raises reliability of process

Geographical Independence
- Allows companies to manufacture without right shoring

Will Robotics replace human jobs?

While in the past, the dialogue surrounding robotics has been about job replacement, the implementation of cognitive technology has led to a more promising situation. With the advent of cobots, the focus has instead shifted to humans and robots working in tandem. Although traditional physical assembly line jobs may witness significant decline, the advent of robotics will also create new opportunities. According to Forrester, by 2025, 22.7 million jobs will be lost in the U.S due to Robotics; however on the flip side, 13.6 million new jobs will be created around working with these robotics. Currently, cobots only make up around 3% of the total industrial robot installed base, but by 2025, more than a third of industrial robots will be cobots, which requires a transformation in the workforce. Despite the prevailing fears, robotics will be a boon and not a bane to the industrial workforce. This collaboration between robotics and human workforce will be the stepping stone for the next Industrial Revolution – Industry 5.0.

Stages of Industrial Revolution



Industry 5.0 – The Fifth Industrial Revolution

Industry 5.0 will revolve around the collaboration between robots and humans in the manufacturing world. The human workforce will revolve around more value-added tasks designed around cobots rather than traditional physical functions. For these cobots to be implemented, the AI collaboration needs to significantly improve from the current capabilities. The creation of these smart robotic networks is integral to leveraging the human intelligence that will be the basis of Industry 5.0. High-level saliency detection, enhanced visibility and object detection as well as utilizing machine learning for continuous improvements to the functionality of robotics need to take the center stage for this transformation to take hold. However, that is not to say that this form of collaboration is a distant goal. According to Accenture's survey of 512 Manufacturing executives, over 85% of them envision some form of collaboration in their production process by 2020. This demonstrates that the advent of Industry 5.0 is imminent — the only question is how soon this will transpire. We can be certain that cognitive robotics will be at the center of this revolution.

Autonomous Mobile Robots:

An Industrial Co-worker

- Enhancing the Supply chain network
- Effectiveness in the production
- Deployment of smart manufacturing system

From all kinds of vehicles to mobile robots, there are several other machines that do not require human control and can work individually. Previously, the industries which were totally dominated by humans have slowly begun to change for the better. Autonomous robots are finding their way into the industries. The understanding between humans and the robots is based on new capabilities and flexibility, which involves project thinking and studies based on humans. As the e-commerce economy is growing rapidly, existence, catering to the various challenges that arise due to this fast development.

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Autonomous Mobile Robots (AMRs) are cooperative and designed to work with humans. Mobile robots are completely safe and can run in an active environment. In case, a human staggers in front of an AMR, a safety-rated laser scanning system understands the obstacle fast enough to either redirect or stop completely to avoid a collision. The industrial AMRs, for example, have a 360-degree safety coverage around the robot, detecting obstacles several meters ahead, so they can regulate their next course of action.

Companies across the supply chain network are installing mobile robots in applications that require the conveyance of resources. For example, at the Flex Facility in Austria, two AMRs move materials along a 600-meter elasticity from the warehouse to the product area without disruption, freeing the employees from repetitious transportation tasks. Similarly, at the New Jersey-based Magna-Power, two AMRs have freed the monotonous, low-value transportation work of components and assembly equal to three full-time employees. This allows the employees to focus their services on higher-value actions.

The availability of advanced platform and systems

AMR involves a lot of technologies and innovations. One of the latest inventions in AMRs is the presence of onboard intelligence systems. These come in a variety of arrangements, and makes it easier to differentiate AMRs from automated guided vehicles (AGVs). Many AMRs can learn their environment either by having a plan uploaded, or by having the AMRs drive around and develop its own route. This type of autonomy allows them to quickly familiarize with any industrial atmosphere.

Another major innovation in AMRs is its computer vision abilities. Most AMRs are equipped with a collection of critical sensors to detect objects all around them. The capability to accurately perceive a dynamic environment in real-time is difficult, and this is what makes AMRs valuable in the current condition of the industries.

Challenges hindering AMR

However, every product has its own challenges when brought into the surrounding. Typical AGVs need some form of external supervision, whether it is magnetic strips or sensors fixed to the floor. This creates a rigid system, which is expensive to adjust to as the production environment needs change, which is the main obstacle AMRs aim to overcome.

AMRs can easily handle navigating through dynamic environments and need little external input for working. Therefore, manufacturing facilities are becoming more dynamic as they pursue different operations. Robots that can operate within these surroundings will have major commercial potential, introducing process automation without slowing down the requirement for frequent changes in the production environment.

As for the future, the next generation manufacturing robot will undoubtedly be a very valuable part of the production team. It is expected that robots will be able to help workers, as robots can pay better attention to work and sense better as well before responding to the environment.

By letting robots carry the load, human workers will be allowed to focus on that particular work which truly matters. And robots don't take breaks as humans, hence, the work remains continuous. All of these improvements, however, mean nothing if robots are out of reach due to their price labels. Thankfully, automation has become increasingly reasonable and affordable over the years allowing companies to employ robots to work faster than ever before.

Role of Cyber Physical System (CPS) In Industry 4.0

- Investments & Funding in projects of CPS in various regions
- Future scenario of various industries by implementing CPS
- Research and development activities in CPS

Can we imagine a factory or an industry where robots, raw materials, automated systems, sensors, controllers, data bases, products communicating with one another? If this happens, the benefits that we are going to get in the future have been discussed here. The changing business surroundings and situations have influenced new innovation developments in industries. We have seen that with the development of Big Data, Artificial Intelligence, Internet of Things (IoT), there has been increase in productivity of various businesses

In the recent years, development of new business technologies has been analyzed in the context of advanced production. The existence and implementation of cyber physical systems (CPS) in various industries have been escalating the Industry 4.0. Consequently, we need to understand how cyber physical systems are stimulating the Industry 4.0.

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Cyber physical systems are the systems that integrate computational entities which are in connection with the surrounding physical world and its enduring processes, and at the same time by using data accessing and data processing services that are available on the internet, they provide information to the consumers. Just as internet has transformed the way people interact with the information, in the same way CPS have transformed the way that humans interacted with engineered systems.

Development of new products and services and high consumer demand towards high quality products with many varieties towards doorsteps and rising of internet allowed consumers have led to the existence of cyber physical systems. Even though the technologies such as Artificial Intelligence, Big Data, Internet of Things (IoT) have moved towards Industry 4.0., nowadays cyber physical system is considered as one of the key factor that is contributing for the growth of Industry 4.0. For example, intelligent manufacturing is mostly based on CPS where machine can perform numerous work processes by communicating with the components. For the adoption of this technology, some of the Governments have taken lead in funding cyber physical systems and to implement it in the factories.

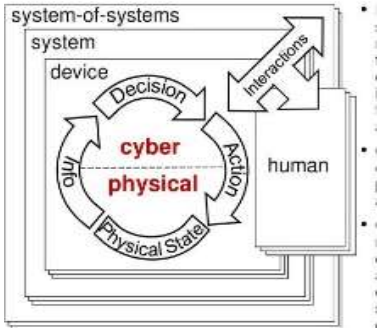
Effectiveness and benefits of funding in projects related to CPS

Recently, in June 2018, European Union had started funding project i.e., BEinCPPPs (Business Experiments in Cyber Physical Production Systems) which is creating a platform for many factories in monitoring the production processes. This has already been developed in Portugal at the shoe manufacturing company KYAIA. This platform provides better opportunities for the European SMEs and there will be increase in adoption of this technology. This project is to spread the potential of CPS in various industries of Europe. For that, it had created a platform that systematizes manufacturing processes and identifies failures in the production process. It also collects data from the factories and analyze it through machine learning techniques and provides workers with real time information and risk or failures involved in the process. The impact of this project is, there is decrease in downtime of manufacturing plant, decrease in costs for production and maintenance, increase in production and allowed real time visibility.

Future Scenario of CPS in various industries such as automotive, medical and others

If the adoption of this technology increases in future, CPS play a significant role and brings many changes in various industries such as automotive, medical, buildings and others. Cyber physical systems are used in emerging driverless cars for easy communication and security on smart roads and also coordinate with planes in reducing delays. In drones, these systems help in checking damaged infrastructure and deliver Wi-Fi access to disaster zones. Buildings such as offices and homes get motor-powered by a smart grid that is user-aware and use sensors to analyze and examine the environment and optimize heating, cooling and lighting. In smart grids, CPS monitors the stability conditions of transmission and distribution networks. They provide two way communication between power grid and consumers.

Cyber-physical systems are assured to transform the distribution of health care enabling smart medical treatments and services. CPS help in detection of changing health conditions by the use of sensors in homes, adoption of bionic limbs and robotic surgeries that help in healing and restoring movement to the disabled and injured and even increase human abilities. Wireless sensor networks gather the diagnostic information and monitor the drug administration and health of patient. CPS are progressively used to endorse sustainability and they help firefighters in detecting and deterring fires, improving agricultural practices and allowing scientists to alleviate underwater oil spills. In the recent years, we have seen cyber physical systems applications in mobiles. The increase in popularity of smartphones has amplified interest in the field of mobile cyber-physical systems.



In addition to these, CPS are used in many applications such as smart manufacturing, smart factory, smart water networks, hybrid electrical vehicles, unmanned aerial and autonomous underwater vehicles gas and oil pipelines monitoring and control, greenhouse control and supply chain management of various industries.

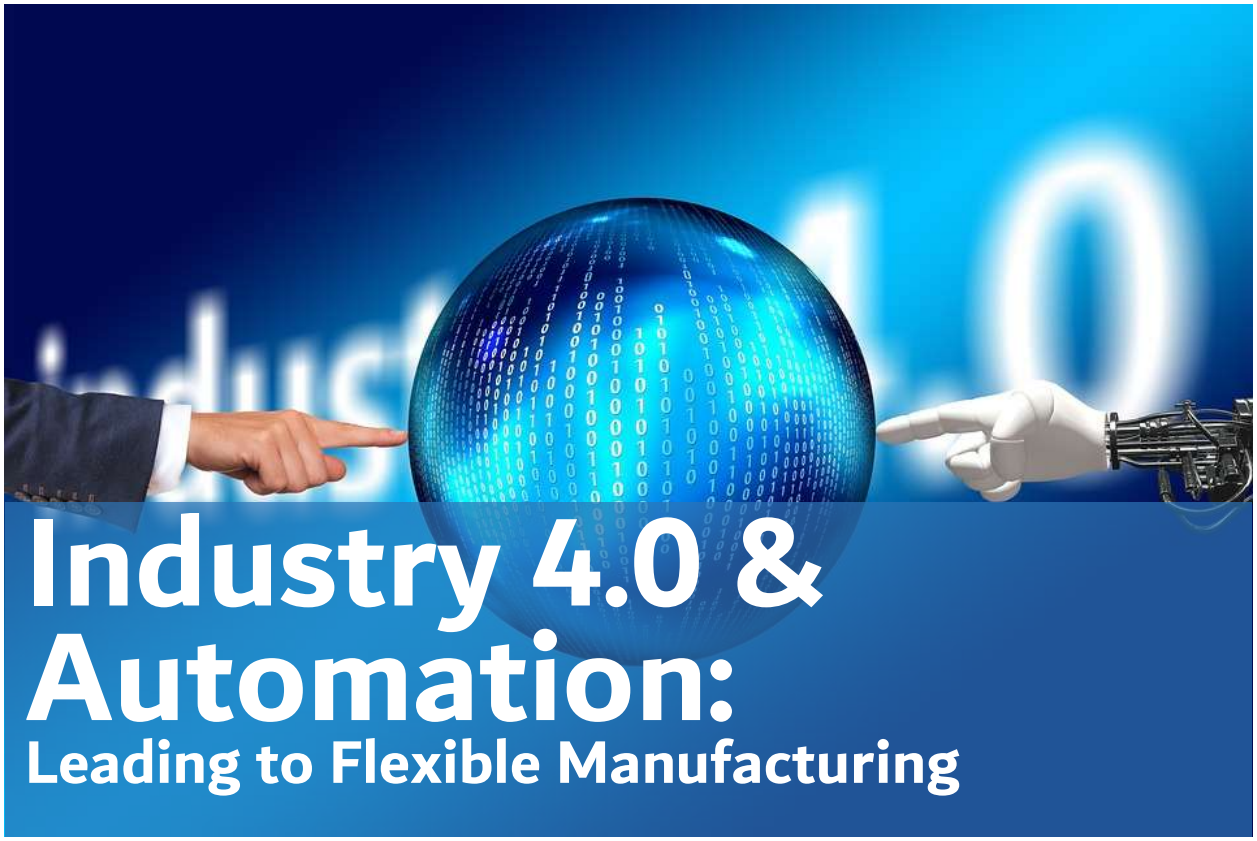
Challenges that hinder the implementation of CPS in various industries

Besides applications and benefits, there are some constraints in implementation of cyber physical systems. Even though many companies are adopting cyber security systems, they are vulnerable to cyber-attacks. Data security is the major problem as CPS interact with complex components, physical systems and networking. For instance, safeguarding the information security of cyber-physical systems is one of the most complicate issues in a wide range of defenses against cyber-attacks. The lack of awareness that means lack of consistent language and terminology in order to describe CPS and in adoption and implementation of cyber physical systems in supply chain management has also become one of the major problem. But advances in CPS will enable adaptability, safety, capability, scalability, resiliency, security and usability that enhances the adoption of CPS in various industries in the upcoming years.

Conclusion

It is clearly visible that cyber physical systems (CPS) is one of the key factors in driving the growth of Industry 4.0. Innovative approaches and modern applications of CPS in various industries than advanced production might provide disruptive changes. It has been identified that CPS have limited applications in supply chain management perspective. There is necessity in further research activities that should be concentrated on supply chain management related to strategic

developments and practices of how to implement CPS in business management, because it is integrating production processes with customer. Without efficient distribution of resources and products, it would be difficult to provide value added services. It has been found that U.S based National Science Foundation (NSF) has identified cyber-physical systems as an important area of research. Furthermore, the implementation of CPS concept in current business models such as such as in self-driving vehicles, medical, and others help companies in maintaining competitive edge, create opportunities for the small and medium players to enter into this market and can also provide even greater efficiency.



Industry 4.0 & Automation:
Leading to Flexible Manufacturing

- Revolution in the production process
- Deployment of technology like AR & AI
- Automating the manufacturing sector

Industrial 4.0 is a revolution leading to smart manufacturing and provides flexibility in production. It refers to the current trend of automation and data exchanges in manufacturing technologies. There are three key principles involved such as digitization, automation, and data collection. By following these principles, efficiency can be improved. It is also helpful in streamlining the cost. Industry 4.0 includes cyber-physical systems, the Internet of Things, and cloud computing. Industry 4.0 basically focuses on improving the flexibility in manufacturing. It also focuses on the quality issue and towards the improvement of productivity.

Industries these days face a strong demand to increase their productivity levels through smart manufacturing and smart factories. Hence, by introducing techniques such as industrial automation and machine technology, hardware and software integration, and various other solutions it is now possible to foster the development of industry 4.0.

Industry 4.0 is a boon for businesses and has proved to be a major factor leading to the development of smart factories. Industry 4.0 and automation together has steadily improved the productivity, quality, product purchasing costs, and manufacturing costs. Companies, however, big or small, especially the manufacturing units, cannot afford to ignore it. Industry 4.0 gives the ability to quickly analyze Big Data, which helps the companies to easily review the market trends associated with the desired commodity.

Many companies are also utilizing Augmented Reality (AR) and Artificial Intelligence (AI) as part of their Industry 4.0 strategy, which has raised the productivity by more than 30 percent. This has resulted in quality improvement with digital versus paper instructions for complex tasks. Improved AI also means that workers can be freed up to handle other tasks, improving resourcing, and reducing spending, where it is no longer needed.

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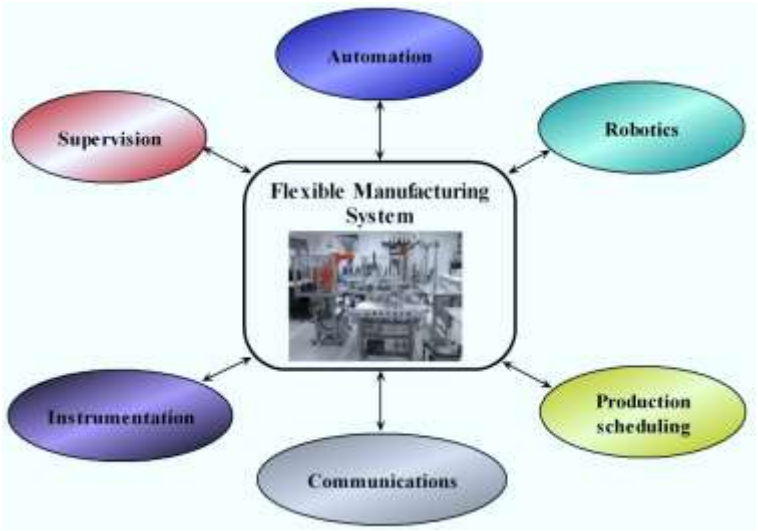
Drawback related to security are a part of Industry 4.0

However, opting for Industry 4.0 approach poses certain challenges. There are many process plants that handle flammable explosives or toxic materials. They require Safety Instrumented System (SIS) to prevent incidents that could lead to disastrous results. SIS is controlled and impacted by Industry 4.0 in a number of ways. The fundamental principle of Industry 4.0 is that all systems, including those devices utilizing Internet-protocol addresses, are connected to a globally accessible Internet infrastructure. It is scary to imagine what could happen if a cybercriminal broke into an Industry 4.0 plant system environment for accessing and controlling each and every device associated with the local area network. Not limited to this, Industry 4.0 promotes the wireless communication layer. Wireless communication is open to outside impact from nature such as lightning, adverse weather, solar magnetic storms, and solar plasma ejection leading to adverse effects.

Though Industry 4.0 has a lot to promise when it comes to revenues, venture, and technological progress, it is still hard to estimate the potential employment rate. In this era, Industry 4.0 and factory automation might be at the top of technological progress in the manufacturing sector, but it seems like machines are taking over the industry. The use of machines enables the organizations to avoid operational downtime and other productive issues. Hence, it is important to analyze the approach and trends of Industry 4.0 and automation, so as to be better prepared for a not-so-distant future.



AI Enabled 3D Machine Vision

- Future Scenario of 3D Machine Vision in industrial applications
- Benefits of AI enabled 3D machine vision in industries
- Enhancing opportunities in automotive industry

The latest buzzword "3D Machine Vision" has been attracting the attention of the manufacturing and other industry verticals, as well as of quality control teams. The universal race towards smart manufacturing is encouraging the use of advanced automation technologies such as Machine Vision (MV). MV is quickly becoming a vital building block for Industry 4.0-enabled smart factory infrastructure

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In industrial locations, it is very hard to find defects and features with irregular patterns such as hard-to-define stains, scratches, cracks, and various other types of flaws. It is difficult to inspect such defects by the conventional rule-based methods. However, now they can be easily identified using neural networks and other related methods that are based on Artificial Intelligence (AI) technology.

MV integrated with AI technology in the manufacturing industries analyzes and provides imaging-based automatic inspection for robotic guidance, process control, and inspection of industrial applications. In 2D MV systems, the 2D sensor is used for any industrial application, however, with limited flexibility.

Hence, for more flexibility, 3D MV systems have come into existence comprising of various cameras and one or more laser displacement sensors.

3D Perception for Robotic Guidance

Multi-camera 3D vision helps in robotic guidance applications providing the robot with part orientation data. In a 3D space, MV systems include multiple cameras mounted at different locations and triangulation on an objective position. According to Dr. David Wright, the former Vice President of Strategic Research at Braintech Inc., ''Artificial Intelligence-based analysis in vision provides unprecedented exploitability and flexibility in industry.

Machine learning is now being used to enhance MV systems to integrate adaptability into deployed systems. Integration of MV with machine learning boosts smart factory infrastructure. This escalates the value proposition of MV by accelerating the deployment of the production processes, improving the operational efficiencies, and enhancing the production optimization. MV is a crucial element in smart factory infrastructure for both manufacturing and quality control due to its characteristics such as efficient communicating network and intelligent exchange of information among machines, sensors, and devices.

Mostly, 3D MV systems are used for pick-and-place applications. 3D MV systems helps to detect the orientation of a part that needs handling more effectively, even when the location and position of the parts vary. A 3D vision system helps in guiding a robotic arm accurately during assembly, and the robotic arm can provide a 3D camera multiple viewing angles for inspection of critical assemblies. A robot with 3D vision can help in detecting the orientation of an object and can recognize it. This allows for intelligent, real-time decision making on the automation system part based on the input of available visual data. 3D vision-guided robotics are better equipped to handle objects with complex geometries, low light conditions, or reflective properties effectively.

The improved vision capabilities of 3D systems over 2D systems opens up vision-guided robotics to applications that were previously unsuitable for robotic vision systems.

For factory automation tasks, many companies choose 3D MV systems for robotics. Thus, these systems have gradually become cost-effective and easy to deploy, especially in settings where new products are introduced frequently. 3D vision systems for industrial robots are increasing in order to automate with a robotic arm. The technology is constantly improving, providing a return on investment (ROI) and profitability for manufacturers all over the world. Many manufacturing companies are spending on R&D activities in 3D machine for the development of new technologies and products.

Future scope of AI 3D machine vision in automotive and transportation

Automation of various systems is gradually becoming a significant part of any manufacturing industry, especially in the field of vision inspection. The automotive industry is one that manufactures components in huge numbers that need to be inspected for quality repeatedly and quickly. In the recent years, automotive OEMs are also focusing on developing vehicles with computer or MV integrated with AI technology that helps in intelligent behavior such as during the navigation and controlling the motion of the vehicle. One of the major commercial innovations took place for autonomous vehicles such as cars and drones. For instance, in self-driving cars, computer or MV helps the cars to react to road environments using LIDAR technology and SLAM (simultaneous localization and mapping) technology, which uses machine learning.

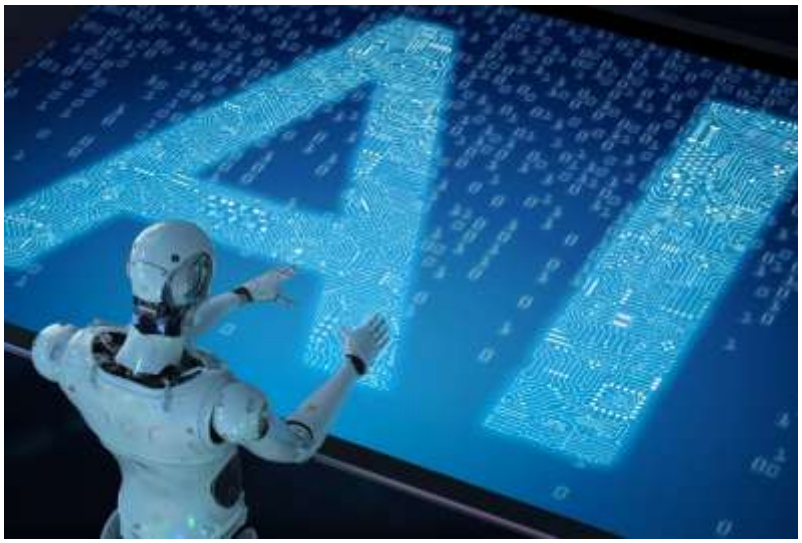
Challenges that hinder AI 3D machine Vision

Besides benefits and applications, there are some challenges in AI-based machine technology. One of the major challenges in computer vision-based AI solutions is, this technology is still in its developmental stage when compared to the progress of natural language processing solutions. This is mainly due to the lack of big, structured datasets and the substantial amount of computational power required to train the algorithms. However, speed, accuracy, and resolution are the main challenges tackled by 3D MV systems.

Conclusion

3D MV is the automatic gathering of data from digital images for quality control and process. The application of technology and software by using artificial intelligence brings more opportunities for vendors in the market and there will be an increase in the adoption rate for 3D MV with AI in industrial applications. Instead of human inspectors, most of the manufacturers these days use automated MV system with updated technologies as it is better suited to perform repetitive inspection tasks. This technology is much more objective, faster, and works continuously. 3D MV system inspects thousands of parts per minute, and delivers more reliable and consistent inspection results continuously.

By increasing the yield, reducing the defects, tracking the parts that need attention with machine vision, manufacturers can save time, money, and increase profitability. The reality of 3D MV will be one of the most groundbreaking technologies in all areas of manufacturing and transportation in the coming years. The technology will find a place in further inspection tasks and ultimately extend beyond the realm of industrial automation.



Artificial Intelligence in Instrumentation Engineering:

A Boon for Industrial Automation

- AI improve and expand the capability of traditional instrumentation engineering measurement systems
- Enhance the production process
- Improving the reliability of equipments

Artificial Intelligence (AI) has brought about a radical digital transformation in the 21st century. AI technology finds a wide range of applications in instrumentation engineering, from measurement and control and system identification to machine (Instrumentation Engineering) performance improvisation.

Instrumentation engineering gives prime importance to the principle and operation of those measuring instruments that are used to design and configure various automated systems in the manufacturing and production industries. With the advancements in engineering technology, various observations are drawn with respect to instrumentation safety posed by the different applications.

Machine Learning and Deep Learning – The Basis of Industrial AI

Machine Learning and Deep Learning are both sub-sets of Artificial Intelligence (AI)

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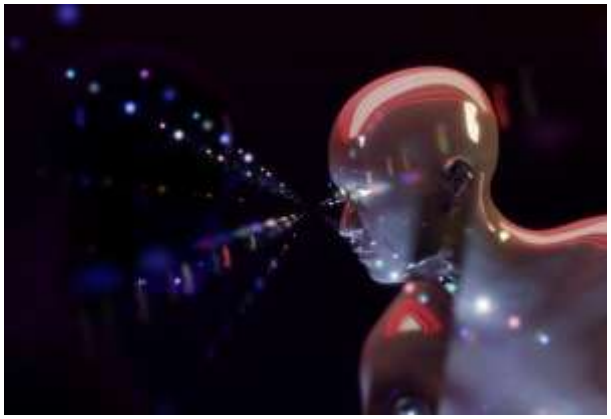
These use advanced intelligence techniques for the prediction of the output results from the input data given. With the help of AI technology the machines provide the desired output as expected by the user. In the current scenario, different research organizations and researchers are using an extensive set of instruments and tools to record the engineering data from different sources. AI techniques enable modern computing systems to manipulate the sample input signals from the user and extract the desired measurements. In instrumentation engineering, AI is implemented to improve and expand the capability of traditional measurement systems, and create new instruments for high-level measurements in different applications.

System identification, prediction, control, signal processing, and vision and pattern classification, are the major use cases where Artificial Intelligence is capable of finding reasonable solutions. The required solution to an instrumentation engineering problem is achieved based on the historical data processed and analyzed by the machine. Artificial Neural Networks (ANNs), which also fall under AI, behave like human brains. Bbased on the historical data given, ANNs give you the correct predictions.

Availability of AI Tools and Technology

The workings of AI ad the way machines cleverly predict the output for specific instrumentation engineering applications arouse our curiosity. Let us understand how these AI technology models work with regard to instrumentation engineering. AI technology creates patterns that represent the description of an object for the machine, , and the machine organizes and analyzes those captured patterns based on experience to execute tasks without requiring specific instructions. The particular pattern captured by the machine can be essentially considered as a sequential arrangement in which some similar structure exists.



The benefits of AI in the field of instrumentation engineering are manifold. It enables automation systems to make correct predictions and with high accuracy. Majority of the Artificial Intelligence technique models are built based on the historical information given to a particular instrumentation machine, which helps give the best solution and prediction for a particular application, thus helping industrial automation companies to function smoothly. AI offers multiple benefits to industrial automation companies by streamlining business operations, enhancing the quality of work, improving the reliability of equipment, and offering increased and consistent output.

Warehouse Cognitive Automation

- Artificial intelligence clubbed with IIoT and robotics
- Leveraging Industry 4.0 technologies to cater to changing warehouse demands
- Human-Robot safer work environment

Cainiao, the logistics arm of Alibaba claims to have the largest population of mobile robots in China. There are more than 100 automated guided vehicles in the warehouse, which occupies approximately 3,000 square meters. Cainiao caters to same-day and next-day delivery services to more than 1,000 regions in China. On placing an order on Alibaba's Tmall shopping site, an Automated Guided Vehicle (AGV) is activated in its Huiyang warehouse. The AGV traces an ordered item in the warehouse and transports it to a human warehouse assistant, who then assembles and ships the orders to the customers.

Taking this as an example, most companies are compelled to change how they operate their storage and logistics, in order to efficiently complete the next-day delivery cycle. To aid such companies, in 2018, Honeywell collaborated with Carnegie Mellon University to advance artificial intelligence and robotic technologies to help warehouses address the rising demands of ecommerce.

The warehouse represents the substantial cost center of the company. Perpetually delivering high service at low cost is the real challenge in the ecommerce marketplace.

Automation provides lucrative solutions to meeting the market needs, such as space saving and improved productivity. The industry has witnessed a migration away from the warehouse-base stockpiling of supplies to high-velocity operations; pushing more products through the same physical assets while bringing down the overall cost. Manifested as distribution centers rather than warehouses, are now an imperative component of the supply chain infrastructure, which provides strategic facilities to offer competitive advantages.

Cognitive automation solutions mimic the way humans think. This means it uses technologies such as natural language processing, image processing, pattern recognition,

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and—most importantly—contextual analysis to make more instinctual leaps, perceptions, and conclusions.

Retail giants such as Amazon, with a vision of delivering packages within 30 minutes are already significantly automated, with a growing number of centers using Kiva robots. Now, it plans to automate the process of picking items from the shelves. According to a member of Amazon Picking Challenge (APC), "Recent developments in robotics have the potential of substantially increasing the degree of automation in warehouse logistics and order fulfilment in the near future." However, according to Peter Wurman, the technical co-founder of Amazon-owned Kiva Systems, the Amazon Robotics is still in need of substantial "scientific progress", before picking is automated, as the current software is not efficient enough to build robotic hands and create motions.

To adapt to variable demands, automation requires evolution beyond the capabilities of simple automation. The need of eliminating the risk of damaged, expired, or lost products, slow processing, and other inefficiencies and productivity challenges grow. Technologies inherent in Industry 4.0 such as computer vision, augmented reality, IIoT, gesture recognition, deep learning, and other cognitive solutions clubbed with robots can lead to smart warehouse automation. The major impact of Industry 4.0 on warehouses is on the business operations, where the primary objective is to improve productivity, reduce risk by eliminating delays and response time, ensure maximum asset consumption and minimum downtime, and automate activities.

Safety augmentation is a critical parameter of robot actuation and sensors, facilitating automated technologies to operate in the human-robot work environment. Embedded sensors automatically detect a human presence in their zone and quickly adjust the robot's activity to ensure human safety. Thus, letting humans and robots work in collaboration.

The impact of cognitive automation along with industry 4.0 technologies on warehouses can create effective facilities. It is essential for decision makers to proactively evaluate the impact of distribution trends along with the probable benefits of automating facilities. This will allow the executives to effectively plan to meet the business objectives in a field that is set to change rapidly over the next decade.

Cognitive RPA: AI-based solutions to develop a robotic-

Based process automation system, with focus on the manufacturing sector

- Developments in healthcare industry creates opportunities for cognitive RPA in the near future
- Integration of RPA with Artificial Intelligence (AI)
- Changes in automation industry with cognitive RPA

Robotic Process Automation (RPA), the application of software and technology with the use of artificial intelligence, has excited executives in the manufacturing industry in the recent years. RPA helps manufacturers replace manual tasks with high-end automated systems. Automation works best when you bring together RPA and cognitive computing. An obvious question is why combine the two in the first place? There is a simple answer to it — both are necessary for a practical yet cutting-edge automation model. Moreover, current trends in the manufacturing industry indicate that RPA is extending automation to new areas and helping companies become more efficient and agile. The advancements in artificial intelligence (AI) and cognitive computing are expected to trigger a new wave of automation possibilities hitherto unthinkable.

The age of automation is unquestionably here. Robots have provided assistance to both the government and industrial sectors in the recent years. The application of cognitive computing in advanced robotics revolutionizes the way we work by bringing about substantial improvements in accuracy, speed, and efficiency to certain mass and mundane tasks. Governments of various countries are realizing the potential benefits that robots and robotics can bring in the way of the Civil Service to help serve the public better.

John Manzoni, British Chief Executive of the Civil Service, in his speech on the subject of civil service transformation (CST) at the London School of Economics (LSE) in early 2018 said: “Many of our [government] services will begin to benefit from the huge potential of robotics – or, more accurately, robotic process automation (RPA).” He further added: “In speed and accuracy of response, RPA could transform the experience of citizens registering for services, or applying for grants of benefits.”

Execution of process automation with cognitive computing in healthcare institutions can augment human thinking and potential, increase scalability, and reduce operational costs significantly. There are various applications of cognitive RPA or RPA in the healthcare industry. Cognitive RPA minimizes the possibilities of human error in physician credentialing; enrollment and patient eligibility; patient scheduling; claims administration; clinical documentation; Medicare billing and compliance; and others. Cognitive RPA complements the existing business processes and enables healthcare institutions to address gaps in the functioning of works done manually.

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Applications of cognitive RPA in various industries such as healthcare, Government and others

Apart from the government and healthcare sectors, RPA also significantly impacts the private sector. At first, the implementation of RPA is a little challenging; however, once the initial set-up cost is taken into account, it has the potential to fuel businesses. The introduction of AI and machine learning with cognitive RPA to industry 4.0 represents a big change for the manufacturing industry, opening new business opportunities. Advanced automation solutions eliminate the repetitive human tasks in business processes. RPA is bound to expand its reach as more enterprises become more aware of its benefits.

Conclusion

Cognitive RPA technology is widening the interest in RPA and generating a good measure of hype. It is increasingly enabling the unstoppable automated execution of business processes in the industry with major improvements and cost models. All the limitations of RPA can be resolved by integrating RPA with cognitive computing. Cognitive RPA can not only reduce the issues developed by RPA, but also transform semi-structured and unstructured data into structured data, which can then be easily processed by robots. New developments in artificial intelligence will bring about a huge change in automation. The transformation of robotic process

automation into cognitive RPA will support new business models as well as drive major competitive advantages. Major enterprises need to start investing on the technology to reap the robust benefits and to compete in the future. The shift towards cognitive RPA will bring about end-to-end automation solutions that provide much faster and higher return of investment.

Artificially Intelligent Cobots in Robotic Process Automation:

The Advent of Industry 5.0

- Future scenario of industrial robots in industry 5.0
- Integration of collaborative robots with Robotic Process Automation (RPA) enhances Industry 5.0
- Role of Artificial Intelligence in Cobots

The impact of robots on various industries in today's world is undeniable. Most people imagine robots as adapting to virtually task, and performing tirelessly and accurately. In the real world of industrial robotics, human–robot collaboration potentially improves production and comfort. These collaborative robots, popularly called cobots, are coherently designed for interaction with humans within a defined collaborative workspace. As industry 4.0 unfolded, there was the emergence of smart manufacturing in industries through the integration of AI, IoT and cognitive computing with the principle of chaining machines with intelligent devices and smart networks throughout the value chain. But the advent of industry 5.0 will bring about amazing technological advancements with incredible speed, and, more importantly, increase collaboration between humans and smart systems.

Innovations and developments in new technologies have gained tremendous momentum, and thus, the integration of collaborative robots with RPA will show the potential impact on automation and usher in the era of Industry 5.0. The transformation of industry 4.0 to industry 5.0 will completely converge robot capabilities and human skills.

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Cobots will be easily programmable and safe and offer a great return on investment. Moreover, these cobots will incorporate AI chatbot applications that work in conjunction with humans across the manufacturing process, and increase the demand for robotic process automation (RPA).

Robotics has always been closely related to the manufacturing and automotive industries. But currently, there are many other industries such as food and beverages, health care, pharmaceuticals, BFSI, and transportation, which have embraced robotics to reduce processing time and increase production rate. The integration of cobots with AI also has the potential to streamline processes and enhance decision making processes in the manufacturing sector.

Cobots with AI features are increasingly being adopted by the automotive industry to convert the manufacturing plants into next-generation automated factories. For instance, Ford has installed several collaborative robots in its refurbished Louisville, Kentucky, truck plant. Besides, Ford also utilizes augmented reality to map the vehicle assembly lines, and predictive analytics to schedule maintenance and repairs at the plant site.

The move towards next-generation factory will increase the production ratio of vehicles. Cobots are game changers for carmakers, helping big and small carmakers and component manufacturers, to give competitive and qualitative service at a better price. The health care industry has already started using artificial intelligence. The transformation of the industry will be driven by the need for precision, accuracy, and performance of the automated process. In this industry, robotics finds a wide range of applications in precise robotic surgeries, =disease diagnosis, and prescription suggestions. The cobots integrated with AI technology will also be of great assistance to the medical sector.

The demand for collaborative robots is projected to grow rapidly due to the increasing applications of cobots in the aforementioned industries. Cobots are transforming the workspace in both commercial as well as non-commercial sectors. In the recent years, some of the robots that are used in various industries are less efficient and that needs to be uplifted with the new technology and other digital tools. The transition from Industry 4.0 to Industry 5.0 will bring about new technologies such as software run robots and cobots that are incorporated with IoT and A.I. This technology will open up opportunities for many companies to develop and manufacture their products by monitoring customer activities.

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