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Technologies Shaping the Future of Industrial Automation in India

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Abstract: Over the past years, automation gets involved in various industrial operations and in decision making too. Some industries take steps to implement full automation over the manufacturing, process and control plants. This paper aims to present the various emerging technologies are adopting and using for the industrial automation. Nowadays, engineering fields are equipped with advanced sensors, machine vision, robotic platform and innovative instruments for fully automated systems. According to Industrial Trade Administration (ITA) reported that the annual global automation expenditure is expected to increase to over $300 billion by 2020. Furthermore, the spend is expected to increase to over $600 billion in the coming years as automation systems become more interconnected within process operations. This paper explores the availability and presence of technology globally in various sectors

Keywords: Industrial Automation, IoT, Robotic Platform, Multi touch technology, Virtualization.

I. INTRODUCTION

The Fourth Industrial Revolution (4IR) technologies erased the lines between the physical, digital and biological spheres of global production systems. Industrial activities include the full chain cycle from raw material, design, manufacture, use and reintegrate the final products and services, will be altered and extended in ways that are difficult to predict – from origination of inputs, product design and manufacturing, to distribution, customer/ consumer use and elements of the circular economy/return/ reuse. Breakthroughs in key areas are revolutionizing the future of automation, including Artificial Intelligence (AI), Robotics, Internet of Things (IoT), Autonomous Vehicles (AV), 3D printing, Nanotechnology, Biotechnology, Materials science, energy storage and quantum computing. At the beginning of 2016, the World Economic Forum introduced the System Initiative on Shaping the Future of Automation, to understand how the technologies concerned are disrupting production systems and to explore how best to stimulate sustainability, employment and the innovative capacity of nations.

The Forum has gathered a unique group of experts, business leaders, worker representatives, civil society leaders, and government ministers and officials, the latter representing nations that deliver 85% of current global manufacturing output. One of the key projects of the initiative is the Technology for Production Foresight Series, which aims to increase understanding among stakeholders worldwide of the value that new technologies could add to global production systems. It also seeks to build knowledge of the keys to unlocking that value, and the potential perils posed by these technologies if their adoption and diffusion are exclusive and not centred on people. Advanced automation is already disrupting job futures across the globe.

In India, however, many industries still have limited access to power and other basic infrastructure and a large portion of manufacturing and services are concentrated in small and medium enterprises. In this context, it is particularly important to make a distinction between automation potential and automation adoption. While a large number of tasks might increasingly be technically automatable, their adoption will depend on a wider range of socio-economic factors, including relative cost of labour and availability of skilled labour. Therefore, adoption of advanced robotics and related technologies over the next decade will be in specific niches and job displacement will thus be concentrated in specific industries and work processes. Recent studies estimate that India has high automation potential, calculated in terms of the task content of various occupations. In many industrialized economies, 4IR technologies are expected to contribute to a hollowing out of labour markets, as many routine and rule-based jobs that typically involve low to medium skills are automated. Cashiers, receptionists, legal aids, and travel agents are thus most vulnerable to the impact of automation. In India, however, the bulk of the labour force is engaged in unskilled or low-skilled and low-income jobs within the unorganized sector. The category of low-medium skilled jobs within the organized sector, such as those of a cashier, is still very small. India is thus unlikely to experience a hollowing out of the labour market in terms that may be similar to other industrialized economies. However, these low-medium skill level jobs within the organized sector are what millions within the unorganized sector, particularly youth, aspire toward. As businesses within the organized sector realign to new technological possibilities, a critical pathway for upward labour mobility and income mobility is likely to shrink. This can pose a significant challenge in the Indian context as middle skill jobs have served as a pathway out of poverty.

Adoption of 4IR technologies will be in niches within the organized manufacturing and service sectors, primarily because of the relative cost of labour and infrastructural constraints. Capital intensive manufacturing industries, such as the automobile industry, are more likely to adopt 4IR solutions. Work processes within the service sector, particularly those that involve routine and repetitive tasks, have high automation potential. Adoption rates will be higher in some sectors, such as financial and legal services, and IT services. In some cases, this may result in the creation of newer higher value jobs such as that of a bank teller, which could become redundant, for example, while increasing the value of a financial counsellor. However, the overall impact on employment numbers is likely to be limited, as these industries and services are traditionally not large-scale employers. Largest employers happen to be from the construction and agriculture sectors wherein they are both likely to experience incremental mechanization rather than advanced automation.
The adoption of select 4IR technologies could provide solutions to improve low productivity and output in the agricultural sector, but low growth combined with the decreasing size of land-holdings makes widespread adoption of these technologies unlikely. The relative cost and abundant supply of labour is likely to make the construction sectors a slow adopter since many, much older machines are yet to be adopted in the sector. With most of India's work-force engaged in the unorganized sector, the impact on India's dual economy structure is a crucial concern. Comprised of small enterprises, daily wage and self-employed workers, the unorganized sector lacks the financial capital and necessary skills to support adoption of advanced technologies. Micro-technologies such as those for digital banking, alongside ecosystem upgrades in transport and connectivity services, could however improve labour productivity. This paper summarizes the key insights and understanding of the five technologies with the greatest impact on the future of automation. In 2020, the five key technologies of focus were the internet of things, artificial intelligence, virtualization, advanced robotics and multi touch technologies (including augmented and virtual reality).

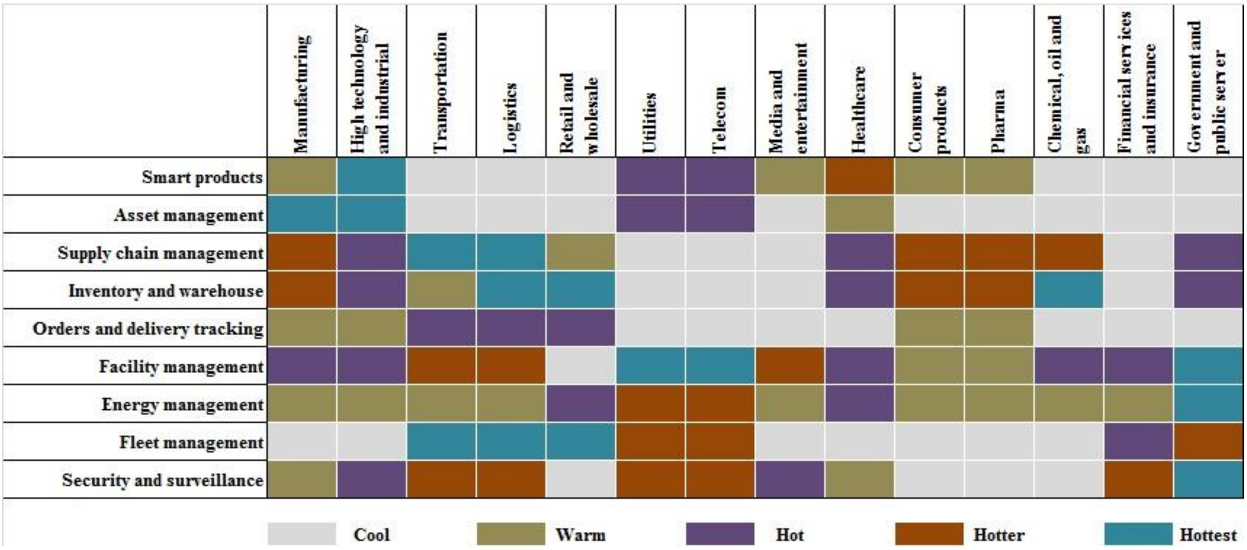

Fig. 1 Technology value chain impact

II. INTERNET OF THINGS (IoT)

The Internet of Things is about extending the power of the internet beyond computers and smartphones to a whole range of other things, processes, and environments. The internet of things is a system of interconnected computer devices. That describes that network of physical objects that are embedded with software, sensors and other technologies for the purpose of connecting and exchanging data with other devices over the internet. The application of the IoT to the manufacturing industry is called the IIoT.

Fig. 2 Industrial Internet of Things (IIoT)

The IoT is a network of intelligent computers, devices, and objects that collect and share huge amounts of data. The collected data is sent to a central Cloud-based service where it is aggregated with other data and then shared with end users in a helpful way. The Industrial Internet of Things more specifically refers to industrial devices that are now equipped with the capabilities to send data to HMI and SCADA systems or the cloud. The IIoT will revolutionize manufacturing by enabling the acquisition and accessibility of far greater amounts of data, at far greater speeds, and far more efficiently than before.

A. Industrial IoT Development Kits

IIoT development kits provide an entire, high quality design environment for engineers and solution architects to drastically accelerate the development and delivery of IoT applications. Using these kits, any development/industrial environment can be quickly turned into a production ready unit. The IoT Development Kit targets a variety of IoT application requirements by providing a range of different hardware platforms, spanning from very compact low-power ARM-based designs to powerful multi-core, latest generation Intel Atom gateways. There are many companies that provide IoT related devices/products such as Advantech Co., LTD, Congatec Asia Ltd., ADLINK Technology, and Icop Technology.

Advantech Co., Ltd provides premium quality, innovative products, services and solutions. This company provides Internet of Things (IoT) products, devices and IoT Gateway devices and industrial IoT development kits. Advantech offers embedded systems, IoT Wireless I/O Modules, automation products, and global logistics support. This company works on development and manufacture of high-quality, high-performance computing platforms.

Congatec Asia Ltd is the leading supplier of IoT gateway Devices. The products of this company can be used in a variety of industries and applications such as industrial automation, telecommunication, transportation, test & measurement. The company's products are made in accordance with modern quality standards. IoT Gateway Devices of Congatec Asia are easily customizable for rapid field deployment. OEMs benefit from an instantly available pre-configured, pre-certified IoT gateway that can easily connect a wide range of heterogeneous sensors, actors and systems to cloud-based services.

ADLINK Technology Inc, offers Industrial Internet of Things (IoT) platforms to serve the automation, medical, transportation and government/defense verticals. Our products include motherboards, blades, chassis, modules, gateways, systems, and end-to-end solutions based on industry standard form factors, as well as an extensive line of test & measurement products and smart touch computers, displays, and handhelds that support the global transition to always connected systems. ADLINK embedded IOT gateway (Industrial Internet of Things) platforms support Intel® Gateway Solutions for Internet of Things (IoT) by integrating Wind River Intelligent Device Platform* (IDP) XT and McAfee* Embedded Control to provide a complete, pre-validated communication and security solution.

ICOP Technology is the world's leading manufacturer of industrial embedded computers, industrial embedded controllers, industrial IoT Development Kits, industrial panel PCs etc used in the automation of numerous control systems. This company provides Industrial IoT Development Kits that offers low power consumption; touch screen LCD, and stackable wireless connection in a package with sample code available. These Industrial IoT Development Kits are integrated with DMP's Vortex86EX low-power consumption x86 400MHz processor (VEX-SOM) and DIGI's XBee module. Furthermore, VEX-IOT-DEV kit provides balanced computing performance with 128MB DDR3 system memory and stable wireless connectivity for your devices.

IIoT utilization in Industrial Automation

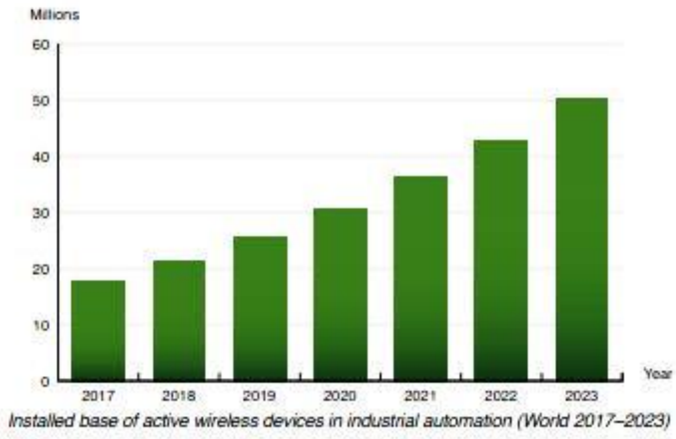

Fig. 3 IIoT utilization Chart in various era

The Industrial Internet of Things (IIoT) continues to gain traction in all kinds of industries and applications. Industrial Automation is one such industry that's seen a big increase in IoT utilization—a very big increase. Industrial Automation

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refers to the use of various control devices like computers, robots, and information technologies for handling and controlling different processes and machines in an industry. It's also done with a reduced need for human intervention, resulting in a more automated control performance. The Internet of Things is the network of physical objects and devices around the world that are connected to the internet and specifically meant to collect and share data. In industrial automation, those connected devices are the computers, machines and robots mentioned above. The growth of IoT in Industrial Automation is highlighted in a recent report by Berg Insight that found that the installed base of wireless IoT devices in Industrial Automation reached 21.3 million in 2018. That growth shows no signs of slowing as that number is expected to reach 50.3 million by 2023.

Wireless IoT solutions are great for parts of facilities that are hard to reach, cost prohibitive to connect with wired installations or have frequent modifications to workflows and layouts. In factory automation, wireless IoT can be used to control devices such as cranes and automated guided vehicles (AGVs) in material handling applications. They can also be used in process automation to connect instruments that enable plant operators to monitor and optimize processes in hazardous areas, which helps to ensure worker safety. "Robust connectivity is critical to support industrial IoT use cases surrounding predictive maintenance and digital twins," said Fredrik Stalbrand, IoT Analyst at Berg Insight. He went on to explain that installation and maintenance of wireless solutions are more flexible and economical compared to wired technologies, enabling reconfigurable manufacturing system design. Berg Insight's report also estimated that annual shipments of wireless devices for industrial automation applications reached 4.6 million units worldwide in 2018, which accounts for approximately 6 percent of all new connected nodes. That number is expected to reach 9.9 million in 2023, which is more evidence of the rapid growth of IoT in Industrial Automation.

While the adoption of wireless IoT solutions in industrial automations can help with everything from improved waste removal, refining supply chains to creating lean operations on the factory floor, there's more: data. Big data. Data resides everywhere in manufacturing. Wireless IoT solutions work to gather and communicate that data so that it can be analyzed and utilized effectively. There is valuable data in Enterprise Resource Planning (ERP) systems, Product Lifecycle Management (PLM) systems, Manufacturing Execution Systems (MES) and Supplier Relationship Management (SRM) systems, as well as all the documents like spreadsheets and other files that a company accumulates. There is also data to be collected and utilized from outside the business from sources like vendors and even sales.Industrial automation companies that continue to adopt IoT strategies stand the best chance to overcome organizational, process, data and system silos by automating the collection of data across divisions and operations. They'll be positioned to better analyze and utilize all that data helping to ensure more efficient and profitable operations.

III. ROBOTICS PLATFORM

More capable, and more flexible technologies are accelerating the growth of fully automated production facilities. The key challenge for companies will be deciding how best to harness their power. At one Fanuc plant in Oshino, Japan, industrial robots produce industrial robots, supervised by a staff of only four workers per shift. In a Philips plant producing electric razors in the Netherlands, robots outnumber the nine production workers by more than 14 to 1. Camera maker Canon began phasing out human labor at several of its factories in 2013. This "lights out" production concept—where manufacturing activities and material flows are handled entirely automatically—is becoming an increasingly common attribute of modern manufacturing.

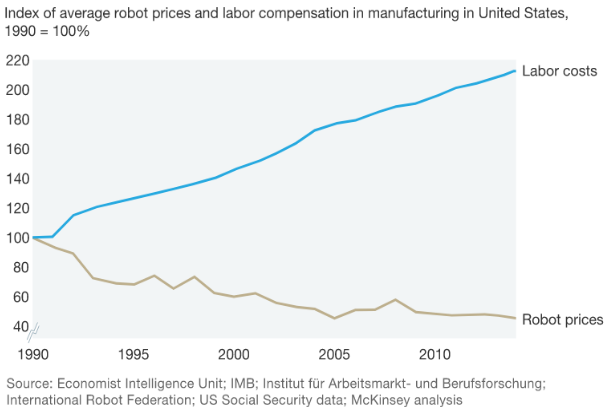

Fig. 4 Cost of Automation

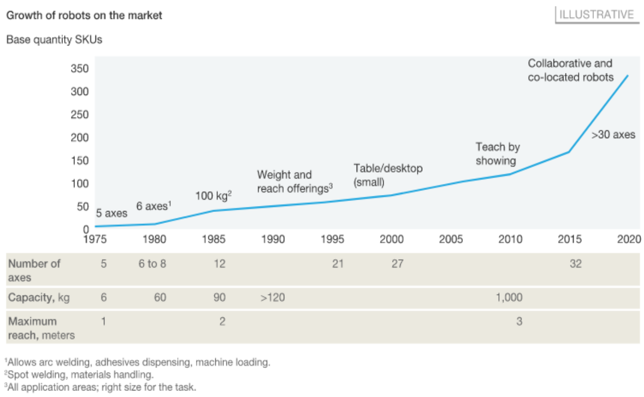

Fig. 4. Growth of Robots in market

In part, the new wave of automation will be driven by the same things that first brought robotics and automation into the workplace: to free human workers from dirty, dull, or dangerous jobs; to improve quality by eliminating errors and reducing variability; and to cut manufacturing costs by replacing increasingly expensive people with ever-cheaper machines. Today's most advanced automation systems have additional capabilities, however, enabling their use in environments that have not been suitable for automation up to now and allowing the capture of entirely new sources of value in manufacturing. As robot production has increased, costs have gone down. Over the past 30 years, the average robot price has fallen by half in real terms, and even further relative to labor costs (Exhibit 1). As demand from emerging economies encourages the production of robots to shift to lower-cost regions, they are likely to become cheaper still.

Accessible talent

People with the skills required to design, install, operate, and maintain robotic production systems are becoming more widely available, too. Robotics engineers were once rare and expensive specialists. Today, these subjects are widely taught in schools and colleges around the world, either in dedicated courses or as part of more general education on manufacturing technologies or engineering design for manufacture. The availability of software, such as simulation packages and offline programming systems that can test robotic applications, has reduced engineering time and risk. It's also made the task of programming robots easier and cheaper.

Ease of integration

Advances in computing power, software-development techniques, and networking technologies have made assembling, installing, and maintaining robots faster and less costly than before. For example, while sensors and actuators once had to be individually connected to robot controllers with dedicated wiring through terminal racks, connectors, and junction boxes, they now use plug-and-play technologies in which components can be connected using simpler network wiring. The components will identify themselves automatically to the control system, greatly reducing setup time. These sensors and actuators can also monitor themselves and report their status to the control system, to aid process control and collect data for maintenance, and for continuous improvement and troubleshooting purposes. Other standards and network technologies make it similarly straightforward to link robots to wider production systems.

New capabilities

Robots are getting smarter, too. Where early robots blindly followed the same path, and later iterations used lasers or vision systems to detect the orientation of parts and materials, the latest generations of robots can integrate information from multiple sensors and adapt their movements in real time. This allows them, for example, to use force feedback to mimic the skill of a craftsman in grinding, deburring, or polishing applications. They can also make use of more powerful computer technology and big data–style analysis. For instance, they can use spectral analysis to check the quality of a weld as it is being made, dramatically reducing the amount of post manufacture inspection required.

Robots take on new roles

Today, these factors are helping to boost robot adoption in the kinds of application they already excel at today: repetitive, high-volume production activities. As the cost and complexity of automating tasks with robots goes down, it is likely that the kinds of companies already using robots will use even more of them. In the next five to ten years, however, we expect a more fundamental change in the kinds of tasks for which robots become both technically and economically viable (Exhibit 2). Here are some examples.

Low-volume production

The inherent flexibility of a device that can be programmed quickly and easily will greatly reduce the number of times a robot needs to repeat a given task to justify the cost of buying and commissioning it. This will lower the threshold of volume and make robots an economical choice for niche tasks, where annual volumes are measured in the tens or hundreds rather than in the thousands or hundreds of thousands. It will also make them viable for companies working with small batch sizes and significant product variety. For example, flex track products now used in aerospace can "crawl" on a fuselage using vision to direct their work. The cost savings offered by this kind of low-volume automation will benefit many different kinds of organizations: small companies will be able to access robot technology for the first time, and larger ones could increase the variety of their product offerings.

Highly variable tasks

Advances in artificial intelligence and sensor technologies will allow robots to cope with a far greater degree of task-to-task variability. The ability to adapt their actions in response to changes in their environment will create opportunities for automation in areas such as the processing of agricultural products, where there is significant part-to-part variability. In Japan, trials have already demonstrated that robots can cut the time required to harvest strawberries by up to 40 percent, using a stereoscopic imaging system to identify the location of fruit and evaluate its ripeness. These same capabilities will also drive quality improvements in all sectors. Robots will be able to compensate for potential quality issues during manufacturing. Examples here include altering the force used to assemble two parts based on the dimensional differences between them, or selecting and combining different sized components to achieve the right final dimensions. Robot-generated data, and the advanced analysis techniques to make better use of them, will also be useful in understanding the underlying drivers of quality. If higher-than-normal torque requirements during assembly turn out to be associated with premature product failures in the field, for example, manufacturing processes can be adapted to detect and fix such issues during production.

Complex tasks
While today's general-purpose robots can control their movement to within 0.10 millimeters, some current configurations of robots have repeatable accuracy of 0.02 millimeters. Future generations are likely to offer even higher levels of precision. Such capabilities will allow them to participate in increasingly delicate tasks, such as threading needles or assembling highly sophisticated electronic devices. Robots are also becoming better coordinated, with the availability of controllers that can simultaneously drive dozens of axes, allowing multiple robots to work together on the same task.Finally, advanced sensor technologies, and the computer power needed to analyze the data from those sensors, will allow robots to take on tasks like cutting gemstones that previously required highly skilled craftspeople. The same technologies may even permit activities that cannot be done at all today: for example, adjusting the thickness or composition of coatings in real time as they are applied to compensate for deviations in the underlying material, or "painting" electronic circuits on the surface of structures.

Working alongside people
Companies will also have far more freedom to decide which tasks to automate with robots and which to conduct manually. Advanced safety systems mean robots can take up new positions next to their human colleagues. If sensors indicate the risk of a collision with an operator, the robot will automatically slow down or alter its path to avoid it. This technology permits the use of robots for individual tasks on otherwise manual assembly lines. And the removal of safety fences and interlocks mean lower costs—a boon for smaller companies. The ability to put robots and people side by side and to reallocate tasks between them also helps productivity, since it allows companies to rebalance production lines as demand fluctuates. Robots that can operate safely in proximity to people will also pave the way for applications away from the tightly controlled environment of the factory floor. Internet retailers and logistics companies are already adopting forms of robotic automation in their warehouses. Imagine the productivity benefits available to a parcel courier, though, if an onboard robot could presort packages in the delivery vehicle between drops.

Agile production systems
Automation systems are becoming increasingly flexible and intelligent, adapting their behavior automatically to maximize output or minimize cost per unit. Expert systems used in beverage filling and packing lines can automatically adjust the speed of the whole production line to suit whichever activity is the critical constraint for a given batch. In automotive production, expert systems can automatically make tiny adjustments in line speed to improve the overall balance of individual lines and maximize the effectiveness of the whole manufacturing system. While the vast majority of robots in use today still operate in high-speed, high-volume production applications, the most advanced systems can make adjustments on the fly, switching seamlessly between product types without the need to stop the line to change programs or reconfigure tooling. Many current and emerging production technologies, from computerized-numerical-control (CNC) cutting to 3-D printing, allow component geometry to be adjusted without any need for tool changes, making it possible to produce in batch sizes of one. One manufacturer of industrial components, for example, uses real-time communication from radio-frequency identification (RFID) tags to adjust components' shapes to suit the requirements of different models. The replacement of fixed conveyor systems with automated guided vehicles (AGVs) even lets plants reconfigure the flow of products and components seamlessly between different workstations, allowing manufacturing sequences with entirely different process steps to be completed in a fully automated fashion. This kind of flexibility delivers a host of benefits: facilitating shorter lead times and a tighter link between supply and demand, accelerating new product introduction, and simplifying the manufacture of highly customized products.
Making the right automation decisions. With so much technological potential at their fingertips, how do companies decide on the best automation strategy? It can be all too easy to get carried away with automation for its own sake, but the result of this approach is almost always projects that cost too much, take too long to implement, and fail to deliver against their business objectives. A successful automation strategy requires good decisions on multiple levels. Companies must choose which activities to automate, what level of automation to use (from simple programmable-logic controllers to highly sophisticated robots guided by sensors and smart adaptive algorithms), and which technologies to adopt. At each of these levels, companies should ensure that their plans meet the following criteria.

IV. MULTI-TOUCH TECHNOLOGY

Most industrial automation and other manufacturing personnel are very familiar with multi-touch technology from their smartphones and tablets. Many works for companies that allow employees to use their personal mobile devices for work purposes, from checking emails to accessing corporate data. Now, multi-touch technology is making its way to the

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automation world through multi-touch Human Machine Interface (HMI) applications. When used in industrial settings, many of the benefits of this technology are similar to those encountered in the commercial sector: relatively low-cost hardware, the ability to access and work with data quickly and easily, and near universal familiarity with the technology. However, when multi-touch technology is used with HMI systems, it offers unique advantages in addition to those mentioned above. Using multi-touch devices such as smartphones and tablets to access and interact with data when in remote areas or simply away from the control room is fast becoming the de facto standard for manufacturers. A significant leap was ushered in with the introduction of browsers, apps and virtual private networks to access HMI systems through hand-held devices. Multi-touch offers the next step: the ability to quickly and intuitively view and analyze data from virtually any location.

Beyond Touchscreen

At first glance, it's easy to confuse multi-touch applications with traditional touchscreen designs. A traditional touchscreen application simply uses single touches to access different screens, basically replacing a keyboard and a pointing device such as a mouse. But multi-touch offers a number of advantages over touchscreens, keyboards and pointing devices. Multi-touch systems recognize the position of several touches and finger movements, which are referred to as "gestures." As with touchscreens, multitouch technology enables users to operate an entire system without the need for a keyboard or pointing device. However, it goes further in that it enables intuitive gestures that facilitate the execution of commands up to three times faster than those performed on traditional touchscreens. Gestures used with multi-touch screens provide the ability to move through many screens by swiping. Zooming by pinching enables users to quickly zero in on areas of interest, and rotation and other manipulation of screen objects is greatly simplified and expedited. A good example of how these gestures improve operations is enabling users to swipe through pages quickly to find the data they need. This is a great improvement over touchscreen buttons, mouse movements and keyboard commands that require the user to slowly drill down page by page.

Low Implementation Costs

There are many new technologies being introduced that started in consumer electronics. Some of these are more easily adaptable for the industrial market than others. In the worst case, some require a paradigm shift or investment that outweighs the benefits of the new technology. Multi-touch for HMI is clearly different in that it offers many real advantages without significant required investment or changes in work practices. The arrival of the Windows 7 operating system and its built-in multi-touch programming capabilities has made it much easier and cheaper to implement multi-touch on tablets and smartphones. Windows 7 has also created a platform that greatly eases development of HMI software for multitouch applications. In response, certain providers of HMI software are including multi-touch development tools with their traditional PC-based HMI packages; and these tools typically encompass PCs, tablets and smartphones.

Fig. 5 Multi touch devices for HMI

Fig. 6 Ease of use

Therefore, a company can invest in the same HMI software package to develop multi-touch screens for the PCs in the control room, and then use the same development tools to provide multi-touch enabled access for smartphones and tablets used in the field. In addition, multi-touch for HMI doesn't require an expensive investment in new hardware. Workers can use their company-provided smartphones and tablets, as these devices have multi-touch functionality built-in. Many companies are going a step further by allowing for workers to use their own handheld devices on the job, a trend known as BYOD, or bring your own device. Job satisfaction is increased when workers use their own devices, and companies often provide a monthly allowance to workers using their own devices, as the cost is typically lower than making a large capital expenditure to provide each worker throughout the company with handheld device.

Inherently Suited for Industrial Conditions

The design of multi-touch screens, with their lack of moving parts, is inherently better suited than keyboards and pointing devices for industrial areas subjected to contamination from dust and water. No moving parts are exposed, which extends the equipment's lifespan. This design enables some off-the-shelf devices to be used in the field without any additional protective measures, while others require only minimal modifications as compared to keyboards and pointing devices. However, just as industrial PCs are made for the rigors of the automation world, panel developers have also introduced multi-touch screens that are reinforced for use in hazardous and other extreme environments. It's possible to protect keyboards and pointing devices in hazardous areas such as Zone 1 or 2, but very expensive. Multi-touch HMI screens provided with a protective overlay of glass or polycarbonate to safeguard them from splashes, dirt and extreme temperatures are often a better, less expensive alternative for these and other demanding areas.

Lowering Training Time and Costs

As mature operators and technicians retire at greater rates, younger workers will have to be trained to replace them, and companies naturally want to minimize training time and cost. Since the majority of these younger workers will have years of experience using smartphones and tablets, using multitouch gestures for HMI systems will be intuitive and quickly learned. In addition, interface to the process or operation will be similar whether the device is a PC, a tablet or a smartphone—as all will utilize multi-touch technology. This obviously is much simpler than learning a different method of interface for each device. With less time required to learn how to use HMI system interface devices, more training time can be spent on learning about the manufacturing processes and operations. On the flip side, in the not-so-distant future a generation of workers will be very unskilled at performing keyboard commands and using pointing devices, so companies that continue to rely on these older technologies will have to spend more time & money training new workers.

Protecting Workers and Machines

The ability to improve safety with multi-touch HMI probably isn't as immediately apparent as the economic benefits and convenience of this technology. However, multi-touch technology used to access HMI systems does enable the implementation of significantly enhanced safety features. In order to ensure worker safety and reduce the possibility of an accidental command, the HMI system screens can be programmed to require users make certain gestures unique to a specific operation. For example, the ability to start or stop a machine can be designed so a checkmark across the screen must be performed as a final step before the machine executes the command. Operations for machines can also require users to have both hands on the screen at the same time in order to execute the command, thus protecting hands from accidentally becoming injured, and ensuring that critical operations are not performed with casual or accidental touches. Some multi-touch applications even enable actions to be performed with gloved hands, an operation that is extremely difficult with keyboards. This frees workers from removing and putting gloves back on, saving time and making it easier to maintain personal protection.

Easier Diagnosis of Possible Problems

Perhaps the most unique functionality multi-touch technology offers is the ability to visualize machines and processes, and then access the right screen to diagnose a problem. One of the difficulties in viewing complicated machines and processes is that numerous layers of screens must be created to capture an entire view (Figure 2). Traditional HMI applications use multiple screen frames, and more frames mean greater memory requirements for the PC or other display device. A multi-touch application, on the other hand, requires far fewer screen layers to show a complete system overview. Smartphones and tablets have less memory than PCs and were once prohibitively slow when trying to move through multiple screens, but now users can access data very quickly and easily via multi-touch gestures. Users can tap options on the screen to shrink and enlarge as needed, getting rid of the constraints of screen frame to enter a new era of visualized control. Perhaps, this ability to drill through screens in an instant or enlarge areas with a simple gesture is the new functionality, the killer app, which will hasten the adoption of multi-touch technology in the industrial workplace.

The Next Step in Visualization

HMI applications at the core have always been about providing visualization for machines and processes, rendering these operations and systems in a way that humans can easily understand. HMI systems are also designed with the purpose of viewing and controlling remote locations, and multi-touch HMI is the latest step in the evolution of visualization and remote access. Figure 2: Multi-touch for HMI enables users to quickly access data and execute commands by using familiar gestures, such as pinch and swipe. In addition to improved visualization capabilities, multi-touch technologies simplify how users physically interact with systems each time they touch a screen to expand or contract a view, or drag an item. Making it easier and more intuitive for humans to interact with machines and processes improves performance and reduces errors. This lets operators spend more time on analyzing and improving systems and processes instead of on access and visualization. In the near future, operators in a control room will most likely continue to use PCs as their workstations. However, it isn't difficult to envision those same operators taking their smartphones and tablets to locations outside the control room to access HMI systems and troubleshoot problems. Furthermore, combining reduced headcounts and smaller budgets with improved remote technology means the workplace of the coming years must and can be far more mobile than in the past. The advantages that multi-touch for HMI bring in terms of improved performance, faster and more accurate command execution, and enhanced safety mean it will become more prevalent in the industrial world.

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Seeing technicians in areas outside the control room, both in plant and remotely, using multi-touch smartphones and tablets to access HMI systems will probably become the norm rather than the exception over the next few years.

V. DIGITAL TWIN

The term digital twin is nothing but a conceptualization of keeping a digital match of a physical object, operation, using the data from smart devices such as sensors. The channel that joins the digital twin and its physical matching part is termed as the digital thread. The digital model is likely to be modified and upgraded on a regular basis with appropriate incorporation of Artificial Intelligence and data. Furthermore, it also provides actual and concurrent virtual reality. Combining the physical object with the computer-generated corresponding item is crucial. As the technology trend of industrial IoT increases, digital twin technology is more significant now than ever before. The digital counterparts are connected with the network technology and their capability to get rid of problems and to provide higher operational performance is making this digital matching part as the essential technology for every organization. By offering the companies with a complete digital replica of products, the digital twin technology allows the industries to notice any physical problems in the equipment well in advance so that they can take appropriate actions to remove the potential issues way before they occur. But, to make a digital replica of the equipment is a daunting task. The best way to make it happen is the creation of digital counterpart for one division in the manufacturing unit, bring it into action and then proceed for developing the digital matching part for other areas of manufacturing units. Moreover, the digital twin is distinct from the CAD (computer-aided design). The real potential of the digital counterpart is that it can quickly offer the actual widespread connection between the physical and digital domains in industries. Digital twin technology is changing the face of manufacturing industry and thereby decreases the costs; control assets and decreases the downtime caused by equipment failure. Digital matching part of a physical object in industries plays a vital role in industrial IoT. This technology is also increasing new possibilities for every business worldwide. Digital replica utilizes technologies such as virtual reality by making use of the data & graphics modeling for perfectly creating a virtual model of any equipment.

Functioning of the digital twin technology

In this present-day technology, sensors accompanied by the physical objects in factory gather data and transmit the data to its computer-generated replica, and their communication eventually improves the physical object's performance. The cherry on the cake is that the virtual counterpart can be created way before the equipment is constructed physically in manufacturing units. To make the exact virtual part of a particular physical product, it is essential for engineers to gather and blend data from numerous sources such as manufacturing statistics, information about its working, and also from analytics software. Apart from this, there is also a requirement of AI procedures that incorporate into the computer-generated replica of specific equipment. Digital replica in the manufacturing unit is used in various levels as mentioned below:

Component level: This level of Digital Twin highlights the crucial single component in the entire manufacturing procedure. The only part which is most needed and the manufacturing process is highly dependent on that particular component.

Asset level: Digital Replica in Asset Level develops a digital replica of a specific part of the equipment that is utilized in the production phase.

System level: Whenever the manufacturers need to improvise the entire production line the system level digital replica is implemented.

Process level: Process level looks at the entire life cycle of a product. Beginning from product/process design and development to manufacturing or production, to distribution, and the way the end user is using the product. Which result helps in the development of current and future products.

Fig. 7 Digital Twin technology

Digital twin concept design plan:

Constructing:
This phase includes the equipping of a physical object with multifarious sensors that measure insight from the physical object and also its surroundings.

The measurements are classified in 2 categories:
1. Operational Measurements, which pertain to the physical performance of the equipment, such as color uniformity, torque, displacement, and tensile strength.
2. The external data which affects the physical equipment operations, such as barometric pressure, ambient temperature, and moisture level.

These measurements can be converted into secured digital messages with the help of encoders. These digital messages are then transferred to a digital replica of the equipment.

Communicating:
This particular phase realizes a real-time seamless bidirectional connectivity between the physical processes and the digital platform. Network connectivity is a vital factor to be included for supporting the virtual counterpart of physical equipment. It further involves 3 elements:

1. Edge processing
This interface connects sensors with process historians and then processes data from the sensors and pass it along to the platform. This translates proprietary protocols to make the data formats comprehendible and reduce the network communication. Edge processing makes network communication faster by processing the ingested data at the endpoints.

2. Communication interface
The communication interfaces help to transfer processed data (information) from the sensor function to integration function. Depending on the digital twin configuration, the sensor, which produces the insight, can be placed anywhere: in a mining operation, in a home, in a parking lot, almost at any location.

3. Edge security
The introduction of new sensors and communications bring new security threats, which are evolving rapidly. The necessity of new solutions to safely enable digital twins will be required as the IP enabled assets grow over time. Using firewalls, encryption, application keys, and device certificates are the most common security approaches.

Aggregating: The data aggregation can support data ingestion into a data warehouse/repository, which can be easily processed and prepared for analysis. Data aggregation and processing can be done both on the cloud or on premises.

Analysing: Another phase that comes into action is analyzing the data. In this stage, entire data is thoroughly examined and envisaged. Mostly data analysts and scientists use advanced analytics platforms to generate insights from the data, which realize intelligent decision making.

Insight stage: Insights, generated from the analytics, are presented on dashboards with visual representations, which highlight any slight differences in the performance of physical world analog and the digital twin model in one or more dimensions. It indicates the areas which are potentially needed to be investigated.

Act: This is where you utilize the actionable insights, generated from the previous step, and fed them back to the physical asset. Insights pass through decoders, which decode the commands, and are fed into the actuators, which are responsible for the control and movement of equipment. The insights can also be updated in the back-end systems which control supply chains.

VI. CONCLUSION

The convergence of technologies creates an avenue for industrial it's to take that next leap towards the fully automated industries, where disparate industrial automation systems will share resources and act in synergy. To stay ahead of the curve, companies will have to capitalize on the technologies already out there, accelerate technology implementation and unlock new sources of value. After all, the move to the next phase of automation is more of an incremental upgrade with technology still serving as a primary driver for innovation.

REFERENCES

[1] S. Balasubramanian, R.W. Brennan, and D.H. Norrie, "An architecture for metamorphic control of holonic manufacturing systems," Computers in Industry, 46(1), pp. 13-31, 2001.
[2] Ohmsakthi Vel R., S. Chandravadhana and R. Nandhakumar. "Experimental Investigation On Adaptive Controlled GAIT Rehabilitation Robots." International Journal for Scientific Research and Development 6.9 (2018): 59-63.
[3] D. Dilts, N. Boyd, and H. Whorms, The evolution of control architectures for automated manufacturing systems, Journal of Manufacturing Systems, 10(1), 1991, 70-93.
[4] G. Zapata, E. Chacón y C. Flórez, "Programación de PLC's mediante componentes inteligentes distribuidos, para apoyar el cambio de paradigma en el diseño de estructuras de automatización. In Memorias III (Tercera) Jornada de automatización de la industria petrolera JAIP Colombia, 2012, pp. 479-490
[5] J. Chouinard, and R. Brennan, "Software for Next Generation Automation and Control," Industrial Informatics, 2006 IEEE International Conference on, vol., no., pp.886-891, 16-18 Aug. 2006, DOI: 10.1109/INDIN.2006.275694
[6] S. Olsen, J. Wang, A. Ramirez-Serrano, R.W. Brennan, "Contingencies-based reconfiguration of distributed factory automation," Robotics and Computer-integrated Manufacturing, 21(4-5), pp. 379-390, 2005.
[7] T. Strasser, A. Zoitl, F.Auinger & C. Sunder, "Towards engineering methods for reconfiguration of distributed real-time control systems based on the reference model IEC 61499," In: V. Marik, R.W. Brennan, M. Pechoucek (Eds.), Holonic and Multi-agent Systems for Manufacturing, Lecture Notes in Computer Science, Vol. 3593, pp. 165-175, 2005.
[8] S. Bussmann, and J. Sieverding, "Holonic control of and engine assembly plant: an industrial evaluation", Proceedings of the 2001 IEEE International Conference on Systems, Man, and Cybernetics, Tucson, AZ, 2001.
[9] F. Maturana, R. Staron, P. Tichy, P. Slechta, and P. Vrba, "A strategy to implement and validate industrial applications of holonic systems," In: V. Marik, R.W. Brennan, M. Pechoucek (Eds.), Holonic and Multi-agent Systems for Manufacturing, Lecture Notes in Computer Science, Vol. 3593, pp. 111-120, 2005.
[10] Zoitl and V. Vyatkin, "IEC 61499 Architecture for Distributed Automation: the "Glass Half Full" View," IEEE Industrial Electronics Magazine, vol. 3, no. 4, pp. 7-23, 2009.
[11] D. McFarlane, and S.Bussmann, "Developments in holonic production planning and control," International Journal of Production Planning and Control, 11(6), pp. 522-536, 2000.
[12] Trends in factory automation: The internet of things (iot), 2015.
[13] D. O'Halloran, E. Kvochko, et al. Industrial internet of things: Unleashing the potential of connected products andservices.World Economic Forums IT Governors, 2015.
[14] I. F. Akyildiz, W. Su, et al. Wireless sensor networks: A survey.Computer Networks, Elsevier, 2002,38: 393-422.
[15] A. W. Colombo, S. Karnouskos, T. Bangemann. Towards the next generation of industrial cyber-physical systems.Industrial Cloud-Based Cyber-Physical Systems, 2014, 1-22.
[16] L. Atzoria, A. Ierab, G. Morabitoc. The internet of things: A survey.Computer Networks, 2010,54(15): 2787–2805.
[17] C. Yang, W. Shen, X. Wang. Applications of internet of things in manufacturing.in:IEEE International Conferenceon Computer Supported Cooperative Work in Design, 2016.
[18] J. M. Chung. Internet of Things & Augmented Reality Emerging Technologies.https://www.coursera.org/iot-augmented-reality-technologies/lecture/iot-architecture, 2017.
[19] A. W. Colombo, S. Karnouskos.Cloud-Based Industrial Cyber-Physical Systems. 2014. R. Dolin. Building an iot for industrial control: Part 1 c what is industrial iot?, 2014.
[20] M. C. Domingo. Review: An overview of the internet of things for people with disabilities.Journal of Network &Computer Applications, 2012,35(2): 584–596.
[21] C. Geis. When iiot meets reality: Key considerations for implementing iiot strategies, 2017.