Automotive Robotic Intelligence- A Sustainable Industrial Journey

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***Abstract*—** Supercomputer was a buzz word in the past decades and now superhuman is today's buzz word. A famous quote from Alan Perils reads as "A year spent in artificial intelligence is enough to make one believe in God." Remember 1960, when a fuel attendant robot surfaced in Colorado and the timeline up to now seen a drastic change wherein people are aiming high to fly in air taxies. Landing on Moon, roving on Mars looked as a fiction but, now it has become a reality with the advent of Robotics, Artificial intelligence and Automation (RAIA) technology. The term "Human Machine Interaction" is now taken over by "Brain Computer Interface" which represents a shift from directive to self-reliant technology. The article's very purpose is to give an empirical insight into Robotics, Artificial intelligence and Automation (RAIA), as the researchers are increasingly interested in economics, social and distribution implications. The article may be seen as a boon to start-up entrepreneurs as all industrial segments relating to RAIA are practically revisited. We are now phasing through 4th Industrial Revolution and this article may pay relevance to it as Ray Kurzweil said "Artificial intelligence will reach human levels by around 2029. Follow that out further to, say, 2045; we will have multiplied the intelligence, the human biological machine intelligence of our civilization a billion-fold."

***Keywords*—** *Artificial Intelligence, Human Brain Interface, Human Machine Interaction, Industrial Robotics, Industrial Automation, Industrial Revolution, Smart Vehicles.*

I ROBOTIC AUTOMOTIVE INTELLIGENCE EVOLUTION

The science of intelligence evolved around B.C.E when "Golem" the clay and dirt model architecture by the Hebrews and Greek's. Four decades later a mechanical knight built by Leonardo Da Vinci was demonstrated and this evolution is now terminating at "Smart Robotics" but, this is just a beginning. Great industrial personalities such as Medith Wooldridge Thring (1964) predicted household robots whereas Bill Gates predicted "A robot in every home by 2015". The predictions came good as we have seen change from individual alighting from a modern vehicle through servo-robotic system to crossing the traffic hurdles through aerial vehicle.

II INDUSTRIAL REVOLUTION AND ROBOTICS

God made human and now human is making a super human "Robot" and presenting as if he is the god in the making. This journey looks fascinating and, thrilling as well.

It all started in 1850 by Chebyshev with the design of walking system. In the 1960's, George Devol demonstrated "Unimate" the first industrial robot, which is a combination of tele-operator and numerically controlled milling machine. This system provided a beginning design platform for industrial robot. Sensory mechanism was adopted in 1961 as an add-on and it was termed as "touch feedback". In 1970, a camera plus arm equipped robot was developed at Stanford University and now the world of modeling is focused on "smart factory" with Nano-robotics. The 'smart factory is the outcome of industrial fourth revolution. The progressive industrial revolution is accounted for the present scenario of Intelligent Automotive Robotics. The first industrial revolution saw production of steam engine, the second industrial revolution saw mass production, the third industrial revolution saw digitization and now the fourth is termed as smart factory.

The continuous technological development and the invention of the Numerically Controlled (NC) machines, the popularity of the computer (1950), and the integrated circuit (1970s) all helped to make it possible to begin to develop the very first, yet simple, industrial robot which led to the robotic sectors such as Agricultural Robotics, Environmental Robotics, Navigational Robotics, Conventional War Robotics, Surgical Robotics, Smart Vehicle Robotics, Aerial Vehicle Robotics, Health Monitoring Robotics, Business Robotics, Educational Robotics and Bio-inspired Robotics.

Theoretical and experimental research in factory automation and robotics has both sustained and encouraged industrial development at many institutions. Knowledge of objects and its practical implementation with respect to robotics is quite essential.

III ARTIFICIAL INTELLIGENCE AND AUTOMATION

Computer science discipline took the world by storm in 1965 and evolved itself as a dominant technology in application domain. This beginning made it possible to replace physical prototypes into electronic ones. This remarkable development led to the industrial automation.

Automation refers to the use of largely automatic, computer-controlled systems and equipment in manufacturing and production processes that replaces almost all physical tasks carried out by previously by humans.

The work culture and lifestyle changes of the world are seen because of Automation. Automation expands throughput and allows companies and countries to be competitive and capable. This allows new business models to focus on the delivery of new goods and services and helps companies improve the efficiency and flexibility of providing these goods and services. Economists agree that the increase in production is the key to gross domestic product, the value of goods and services manufactured in a country and, consequently, the improvement of jobs and wages.

Artificial intelligence (AI) is a generic term pointing towards modelling or imitating intelligent behaviour. AI started gaining ground in 1950s as an educational discipline and scientists and researchers then began to look at the opportunity of applying the intellectual capabilities of machines such as humans.

In October 2017, Bloomberg published an article claiming that artificial intelligence is likely to be the "most disruptive force in technology in the coming decade" and warning that firms that are slow to embrace the technology may risk extinction and hence now a new name "robot army".

John McCarthy in 1955 started working on the subject AI. Well-known examples from the field of robotics and AI are the so-called 'smart factories', driverless cars, delivery drones or 3D printers, Intelligent algorithms are expected to effect the human workforce by a hooping one third.

Robotics is a science of theoretical and applied mechanics associated with machine learning aspects. It is an art of human machine interaction associated with internet of things. Robotics initially was a mechanically tuned automated system but now, robotics alongside automation is associated with Artificial Intelligence hence gaining a speedy revolution all over. Robotics is a field within artificial intelligence. It encompasses mechanical devices, generally controlled by computers, to perform tasks that require extreme precision or tedious or dangerous work now being performed by people.

Conventional robotics uses artificially intelligent planning techniques to program the behaviours of robots and works towards robots as technical devices that must be developed and controlled by a human engineer. Contrastingly the autonomous robotics' tactic suggests that robots could be developed and controlled independently.

Robotics, Artificial intelligence and Automation (RAIA) (Neapolitan & Jiang, 2013; Warwick, 2012) The "Fourth Industrial Revolution" (Schwab, 2016), a.k.a.Industry 4.0 (Andelfinger and Hänisch, 2017), is transforming the global economic landscape. Following the progress in robotics, artificial intelligence and automation technologies (RAIA) (Neapolitan & Jiang, 2013; Warwick, 2012), companies from various economic sectors are starting to adopt RAIA to decrease costs, generate additional revenues, provide consistent product quality, streamline operations, expand production/service capacity, improve company's competitiveness. This is robonomics which is largely being adopted my most industries.

As the costs for computer usage have been declining, we are able to increase the degree of computer-controlled automation in factories and plants, allowing less frequent human intervention and reducing the start-up costs for new designs.

IV INTELLIGENT AUTOMOTIVE ROBOTIC SECTORS

Robots and intelligent machines do carry out not only supporting functions but, also lifesaving functions. In today's world the aspects which are dominating are saving one's economy, skilled manpower scarcity, increasing population, environmental degradation, war and surgical threats and keeping this in view research is on for aerial vehicles (Traffic due to increase in population), Agricultural robotics (Skilled man power scarcity), Smart Vehicles (Environmental degradation), Military Robotics (War threat) and Surgical Robotics (surgical demand).

The world of change seen due to Robotics is because of Artificial Intelligence (AI) and Internet of things (IOT) such as to make robots to act autonomously under unstructured complex environment. Robotics, AI and Automation have given rise to human brain interface (HBI) or Brain computer interface (BCI), Human robot interaction (HRI), Assistive robotics, Humanoid robotics in the fields of Business robotics, Educational robotics, Environmental robotics, Agricultural robotics, Military robotics, Surgical robotics and Bio-inspired robotics etc.

Tawlar developed the first BCI-based rat-robot navigation system in 2002. As a new type of robotics system, rat-robot shows huge potential in many applications, as in searching and rescue area. Naturally, it is expected to perform more tasks controlled by computers automatically. However, the state-of-the-art rat-robot still relies on the human guidance.

The idea of autonomous car was first undertaken in 1939 by Bel Geddes and before 1958, the engineers of General Motors demonstrated the first "autonomous car" on a test road built in 1974. A group of forty six researchers foretold that these

automatic highways will become a reality in 2000-2020. It was in 2010; Google announced and conducted research on autonomous vehicles with the company driving the autonomous cars (six Toyota Prius and an Audi TT) for thousands of kilometers of tests on public roads in California. By the end of 201 an autonomous car was seen driven in Berlin and a more likely estimate is that these systems will work around 2030.

The life taking gulf war saw nearly 12,000 ground robots and a fleet of 7000 surveillance planes or drones used to identify and defuse roadside bombs. The step taken by US is seen as milestone in the field of military robotics and this technological development saw tremendous military revolution. The US military then focused on building a fully autonomous unmanned combat aerial vehicle (UCAV) by 2050**.**

The frontiers of robotics automation and the ability of robots to collect scientifically relevant information allowed scientist and engineers to focus on planet and its environmental processes. This focus definitely shifted research gears in the direction of robotic systems so as to make them able to perceive, plan, move and act in natural environments. Keeping these findings in mind scientists and researchers deployed observation system for natural environments such as for land, air, water surface, underwater or underground.

Shakey the Robot (1966) is prototyped at Stanford and eventually found place in Carnegie Mellon's Robot Hall of Fame in 2004. Shakey was the first intelligent autonomous robot that made its own decisions about its behavior. Shakey used to reason the task performance once it was given to it as an instruction. As an example of instruction "move the block onto the table", Shaky robot use to look around the room, identify the block and the table, and then figuring out how to get the block to the table, including navigating around any obstacles in the room.

The use of robots for education is not unheard of. The robots like “HERO” and “GEMINI” are one of the pioneers in the introduction of robots in 1980s and since then robots have been increasingly used to teach programming and other fields related academics.

V ROBOTICS, ARTIFICIAL INTELLIGENCE AND AUTOMATION: FEASIBILITY ASPECTS.

Industrial robots provide a variety of benefits such as accuracy, lower labor costs, quiet operation, reduced product damage, smooth handling in packaging products and speed. Some of the hazardous work benefits are got from industrial automated robots such as pick and place with respect to injection molding machines, CNC mills, lathes and presses, loading corrugated cartons or other packaged items (Palletizing) onto a pallet in a defined pattern giving stability during transport, cutting by using dangerous laser, plasma and water jet cutters giving greater flexibility, in finishing to get consistent quality finish, for accurate sealing and gluing works, in spraying to avoid direct human contact with volatile and hazardous solvent-based paints and coatings and in welding by using MIG, TIG, arc and laser and spot welding to produce precise welds, etc.

Nevertheless robots are treated more efficient than humans by looking at the aspects of requiring continuous attention, working with sensors in an unpredictable environments, heavy duty works and robots commands a consistent, dedicated attention, robots do not have faulty memory.

Artificial intelligence associated with robotics and automation helps in a wide range of functions right from self-driving cars to drones. Here are some key benefits from a combination of AI and robotic process automation such as fraud prevention, product brand management such as Watson Analytics for Social Media, customer Service like chat bots which are used to automate customer service, sales, and marketing messages, software testing and development with vast number of tools and even inhuman resource management in which the HR recruiting professionals receive aspirant information in the form of packets that can be organized and managed through various options.

Automation makes task easier for industry based persons and the approach seems to be beneficial due to reduces cost which gets added due to skill training etc., improved efficiency due to errorless and foolproof programming,

But, still the Automotive industry and manufacture industry face challenges such as technical feasibility, cost of developing both hardware and software, supply and demand dynamics and adapting, enhancing human capital for automotive industry and for manufacturing industry the challenges are policy matters relating to type of product, quality, scale of production, level of plant integration, type of production, possibility of future expansion etc., capital for buildings, raw materials, machines, highways, posts, etc., acquiring a land, workforce requirement that too skilled and semi-skilled, safety of employees, raw material supply, efficient equipment’s and factory overhead.

The robotic industry is totally electro-mechanical and these industries too have challenges such as global competition and new innovations drive the prices down, maintain operational compliance, supplier quality management, closed-loop communication

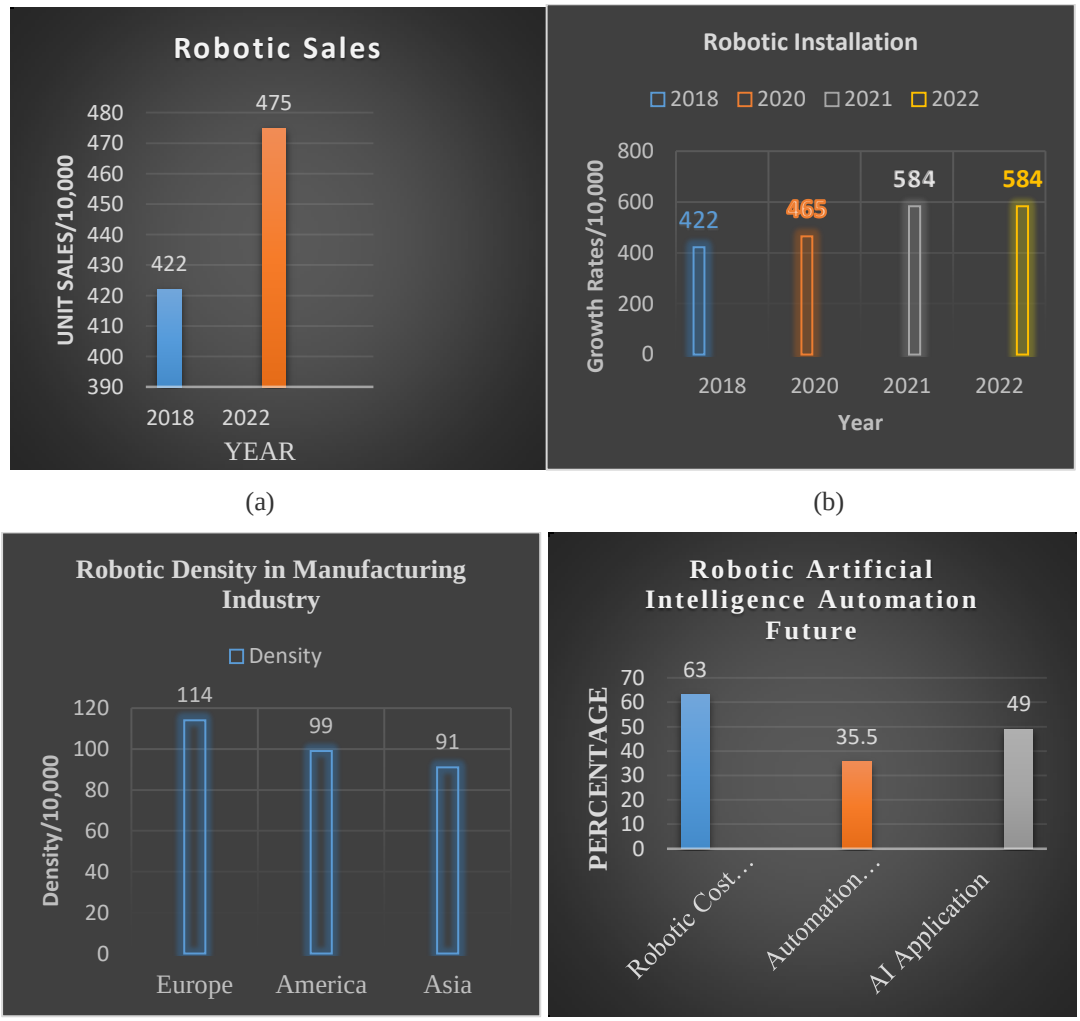
between sales, manufacturing, and engineering is vital to ensure product launches hit time, volume, and quality targets as product have short product lifecycle and the industry suffers from uncertain demand and sustainability too.

VI ROBOTICS, ARTIFICIAL INTELLIGENCE AND AUTOMATION: PREDICTION AND GRAPHICS

As per International Federation of Robotics (IFR), 16.5 billion USD sales values was shown with 4, 22,000 units sold globally in 2018. IFR predicted that an average growth of 12% is expected from 2020-2022 and automotive robotic density ranging from 114 in Europe, 99 in America and 91 in Asia.

Conclusions laid out by the graphics (figure 1) and according to waveform.org and raconteur.net info graphics:

- By 2030 only 35% of time will be spent on routine work due to rise in automation.
- By 2025, 10-15% projection will be seen in manufacturing, transportation and storage sectors with respect to automation jobs.
- Robots sales will grow from hereon as cost of robots are falling by 65% in between 2015-2025. This trend is expected to continue.
- Artificial Intelligence (AI) is expected to have an economic impact $15.5 trillion by 2030 with 49% AI applications to be used in automotive and assembly sectors of manufacturing.
- By 2035, one can see high automation potential closer to 35-50% and according to research conducted by Gartner; there has been a 270 per cent increase in the number of enterprises implementing AI over the past four years.



(a) (b)

(c) (d)

Figure 1(a-d): Illustrative Graphics

VII CONCLUSION AND FUTURE SCOPE

The paper presents past, present and future aspects of robotics, artificial intelligence and automation technologies (RAIA). Assistive technologies and when to assist is the actual question which is solved by human brains. The article addresses industrial revolution, industrial automation, AI and automation, industrial automotive sectors, feasibility aspects, and predictions up to 2035. It is thrilling to see that a human clone in the shape of robot and the process is on to design a super human. Adaptation of RAIA bridges the gap between socio-economic and technology and the speed at which automation is moving, it is worth a mention here, a quote by Elon Musk which says "Robots will move so fast that you need a strobe light to see them" and with respect to humans adopting them, is quoted by Tom Preston Werner as "You're either the one that creates the automation or you're getting automated".

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