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Review On Industrial Robot In Industries And Educational Institutions

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Abstract

As per the current scenario there is a rapid increase in the utilization of robots in industries for various purposes in-order to increase the productivity and mostly safety of workers. The robots may help the organization to develop in a short span of time but on the other hand it is necessary to discuss about the robot handling difficulties. The robots in educational institutions provides transfer of knowledge by hands on experience in science and technology, English language knowledge since robot play a role of a tutor (Humanoid Robot). The transformation of automation to the next stage is by the use of robots and various modern methods of production with the help of database management system (Internet of things). In Industry 4.0, Industrial Robots acts as one of significant drivers. Technological advances in the robotic arm system modalities have improved its collaboration with human and unstructured environment. The objective of this paper is to review the pros and cons of the industrial robot in industries and to indicate usage of the robotic arm in industries with human collaboration and its role in educational institutions.

Keywords: Robots, Productivity, Educational Institutions, Industry 4.0, Human collaboration.

I. Introduction

A. Industry 4.0 Survey

In every country's economy industry segment is important and plays a vital role in enhancement of the individual. Industry, from the paper renown's on manufacturing which prescribes the production of products from raw materials [1]. The word "Industry 4.0" is into use in public since 2011, on novelty named "Industry 4.0" where a connotation of executives as of commerce, government, and universities endorses the policies and implement to enhance the efficacy manufacturing industry of Germany [2]. Germany introduced advanced technologies in their manufacturing and so it thrives as a global front **runner in manufacturing [3]. Industry 4.0 is one of the** important technical initiatives taken by the German government in 2011, which made industry 4.0 trend among researchers and industries. Several publications have discussed this topic [2-3], like smart factory, advanced manufacturing technologies, internet of things and other factors oriented to industry 4.0 comes to limelight by the experts [4]. The mutual connection of humans, entities and schemes primes to vigorous, instantaneous developments and on organizing own inter-company strategies are gauged and augmented by means of norms like charges, accessibility and supply proficiency. The connection between people, objects and systems will create dynamic, self-organizing value systems between companies in real time. These value systems will be weighed and adjusted based on criteria like charges, accessibility and supply proficiency. And the links between all production sectors in the economy. Many technical fields have strengthened Industry 4.0: the integration of horizontal and vertical systems, the Internet of Things, network security, the cloud, big data analytics, simulation, metal additive manufacturing and robot [5].

B. Safety Standards Survey in Relation to Human Robot Collaboration

On considering human robot interface in industry 4.0, there also comes the safety aspects in relation to human and robot. So, the industrial guidelines that integrate these robots associated risks for workers include the international standard ISO 10218 (Safety requirements for Industrial Robots) and the Technical Specification ISO/TS 15066:2016 (aimed to revamp and enhance the partial requirement laid out in existing standard ISO 10218). The American and European standards are developed based on the ISO 10218 and TS15066; American standard ANSI/RIA R15.06, the European standard EN 775 is derived from the ISO 10218 and national standards comparatively Spanish UNE-EN 755 is lodged from the EN 755 by the Spanish Association of Normalization and Certification. In order to avert misfortunes, choice of a safety system ought to be upon examination of aforesaid risks. Generally, robot and human workspaces has to be detached based on the previous safety systems. Integration of sensor systems to be adopted to avoid the person's entry in the unsafe zone, which acts a danger to the workers as the robots will be in operating condition so this parting in standard UNE-EN 755:1996 was redirected [6].

Fig.1. Structure of paper

According to customary morals, authorized employees only be allowed in the robot workplace that too when the robot is not in auto mode. The quest of suppler and competent manufacturing is driving noteworthy variations in industry. Germany have chiefly incorporated the revamp of automated manufacturing to Industry 4.0 or USA have nurtured intelligent factories [7], on the evolution of novel systems which opens up the modern technical advances in info and communication expertise (ICTs), analysis of data and components as sensors or robots. These revolutions are making the experiments carried out by robots in industries are no more curbed on the parts or other repetitive tasks. As an alternative, we come to know there is a drastic increase in tasks where human beings and robot associate their skills for two-way work such as assembly line. To enable nominal combined human-robot work, as mentioned before is necessary to terminate the obstacles. As an alternative, various kinds of protection measures has to be familiarized to prevent accidents by sensing the objects and signal, put forth needed precautionary steps and damage to humans is minimalized due to unexpected or unavoidable impact. As per the update in the ISO 10218 from the year 2006, deviations in work practices in industries been replicated [8] and the regulation implementation rules [9]. New perceptions are presented with the concepts of concerted operation, work environment, collaborative robots are of direct importance to this review. The new version of the standard ISO 10218-1 [14], and ISO 10218-2 [10] are attentive on the above definitions, providing information about the combined operational needs and support work typologies. The preceding consists of as an instance start-up controls, running of the protection system, movement decelerating, pace manage, whilst the later accommodates for instance guide, interface window, and willing workspace. The international standard ISO: 8373-2012 [11] mentions terminology used in accordance to robots and robotic devices operating both in industrial and non-industrial environments. Here, new expressions elaborate as per advancement of different collaborative tasks in manufacturing and other tasks are demarcated, alike human-robot interaction and hospitality robots, besides conventional terms like robot and control system. The up-to-date ISO/TS 15066:2016 [12] technical information tends to inculcate the requirements and direction in ISO 10218 for the purpose of human-robot. The manner in which standards have advanced in the past ten years shows the contemporary drift towards the researches known in collaboration of human-robot (HRC) as per industry norms. In last few decades, various types of robots carry out collaborative tasks with humans (e.g. service robots, human assisted robots and sensors), on a whole above robots differs in uses on comparison with the mechanized robots used for engineering services and not discussed in the paper. Papers in the capacity of human robot collaboration safety have been published [13]– [14]. On revision of cutting edge protection systems comprising educational robots, systems used for capturing motions and replicated workspace deploys numerous kinds of vision system and procedures for blend of visual information has been provided in this publication based on past reviews. Likewise, the paper aim is to showcase the approaches on care of robot within the outline given by Cyber-Physical Systems. Robots are gradually being introduced into culture, and the service robot's numbers has surpassed the number of industrial robots in 2008 [15].

C. Survey of Robots in Education sector

Robots gradually began to integrate into the daily lives of families and schools. Robot technology is more important for children and young people, because robot technology can be reasonably improved and expanded with the help of robots. Indeed, more emphasis should be placed on how to best integrate educational robots into on the subsist of children and adults. With the continual advancement of expertise, it is keen to analyze the prospective of robots as an effective supplement tool for education. Robots can be an interesting platform for exploring engineering studies such as computer science, electronics and machinery. According to report it has been proved that children deliver well in post-learning inspections and stimulates curiosity among students to learn languages with aid of robots instead of books and recordings in cassettes [16].

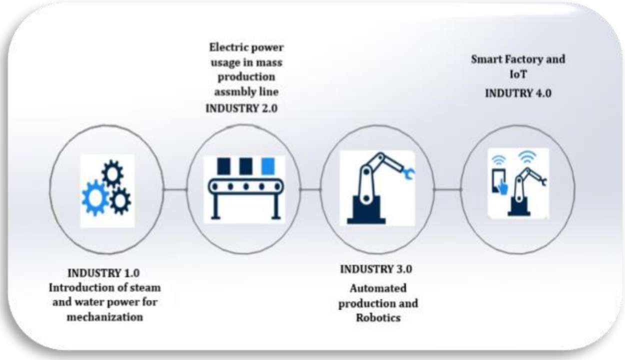


Fig.2. Stages of Industrial Revolution

Instructive robots are a subcategory of educational technology, which ease learning and enhance the education of students. The Robots provide to ensure the reflection and the scalability of the social interface in the learning environment, so as to make

progress in purely programmatic learning. Obviously, not all instructive robots involve collective interaction, which will be discussed later in detail in this paper under section 4 of robots in education. In this paper, we analyze the field of sustainable development of robots for educational purpose. The intention on reviewing the paper is to: initially, deliver a comprehensive outline about the robotics in education because the literature related to robots are very less. Review from paper [17] and [18] are the only available source for study.

The first was launched in 1996, as robotics was in its beginning stage. The second one focuses only on case studies, even though it is new (so there is no meta-level); it only looks at students; it is clear that robots can be used of non-technical purposes, picturizes the Lego brainstorming. There are broad robotics (more precisely social robotics) overviews that take educational robotics into account, but not on a large scale. This will enable academic robotics researchers to assess their exploration analytically and categorize it into apt measurements, for example, by selecting proper research questions, robotic behaviors for their education events, or apposite robotic kits [19]. Research in this field spans a huge space, covering different cultures, age groups of learners, types of robots, and expertise. Therefore, the meta-level method will help to better understand the field. Finally, this review attempts to point out the prospects for further research on educational robots. In addition, it tries to predict the research of various swarm countries like Japan [20], [21], South Korea [22], [23], Australia [24], Germany [25], and the United States [26] and the Netherlands [27], [28]. It also provides us with hybrid robots. In addition, the article has not only been nominated by robotics symposia such as HRI, IROS1, RO-MAN2 and by educational sources such as robotics and its technology. The structure of the article is as follows: Mainly defining bottom-up literature search results. Analysis of previous literature led to the problem of using educational robots, and then we summarized our results in conclusion section on the above issues. Then the future research path, and finally put forward the "look into the future" in this field are discussed.

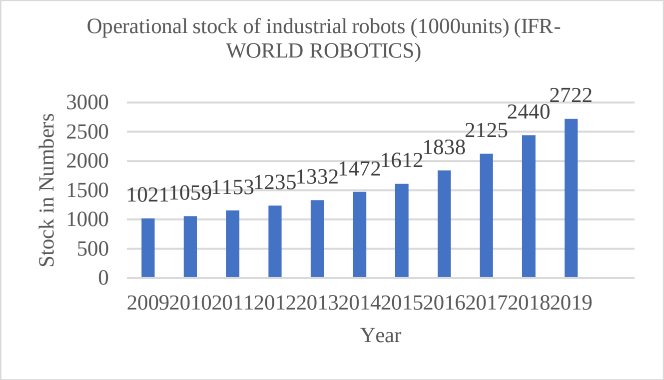
II. Role of robots in Industry 4.0 era

Robot's use initiated in industries because there is an increasing need for assistance. The global robotics report 2020 projects that industrial robots have been used in factories across the globe with an increase of 12% installations across the globe which is of 2.7 million (International Federation of Robotics). The shares of total stock installed across industries in 2020 are as follows Automotive - 34%, Electrical and Electronics industry - 25% and Metal industry - 10%. The value of new installations is 13.8 billion USD dollars. Various market surveys have been added for further understanding the robots market based on application and sales. Numerous forecasters are there some ideal forecasters for precise predictions across the globe were chosen. The installations in top five countries are around 73% (China, Japan, USA, Korea and Germany). Robot density worldwide in manufacturing industry is 113 robots per thousand employees. The robot's market has a potential to restructure the global supply chain. In the year 1784 which is of 237 years before the initial mechanical evolution started; Industrial Revolution comprise of four stages.

At the culmination of the 18th century, first industrial revolution on the basis of water and steam generated mechanical power. In 20th century beginning, the next industrial rebellion happened is the emergence of belt conveyors and produced in mass, and the labels of famous people such as Henry Ford and Frederick Taylor were also associated with it. The next revolution is digital industrial automation through integrated circuit technology and information technology (IT) systems. Development of Autonomous Robots, Automation Advancements and Internet of Things pushing the industries into the fourth stage. Terminology Industry 4.0 makes use of robots as its intelligent system shown in fig 2. In the latter decades of 20th century, industries have significantly improved the level of industrial automation and robotics. It became more efficient, flexible, multifunctional, secure and interoperable, thus creating extraordinary smart manufacturing companies, which will become the core of Industry 4.0 and cover data and communication innovations to achieve branch chains and create fields breakthrough. This provides a higher degree of computerization and digitalization.

It infers machines utilizing self-improved, self-plan and man-made perception to complete complex endeavors to pass on vastly supreme cost efficiencies and better-quality product. Through utilization of advanced examination in sharp running plans, manufacturing organizations be able to keep away from machine failure on the processing plant floor and results in decrease in interruption and productivity increases. A few organizations will actually want to develop 'lights out' processing plants where production takes place in absence of lighting with mechanized robots or warmth on returning of workers to home. Human specialists can be utilized all the more viably, for those undertakings which are truly significant. The industrial manufacturing life sequence gets inclining towards the expanding uniqueness of client prerequisites and incorporates: the thought and the request for advancement and creation, the circulation of items in addition to reuse, and besides including every connected service

Fig.3. International Federation of Robotics (operational stock**)** **-https://ifr.org/ifr-press-releases/news/record-2.7-million-robots-work-in-factories-around-the-globe**



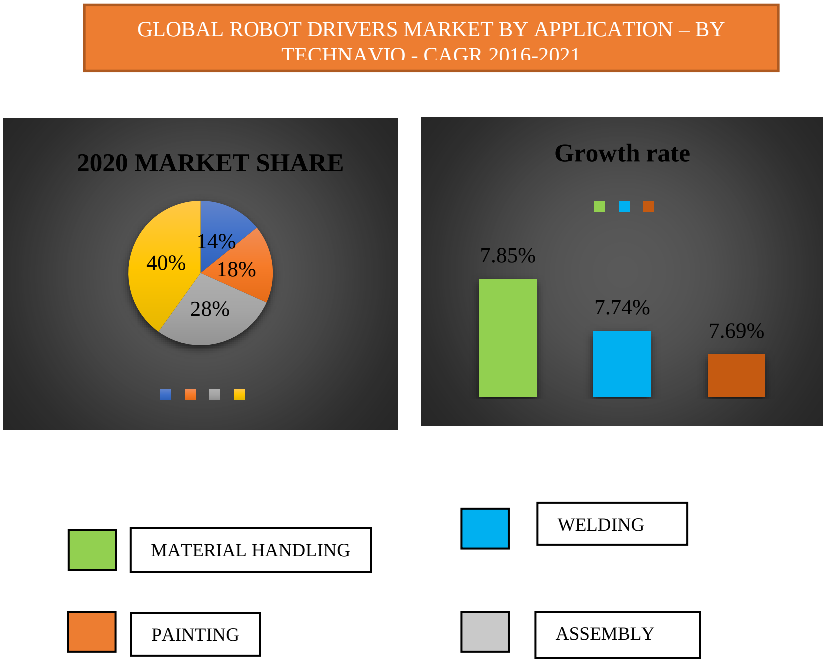


Fig.4.Market Share Analysis based on application in various industries

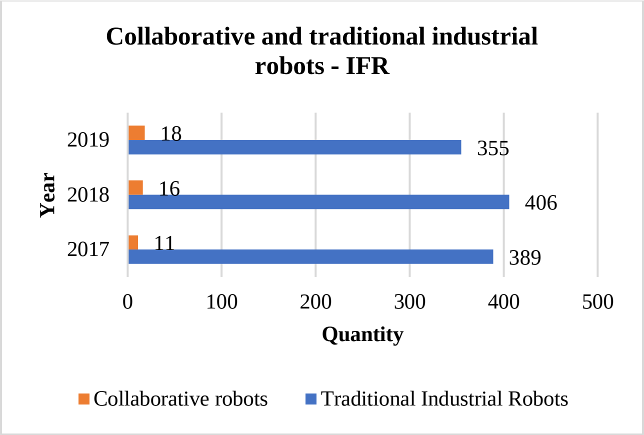


Fig.5. IFR Survey of Industrial and Collaborative Robots Installation across the globe - **https://ifr.org/ifr-press releases/news/record-2.7-million-robots-work-in-factories-around-the-globe**

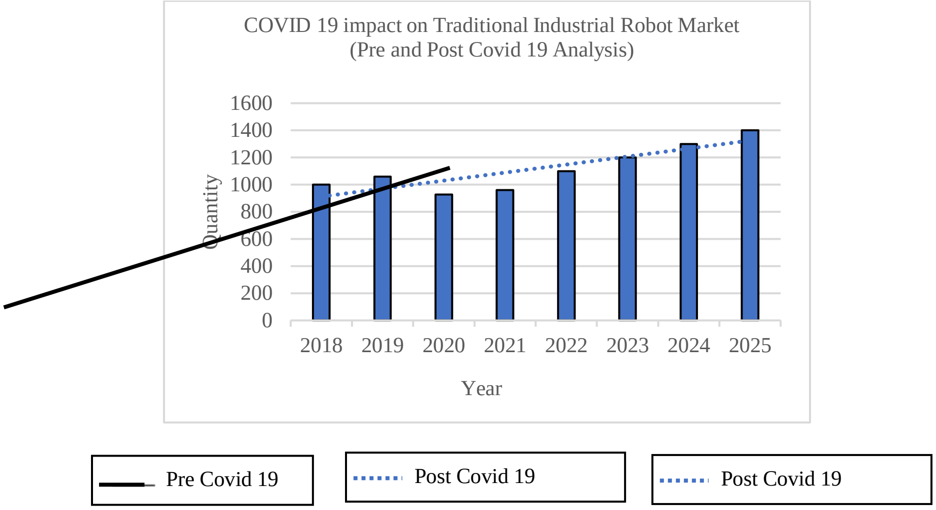


Fig.6. Press Release, Markets and Markets on Industrial Robots Forecast –

https://www.marketsandmarkets.com/Market-Reports/impact-on-industrial-robotics-market-158051867.html

III. Human – Robot Collaboration

The growing demand for robotic vehicles in residential or industrial work environments is focused on improving numerous well-functioning robots that are ready for high-level detection and trigger control [29]. Systems that array from robotic arms to full humanoids are expected to be used in various tasks in association with human worker for help, around that necessitate cooperative effort for a harmless, efficacious, time and energy economical implementation [30]. As a result, the addition of robotic systems in concerted way is been widespread and growing rapidly in research area. Physical human–robot collaboration (PHRC), that descent at intervals is wide-ranging space of human–robot interaction is outlined once humans, robots and also the environment is coupled to complete the task on interaction with either machine or human [31]. In literature, human–robot interaction (HRI) safety problems and its issues related to its operations have been extensively discussed (Example-collision avoidance in production line). Preferably, every dynamic issue of this sort of gadget needs to be able to looking at and estimating the enhances contributions to the whole gadget's reaction thru the synthesis and processing of the sensory information [32]. As a significance, an apt reactive conduct may be replicated (e.g., with the aid of using the human from a set of won abilities is achieved) or evolved to counterpart and enhance the overall performance of the collaborative allies. Hence, we rely in this review paper on other imperative facts of PHRC [33]. An important strategy throughout this direction is that the formation of a shared authority framework inside that the noteworthy competences of all individuals and mechanisms are often oppressed. For illustration, individuals' important psychological feature skills in education and adaptation to many tasks demands and instabilities are often wont to supervise the cooperative robot's superior physical competences. Hence, this paper focus is on alternative related crucial parts of the HRC, i.e., human–robot boundaries, robot management models, system fidelity and appropriate user cases. In addition, with the old saying to appreciate an affordable convergence of views for the obligatory forthcoming growths, our attention goes to be wholly on the physical sides of the human–robot collaboration.

Fig.7. Safe Physical Human Interaction

https://www.google.com/url?sa=i&url=https%3A%2F%2Fhal.archivesouvertes.fr%2Fhal01643655%2Fdocument&psig=AOvVaw1Reb7jA03oXK16eLrYxtfP&ust=1627024945193000&source=images&cd=vfe&ved=0CAQQr4kDahcKEwiA7uPfk_bxAhUAAAAAHQAAAAAQAg

IV. Robots in Education

This section collects research results based on research conducted over the last decade and demonstrates the impact of robots on education and students. Four main aspects are analyzed: research type, the behavior and development of children based on the influence of robots, the views of patrons (parents, children, and teachers) on educational robots, and finally, student's feedback on the design and appearance of robots. Among the first four, three parameters are of interest to analyze the role of robots in education. The results are analyzed and designed on the basis of studying several articles. This paper describes the strategies of researchers for the results of robots in non-experimental studies (mixed methods, anecdotes, horizontal, vertical, correlation, and detailed study) and quasi-experimental (before and after the test). This article also describes the impact of robots on student's skill development, divided into four sets: cognitive, interactive, conceptual, language, and social (collaboration) skills. The robots use in student's education; design has been shown to affect student's perceptions of robot's character or skills. The following sections discuss the skills children learn from educational robots.

Theme	Electronic Robot Kit	Mechanical Robot Kit	Humanoid Robot
Language		LEGO Mind storms robot teaches ROILA [35]	Teaches English language to students [39]
Science	Students learn programming while using Arduino [40]	Programming languages has (CHERP) been studied with the aid of robots [38]	Acquisition of physics content knowledge [42]
Technology			

Table 1 – Use of Robots in various domains and computing information

Analytical skills, teamwork, and collaborative research were steered to test on the robot's introduction and the way it has changed the education, particularly for children with skills of 21st century and stimulate students' interest in science and robotics [34-35]. The research shows that students can find creative solutions and use project-based courses [34]. Robot toolkits, especially Lego Mind Storm, enable students to work in small groups to complete assignments. Robotics is also considered a powerful tool for developing student teamwork skills [35]. As a constructive learning strategy robots are used in various activities of children. Students deliberate on problem solving along with their peers and shares their information on building of a robot. The survey results also confirmed that robots can create collaborative and engaging learning experiences. Primary school robots help children participate in teamwork and create their own artifacts for robotics projects, thereby improving their teamwork ability and problem-solving ability [36]. This is a complement to a landmark study in which robots enable children to use deep imagination to solve problems and improve their learning experience with their peers [43].

Accomplishment scores, science notions and sequencing skills: The review conducted observes students' attainment scores with the observe of automatons in their science prospectus [37]. Science, engineering ideas were educated effectively for kids around age 9–11-year-old with the help of robots. Results from various experiment study buoyed the utilization of the robotic programming comparable to CHERP, a concrete program that led to extend sequencing skills in prekindergarten and preschool kids [38]. In order to boost the understandings of science concept for non-English speaking student's robots aid is given as a support [39]. Results detailed that every student found vital gains in science knowledge in abstract level with astonishing increase from 26.9% to 42.3% on comparison with pre -test to post- check subsequently. The secondary school students gained arithmetic resolving abilities, review technical skills. Robots were conjointly secure to progressive wisdom of science, technology and problem-solving, that\ sustained by Barak's investigation of annotations, discussions and concepts of students engaged on their Arduino projects. In the same way, subjective archives within the learning exposed robot kits as an agent for scientific problem resolution through contribution by multifaceted tactics like integration and correlating concepts and skills over vibrant tasks [40].

Language development: a humanoid robot teaches a second language in elementary school [36]. The results exhibited that robots generate an interactive and connected learning experience when children reacted with high inspiration. Robots' assistance enabled a demonstration of high mobile behavior and extensive repetition. The survey shows that a robot was used for storytelling, with the robot being used in student learning and giving children the opportunity to learn in a mixed reality environment [41]. Great enthusiasm for telling the story and they acted synchronously, but also got involved with their robots in creating stories. The effectiveness of robots could be examined on the basis of several characteristics in the educational sector: the study of design should be meaningfully improved, reporting and provision of statistically significant results, the impact of the robot on the behavior and development of the child, the relevance of the perception of the use of robots by the stakeholders inside and outside the classroom and the reaction of users (especially children) to the design of the robot. The researchers, largely relying on non-conventional means, implemented several approaches to corroborate their studies. Though, this clearly indicates that experimental approaches are profoundly deficient; as indicated [20], a qualitative analysis is required. The practice of using robots in education tends to develop children into a variety of academic skills, such as understanding scientific concepts, developing mathematical concepts, and improving achievement scores [42-44].

V. Conclusion

Robots are becoming an integral part of industry 4.0 which is making the factories smarter and autonomous. As the level of artificial intelligence increases, the robots are capable of learning, reasoning, and inculcating improvement by self. So as the machines controls by itself; there is a way for self-substantial pros and cons, which is discussed elaborately in this paper. The study on various paper on the industrial robots in industry 4.0 emphasize, the robot plays a vital role in human collaboration and in the education.

The Human-Robot Interface helps in avoiding danger to the humans in unconditional work areas. Deliberate quality work life can be attained by the labor in an effective way by reducing the cycle time with robot interaction but also the accuracy increases and it can optimize the labor from hazardous environments. Its usage in education helps in better understanding of concepts and can develop a motivation to students and can also enhances the language competency. But also provides novelistic characterization in children which tends them to dream unimaginable and make it possible.

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