

TRANSFORMING INDIAN INDUSTRIES THROUGH ARTIFICIAL INTELLIGENCE AND ROBOTICS IN INDUSTRY 4.0

Darpan Sanjay Kanekar*¹

*¹Department Of Information Technology, B.K. Birla College Of Arts, Science & Commerce (Autonomous), Kalyan, 421301, Maharashtra, India.

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ABSTRACT

The magic term, Artificial Intelligence (AI), has altered both our personal and professional lives. Because of its potential benefits, AI adoption is regarded as critical in the industry 4.0. Since its inception, it has brought several possibilities as well as obstacles to various businesses.

As a result, several AI-powered technologies have been developed that have the potential to dramatically boost the economy by increasing people's quality of life. AI has a significant impact in several sectors of the Indian economy, including agriculture, industry, and services such as banking, transportation, public administration, and defence. As a result, it has a significant impact on GDP growth.

As a result, the benefits of AI are projected to be amplified across the aforementioned industries. As a result, no country can escape the influence of technological breakthroughs in the globalization period. However, by putting in place the required infrastructure and policies, the advantages may be maximized while losses are minimized. While other governments have determined their AI policy, India has yet to do so. As a result, the current essay examines the current and future usefulness of AI in Indian industry and offers a path ahead for India.

Keywords: Artificial Intelligence; Robotics; Machine Learning; Industries; Technology.

I. INTRODUCTION

Artificial intelligence (AI) is a rapidly evolving area, with robots increasingly influencing our lives. In recent years, it has occupied a prominent position. Any significant improvement in technology brings with it a variety of opportunities and problems. We may create technologies capable of promoting their own concert by deriving from data over time with the use of technologies such as machine learning (ML). Despite the fact that artificial intelligence has been the subject of substantial study since the term was established in 1956, it has only lately resulted in the large-scale deployment of intelligent applications for various domains and jobs. The late 1950s and early 1960s saw the development of broad methodologies that could be used in a variety of disciplines. The findings were not promising, prompting the field's first winter, which began in the late 1960s and lasted into the late 1970s. It was discovered that domain knowledge is crucial, hence the focus of the research was on representing and exploiting knowledge. The systems that were created were known as knowledge-based systems.

According to PWC (2017), India relies on three key backers for the AI research and innovation process: the government, the corporate sector, and academia. Furthermore, actions must be made from corner to corner of these three groups, and their potential influence would be on employment-related problems, governance challenges, and obstructions to developing an eco-system, therefore it would be beneficial to speed up the research and development process. As a result, the academic community in India has launched a number of projects and breakthroughs in the fields of AI, ML, and robotics inside commercial operations and consumer lifestyles. As a result, the Government of India's Ministry of Commerce and industrial intends to encourage the use of AI in India's trade and industrial transformation. According to Kamakoti et al. (2018), AI is relevant and has an influence on numerous businesses in India. Manufacturing, financial services, agriculture, education, and defence are examples of industries. They have also made several proposals to the government about the use of AI-led economic development. Furthermore, the 2018 financial statements indicate the government's desire to invest more in research initiatives connected to AI, robotics, and automation as part of Industry 4.0. Furthermore, the Government of India was entrusted with establishing a national program to perform research and development in the aforementioned and other new age technologies (Mendonca, 2018).

Whereas these initiatives would be strategic in nature, with long-term objectives for fostering research and development as well as commercialization of AI driven products. Furthermore, the prospective efforts are planned to adopt a more operational approach with clear incentives targeted at smoothing the development of the absorption of smart solutions inside sectors and its linked operations. In terms of financial support for AI programs, the Government of India's Ministry of Electronics and Information Technology has been funding projects by educational institutions in the areas of ubiquitous computing and wireless sensor networks for real-time landslide monitoring and perception engineering artificial sensing, perceptual robotics. Over the last decade, the ministry has also run a program called Technology Incubation and Development of Entrepreneurs (TIDE) to encourage technological innovation (Meity, 2017). Furthermore, there are potential opportunities for corporations to establish R&D centres with government assistance and encouragement through programs such as Digital India and Make in India, which have established a permissive and favourable regulatory framework. More than 37% of significant financial institutions have already invested in these technologies, with a further 70% planning to do so in the near future (Belgavi et al, 2017).

In terms of the Indian economy, agriculture generates the majority of revenue and accounts for roughly 18% of the country's overall Gross Domestic Product (GDP) (Sunder, 2018). As a result, despite the fact that India is an agrarian country, it has been using cutting-edge agricultural technology in order to spur growth. On the other side, the Indian government intends to increase the manufacturing sector's proportion of GDP to 25 percent by 2022 through the Make in India project (India Brand Equity Foundation, 2018). In addition, the services industry in India, such as banking, transportation, public administration, and defence, contribute significantly to GDP growth. As a result, the benefits of AI are expected to have an overstated impact on the above-mentioned sectors, with a 7.5 percent annual GDP growth rate for the Indian economy (Financial Express, 2018), and it also plans to tap the untapped potential of 2.2 percent of the population that is differently abled (Kamakoti, 2018). With the assistance of technical breakthroughs, these groups may overcome the aforementioned restrictions, enhancing their quality of life and contributing to the economy to the fullest extent possible. With this context in mind, the current research attempted to investigate the importance of AI and robotics, as well as their real-world applications in Indian industry.

II. THE INFLUENCE OF AI IN DIFFERENT INDUSTRIES

Manufacturing and Supply Chain Management

Under the strain of Industry 4.0, industrial industries are digitizing and expanding their supply chain operations through the Internet of Things (IoT). Furthermore, with the aid of AI and ML approaches, the manufacturing industry has been evolving by incorporating higher visibility, flexibility, and operational competence in the supply chain process. It involves accurate demand forecasting and better decision-making via structured scenario analysis. By employing statistical modelling approaches, it also aids in the inventory optimization process. As a result, it analyses inventory supply levels as well as missed sales scenarios (Hitachi. (2017). AI-enabled manufacturing units are optimizing their production processes through greater monitoring and process auto-correction; as a consequence, inefficient machines in the processes may be discovered and parameters adjusted to achieve higher yields. All of this helps manufacturing businesses lower the cost of poor quality by measuring the implicit and explicit expenses associated with poor quality work in progress (WIP) and finished items. The effective use of AI and robots in the industrial and supply chain sectors has relied increasingly on assistance from the government and commercial sector (Sharma, 2017).

Health and safety for the general public

Because of the high population density relative to the number of hospitals, medical facilities, physicians, and care workers in India, the healthcare industry is already under strain. As a result, a sizable portion of the population is disadvantaged even when it comes to receiving fundamental healthcare services. While an immediate increase in the number of health care providers is unlikely, AI-enabled intelligent technologies can be used to improve the efficiency and accessibility of existing resources, allowing them to serve more patients while also improving outcomes and lowering costs (IANS, 2017).

AI is assisting in the provision of tailored care to patients. Each patient is an individual who may require a unique treatment. Furthermore, a disease may have hundreds of subgroups that require distinct therapies that include a pharmacological cocktail. For example, it is becoming clear that cancer has hundreds of kinds, each of

which needs a unique therapeutic cocktail for successful therapy. Pharmaceutical corporations, on the other hand, rely on large-scale randomized clinical studies to evaluate new medications. This would be successful in limiting the number of instances. This is why therapy is frequently based on trial and error. Once we have a large enough database of cancer cases, it is feasible to locate cases identical to the one under consideration, and there is a strong chance that the therapy proved to be helpful in previous cases will also be effective in the current situation (Tenenbaum & Shragar, 2011).

AI has been used by Indian start-ups and SMEs to meet the country's desire for high-quality, low-cost healthcare services. Startups that capture patient-related data using sensors in smartphones and wearable devices, remotely extract information from patient records for monitoring health, supporting diagnosis, enabling health trackers and predicting onset of symptoms, and enabling patient connectivity with specialists. These startups have used big data and artificial intelligence to diagnose diseases like cancer from medical imaging and reports, as well as generate personalized treatment programs for people. As a result, AI in India is increasing physician productivity and availability (Tribune News Service, 2017). Artificial intelligence-powered robots can help doctors perform accurate surgical procedures. AI platforms have already proved their legitimacy as expert systems for guiding doctors on illness diagnosis and treatment.

Some businesses are creating AI-based systems that can offer advice. It is especially effective in non-critical situations or when a real doctor is unavailable. It gives the user advice depending on the symptoms given. It asks a few easy questions in natural language spoken to the user, and the user can respond in natural language. It scans a big database of symptoms and recommends medical treatment. If it deems it essential, it encourages the patient to consult with a doctor as soon as possible. Other applications for AI include early detection of possible pandemics and tracking illness incidence to control transmission, as well as image processing and diagnostics for radiology and pathology. AI assistive and augmentative apps serve a key role in increasing efficacy, particularly among less experienced practitioners. Furthermore, they make healthcare more accessible to a broader segment of population.

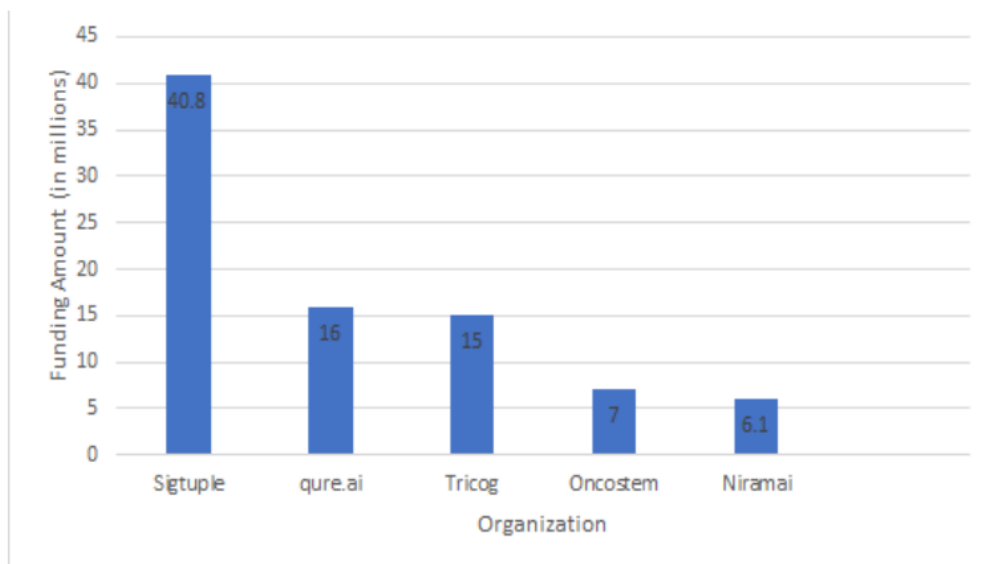


Chart 1: Top Five Artificial Intelligence (AI) organizations in healthcare in India

Source: <https://innohealthmagazine.com/2020/trends/top-artificial-intelligence-organizations-in-healthcare-in-india/>

Agribusiness

Agriculture and related industries such as forestry and fisheries accounted for more than 13% of India's GDP in 2013 and employed more than 50% of the workforce (Kamakoti, 2018). Inadequate demand forecasting, a lack of guaranteed irrigation, soil degradation, overuse/misuse of pesticides and fertilizers, farmer access to financing, and disorganized and low-tech practices are some of the current issues in the industry. And these difficulties may be handled by deploying AI-powered intelligent technologies that would help farmers to produce, process, store, distribute, and consume agricultural goods in a better manner. Site-specific and timely crop data facilitates the application of appropriate fertilizer and chemical inputs, crop health and disease,

spreads, monitoring farm animal health, and intelligent farm mechanization via autonomous machines such as harvesters, thereby increasing yield per square unit of land. AI and ML technologies can make commodity packaging and storage more efficient, resulting in less waste and spoilage (Kulkarni and Ganesh, 2017).

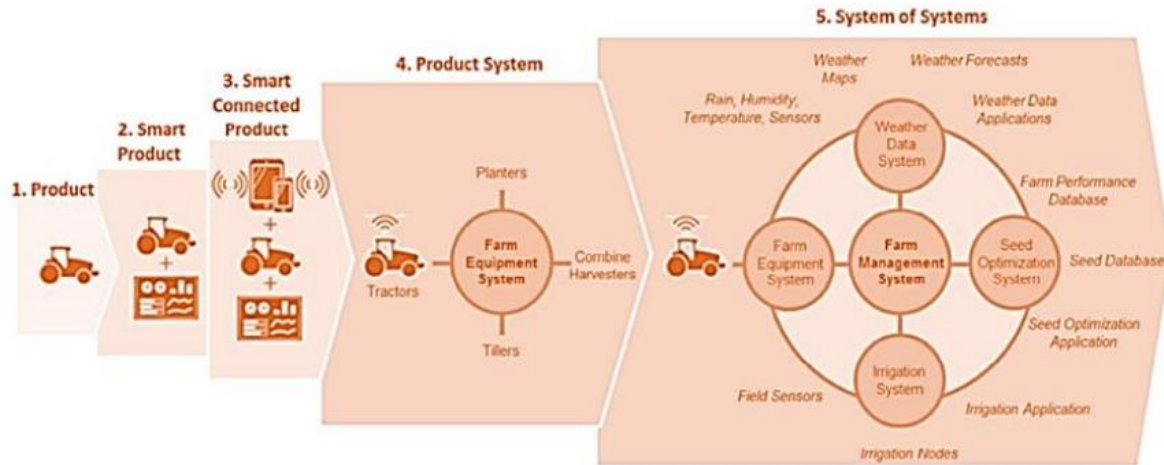


Fig. 1.:System Evolution (www.tporganics.eu)

Financial Services and Banking

Artificial Intelligence, machine learning, and robots have several applications in finance. Their promise, however, has not been completely realized in India. On the bright side, financial services behemoths and Financial Technology firms have collaborated on proof-of-concept programs based on the use of AI and ML to automate and expedite work processes in institutions (Economic Times, 2017). This includes the use of Chatbots to support automated conversational flows and efficient customer service, intelligent agents such as robot-advisors for personalized financial planning, and sophisticated algorithms to aid fraud detection and money laundering prevention. The chatbot asks clients natural language inquiries and performs the required activities. Chatbots are also used by certain financial consulting businesses to connect with consumers. The chatbot asks the consumer questions that differ from one customer to the next in order to gather basic information about the investor's needs and then produces plans based on market trends, etc. The plans can be revisited if new information becomes available. While a human counsel can accomplish this, a chatbot can do it more rapidly and correctly [Yacoub, 2018].

In India, the State Bank of India, HDFC Bank, ICICI Bank, and Axis Bank have begun to use AI-based apps to provide customer care. Each day, large financial institutions such as payment regulators process billions of transactions through various channels such as ATM withdrawals, credit card payments, and ecommerce transactions. Advanced analytical methodologies and machine learning algorithms, combined with human experience, enable institutions to identify transactions as possibly fraudulent at the time of occurrence, allowing the harm to be contained as soon as feasible (Sarkar, 2017). The introduction of intelligent technology coincides with the government's aim for financial inclusion across the Indian economy through initiatives such as Jan Dhan and Cashless India. The value of AI systems in extracting insights from massive amounts of data while also assuring transparency, speed and efficiency, and regulatory compliance cannot be emphasized (PWC, 2018).

Furthermore, automated work flows and algorithmic risk scoring in banking and nonbanking financial institutions can reduce incidents of compliance breaches caused by malpractice, lapses in human judgment, and a lack of visibility on financial exposure to specific counterparties, among other things. This would be especially beneficial to the lending sector, which has recently been under scrutiny due to the risk assessment procedures utilized.

AI innovations, such as 'lean data learning' methodologies, might enable institutions to evaluate micro companies and SMEs based on minimal historical data, improving capital availability to them. By offering more personalized services and boosting back-office efficiencies at financial institutions, AI, ML, and robots have the

potential to change consumer experience, particularly at the "last mile." Some software has been created to assist in tax return preparation. AskMyUncleSam is an example chatbot.

Because the US tax system is complicated, with a plethora of deductions, etc., many taxpayers seek the assistance of a tax return preparation. The chatbot walks the taxpayer through the procedure. It examines the data on payments received, investment losses and profits from brokerage accounts, and so on to identify all possible deductions and obligations. It responds to user inquiries by utilizing its knowledge base of tax code, legal cases, and so on. The financial services industry is vital to economic stability, and the potential consequences of data privacy and security issues are enormous (PTI, 2017).

Education

Since the 1980s, intelligent tutoring systems have been created. Several applications have long been in use. With advancements in AI techniques such as natural language processing, etc., a variety of new applications may now be developed (Sunil Kumar, 2018). Because education is so important for progress in so many areas, the overall impact of AI on education would be significant.

AI in education uses include answering students' questions, asking questions and offering feedback, and assessing narrative replies. According to one study, AI will alter education over the next 4-5 years (Kanejiya, 2017). AI is being used successfully by Indian start-ups to improve education quality. Data acquired from students may be utilized to assist them improve on previous mistakes through a feedback and personalized recommendations process offered by an AI platform (Dalal, 2017).

As a result, pupils' results improve over time. To some extent, it also addresses the issue of instructors' inability to offer personalized attention to pupils as well as the uneven speed of student learning. Teachers are also given feedback using ML approaches. AI has made it feasible to evaluate students' subjective replies. The use of computers to analyse subjective responses saves time and ensures consistency in the evaluation. Bots are being utilized to evaluate the subjective answers provided by students taking the ETS GRE (ETS, 2018).

Students are expected to offer narrative responses in one section of the test to measure their reasoning abilities. To decrease the chance of inaccuracy, this was previously evaluated by two human experts. ETS has now replaced one of the two human specialists with a bot after extensive testing of the application's performance. Despite the availability of a vast number of digital learning material, the usage of computer-based education has remained restricted due to the lack of personalisation. A human instructor tailors the curriculum to the student's needs. Every kid possesses a unique set of skills and abilities.

As a result, using the same information for every learner is ineffective. If the learner does not comprehend the current topic, the system should not go on to the next topic. Similarly, if a student already knows the topic, the information becomes repetitious and the learner loses interest. AI has enabled personalization. A system like this can tailor the curriculum to the needs of the student. It evaluates the student's performance and adjusts the information accordingly.

For example, by detecting places where students lack understanding, the platform may assist teachers in acting on their knowledge delivery and filling gaps. Robotic teaching assistants connected through the cloud may reduce the inaccessibility of skilled knowledge practitioners un remote areas by replicating their teaching style, either alone or in real-time collaboration with human teachers (Fagella, 2017).

Customer Service and Marketing

Digital assistants, customer care bots, and recommendation engines for e-commerce and entertainment websites are just a few instances of how AI is infiltrating customers' lives. Indian start-ups have used AI to improve user experience by offering personalized suggestions, preference-based browsing, and image-based product search. Personalised design and manufacturing, deep learning for forecasting client demand and purchases, and effective inventory and delivery management are some further applications for AI applications (Dhanrajani, 2017). Shopper-friendly robots in retail stores can aid customers by leading them to the relevant product sold in a certain location of the store. There are several product and service recommender systems available, including one utilized by Amazon on its purchasing platform (Sunil Kumar, 2018). It maintains track of the goods individuals buy over time and finds specific trends that are used to determine which products and

services are of interest to the consumer. These patterns are produced utilizing machine learning approaches rather than being defined and hard coded in the system (Alluhaidan, 2018).

The chatbot considers the user's emotions as well. Amelia, an IPSoft customer service assistant, employs sentiment analysis to identify the attitude of the consumer and change its answer appropriately. For example, when confronted with an angry customer, it uses words / phrases to reassure. Because all discussions are saved, it starts with the one that is related. This clearly has an edge over human CEOs who cannot immediately extract the relevant dialogue from the database. If the chatbot is unable to fix the issue, the call is sent to a human executive (Amelia, 2018). A chatbot is used to place online orders for items and services. Starbucks coffee may now be ordered by chatbot. The consumer may purchase coffee by speaking natural language and defining the sort of coffee, for example, and the order is delivered to the nearest Starbucks location. The pre-registered credit/debit card is used to make the payment automatically (Sarah Perez, 2018).

Amazon has installed an automated sales system at its Seattle location. It observes each consumer and records information about the things he selects for purchase. When the consumer has finished collecting all of the necessary things, he or she can leave and the payment is debited from the pre-registered credit/debit card. This type of technology is anticipated to minimize the need for human salespeople in stores (Amazon Go..., 2018).

Sector of Energy

In the energy industry, AI is being employed in a variety of ways (Jucikas, 2018). Making clean, inexpensive, and dependable energy has been identified as critical for combating a variety of issues, including poverty. Google has successfully used AI to cut energy use by 40%, saving millions of dollars. Google employed DeepMind's AI to estimate loads at various places and manage equipment effectively. In light of this breakthrough, National Grid in the United Kingdom is collaborating with the DeepMind team to investigate the possibilities. By balancing energy sources to the national grid, DeepMind hopes to reduce the national energy cost by 10%. The additional power created by the operators but not used results in power waste. This is becoming achievable because of the availability of historical data for learning and prediction.

IBM is collaborating with the US Department of Energy to forecast solar energy. IBM created the system by combining data on weather, environment, and atmospheric conditions acquired from many sources such as weather stations, satellites, sensor networks, and so on. IBM says that the created model is 30% more accurate than the best solar forecasting model currently available. Following its successful use in solar energy, IBM is looking into applying it in wind and hydro-power facilities. AI has also been used to forecast load patterns by analysing user behaviour. To collect this information, energy providers are installing smart meters that report use statistics on a regular basis. Because various people and groups have varying consumption patterns, it is critical to collect this data for load forecasting (Sunil Kumar, 2018).

III. THE LEGAL SECTOR AND LAW FIRM

According to Meng Jianzhu, former Head of Legal and Political Affairs of the Chinese Communist Party, artificial intelligence has the potential to improve the legal sector's accuracy, predictability, and efficiency with precision and speed unrivalled by humans. Predictability and precedent are two fundamental features of law. Artificial intelligence may substantially aid in the alignment of these processes and the provision of high-quality analytical data, while also supporting the legal sector in a variety of other areas, notably in lowering the amount of time spent on the tedious process of examining and handling legal papers. AI allows attorneys to devote more time to vital tasks such as counselling clients, preparing for court appearances, and negotiating bargains. The impact of technology on the legal industry is not new; the internet, emails, and computerized legal databases have all been around for a long time. What's interesting is the extent to which machine learning is viewed as a danger to the legal profession.

In this part, we look at how AI is influencing the legal profession and how far it has progressed. It began as a tool to better comprehend natural intelligence through the creation of artificial agents, and it has since created a plethora of methodologies and strategies for incorporating intelligence into information systems. Some of these techniques are associated with knowledge-based intelligence, such as reasoning, knowledge representation, (precision) language processing, and symbolic machine learning, while others are associated with behaviour-based or data-oriented processing, such as adaptive control, neural networks, data-oriented machine learning,

and statistical NLP. Data-oriented intelligence is connected with unconscious brain activity, whereas knowledge-oriented intelligence is related with conscious human intellect.

• **Precedent:**

In law, precedent is a decision or choice of a court that is referred to in a subsequent dispute for example or relationship to legitimize picking a comparable case or purpose of law in the same manner. Legal certainty is an important hidden incentive in the Dutch legal system. It contends that the government's actions should come as no surprise. In any event, this does not entail that courts must always follow the law's declared objective. In other circumstances, politicians purposely leave room for interpretation or even allow courts to disregard the declared goal of the legislation in order to ensure a reasonable and fair conclusion.

• **Prediction:**

Using common language handling and AI, UK experts sought to predict ECHR (European Court of Human Rights) decisions. The projections predicted if there would be a human rights violation with a 79 percent accuracy rate. The method for assessing information to create expectations looks to be successful, but the scientists did not intend to build a system that can entirely regulate the designated authority's action.

Cyber Defence

The fast expansion of the virtual world's size and complexity has resulted in a never-ending battle between cyber attackers and security service providers. Each side is attempting to create more advanced strategies and tools. The cyberspace environment is a dynamic environment in which situations change frequently and cannot be predicted with precision. Because AI systems are adaptable to changing environments, their application is expanding across all phases of the cyber defence chain, including early warning, prevention, detection, and response (Wirkuttis & Hadas, 2017). The automation of procedures using AI minimizes the need for human intervention. Because human engagement is required at numerous levels, traditional cyber security solutions are sluggish. Any delay must be kept to a minimum since it might cause substantial damage. The loss is not confined to monetary losses. Access to patient health records is hindered in the event of a denial-of-service assault on a hospital. This might be catastrophic for a patient who need rapid attention. Artificial police agents may now be created using AI technology to monitor the whole network. This task is performed by intelligent agents.

An intelligent agent is a program that can perceive, think, and act autonomously. These agents can interact with one another in order to work together to complete a goal. A sufficient number of intelligent agents may be installed to monitor the network in a decentralized manner to detect harmful actions. Despite these advancements, it is not yet practical to replace humans with machines in cyber-attack defense. Human and machine both have advantages and disadvantages. When both of their skills are combined, the success percentage is larger than in individual situations.

Transport

AI has a great potential applicability in self-driving cars. Google, Uber, and Tesla are among the corporations testing its vehicles on public roads. A driver-less bus is being tested in Singapore. So far, there have been very few incidents reported, and the data suggests that the chance of an accident with driverless cars is lower than that of human-driven automobiles. Self-driving automobiles are projected to have far fewer accidents than human-driven cars (Jiang, 2015).

Self-driving automobiles employ the light detection and ranging (LiDar) method, which employs laser beams to generate a three-dimensional representation of the physical environment surrounding the vehicle. It calculates the distance, speed, and form of moving objects such as another automobile, pedestrians, and so on using laser beams. Apart from roads, folks who are unable to walk owing to physical restrictions might benefit from the technology. Several firms are competing in this technological field. There has been some discussion over whether these automobiles should be permitted on the road due of the hazard they pose to people's safety. Regulations must handle a number of difficulties. For example, who is liable if an accident occurs - the owner of the automobile or the firm that manufactured it? Some US states are developing rules to address these concerns. The firms are proceeding and have firm intentions to make it available to the public in the near future.

Virtual Personal Assistants

The virtual assistant assists the user in doing duties or does the activities autonomously on their own. A number of virtual assistants have been created. Google Assistant, Siri, Cortana, and Alexa are some examples from Google, Apple, Microsoft, and Amazon, respectively. A virtual assistant may be interacted with using natural language. An illiterate or blind person can utilize it since it can interact with spoken language. Virtual assistants handle a wide range of duties such as streaming music, playing audio clips, controlling home gadgets, organizing calendars, purchasing via e-commerce, and so on. Because of advancements in natural language processing and speech recognition, these assistants are becoming increasingly useful. This makes it handy to the average individual who lacks specialized training. Speech recognition allows you to utilize it even while driving, for example. Vendors are attempting to integrate these aides into automobiles. Siri is already integrated into certain automobiles. Nissan has begun to use Microsoft's technology into its vehicles. Hyundai is also integrating Alexa and Google Assistant.

National Security and Defence

AI is also used in the sectors of defense and security. It may be used to defend economically susceptible industries and infrastructure, such as airports and power plants. Individual abnormal behaviour identification and infrastructure disruption prediction enabled by networked sensors and pattern recognition are just a few examples of possible AI use cases in this area (Kumar, 2017).

Along with AI applications in defense, robots may be employed to undertake dangerous tasks such as retrieving explosives, detecting mines, space research, deep water probes, scouting for hostile regions, and gathering video feed, to mention a few. Unmanned aerial vehicles (UAVs) and unmanned ground systems (UGS) guided bombs and missiles were the first to use AI and robotics in defence and military applications.

Utility Services in General

AI and ML hold great promise for public sector entities such as large energy, power, and utility companies in the areas of smart metering, real-time information on energy usage that reduces wastage and loss, efficient grid operation, storage, and predictive infrastructure maintenance, all of which benefit companies and consumers by allowing for more cost-effective supply and usage of energy, resulting in more secure supplies and fewer outages. Customers may customize their energy needs with smart meters, lowering prices. The information gathered during the procedure might be utilized to develop personalized rates and more efficient supplies. AI, machine learning, and Internet of Things (IoT) are critical components of the government's goal of smart cities and smart industrial zones. Cities provide a wealth of information that can be captured via various sources such as mass transportation tickets, cameras and sensors on roads, pavements, airports, malls, tax information, police flings, and so on, creating an infinite number of possibilities for improving the quality of services for citizens. Deep learning algorithms can process large amounts of data collected by IoT devices and offer meaningful insights. They enable, among other things, determining patterns of footfall in public places over time, peak loads of automobiles and parking lots, and identifying increasing occurrence of crime at sites. One of the most visible effects would be real-time monitoring of public facility resource utilization (electricity, heat, water, fuel, etc.) and autonomously altering inputs depending on usage patterns, resulting in large savings. AI may also be used to improve public infrastructure including trains, civil aviation, nuclear reactors, communications towers, and power plants. Predictive maintenance utilizing advanced analytical models can assist increase the availability of such infrastructure while reducing safety issues (Deity, 2015).

Assistive Technology Enabled by AI for Physically Disabled

In India, AI-enabled assistive technology for differently abled people remains a mostly unexplored market. While certain accessibility features are occasionally available in devices such as smartphones, they are typically secondary and are not always designed with the customer in mind (Umachandrani, 2017). The automated captioning used by prominent video streaming services to cater to those with complete or partial hearing impairment is one example of AI-embedded accessibility features for the differently abled. Similarly, AI has the potential to improve the daily tasks of persons who have vision, speech, or movement limitations, allowing them to be more productive. Smartphone apps with image processing skills, for example, may explain an object or scene to a visually impaired person or read the content of bills and papers to them (Mahalaskshmi, 2017). In terms of smart prosthetics quality, India is improving by adopting modern designs and technology. However, in

terms of quality and innovation, it falls behind more developed countries. Affordability is also a problem for differently abled persons who are low-income. AI, when combined with other developing technologies such as 3D printing and IoT, has the potential to significantly increase the availability, price, and practicality of smart prosthetics advances (Simonite, 2017).

IV. PRESENT SCENARIO OF AI STARTUPS IN INDIA

Several start-ups are sprouting in the AI, ML, big data, and cloud arena, catching the attention of investors, with a considerable number offering goods and services in healthcare, Fintech, customer service, and education (Kamakoti, 2018). The government's major initiatives, Make in India and Startup India, are also driving this trend. Through innovation and the use of modern technology, smaller and nimbler startup organizations are already becoming formidable challenges to the current industry leaders. This demonstrates India's high potential for AI/ML growth. Large IT services organizations are already developing AI platforms, while smaller specialty AI start-ups are focusing on specific challenges, resulting in the development of a comprehensive environment for AI to thrive in India.

Artificial intelligence (AI) start-ups in India are expanding into a variety of areas, including e-commerce, healthcare, education, and financial services, as well as retail and logistics (Singh, 2016). AI, ML, and robotics start-ups have made important contributions to innovation in these sectors in recent years. Digital technologies have generated new opportunities and enabled them to establish new income streams centred on these new technologies. These startups and small and medium-sized organizations (SMEs) can become producers of full solutions that can be used by businesses and consumers as stand-alone or integrated apps. Aside from establishing new revenue sources, businesses may use new technology to make high-quality goods at lower costs (Nair, 2017).

AI start-ups throughout the world are classified into 22 distinct categories, such as autonomous cars, business intelligence, healthcare, and so on. Figure 1 displays the percentage of 200 AI start-ups (AI17 and AI18) in various lines of business, which covers the majority of the industries where AI is making an effect. It is apparent that the expansion of AI is all-encompassing, from education to healthcare, from home to industry; there is no location where AI is not employed or investigated. Figure 1 shows that in AI17, Core AI received the most attention, while in AI18, cybersecurity benefited the most from AI technology. The data was thoroughly analysed, and the top six industrial sectors of AI17 and AI18 were discovered to include cybersecurity, healthcare, business intelligence, enterprise AI, core AI, and cross-industry.

These leading AI start-ups are developing technology and process-oriented improvements that will result in efficiency benefits and economic possibilities in the near future.

Some of the processes within the top six industrial sectors mentioned above that will be accountable for technological revolutions in the global market are investigated. Medical image analysis, medication development, robotic surgery, virtual nurses, health monitoring, personalized product search and suggestion, sale and demand forecast, customer segmentation, cyber-attack prediction, and automated manufacturing are some of the processes involved.

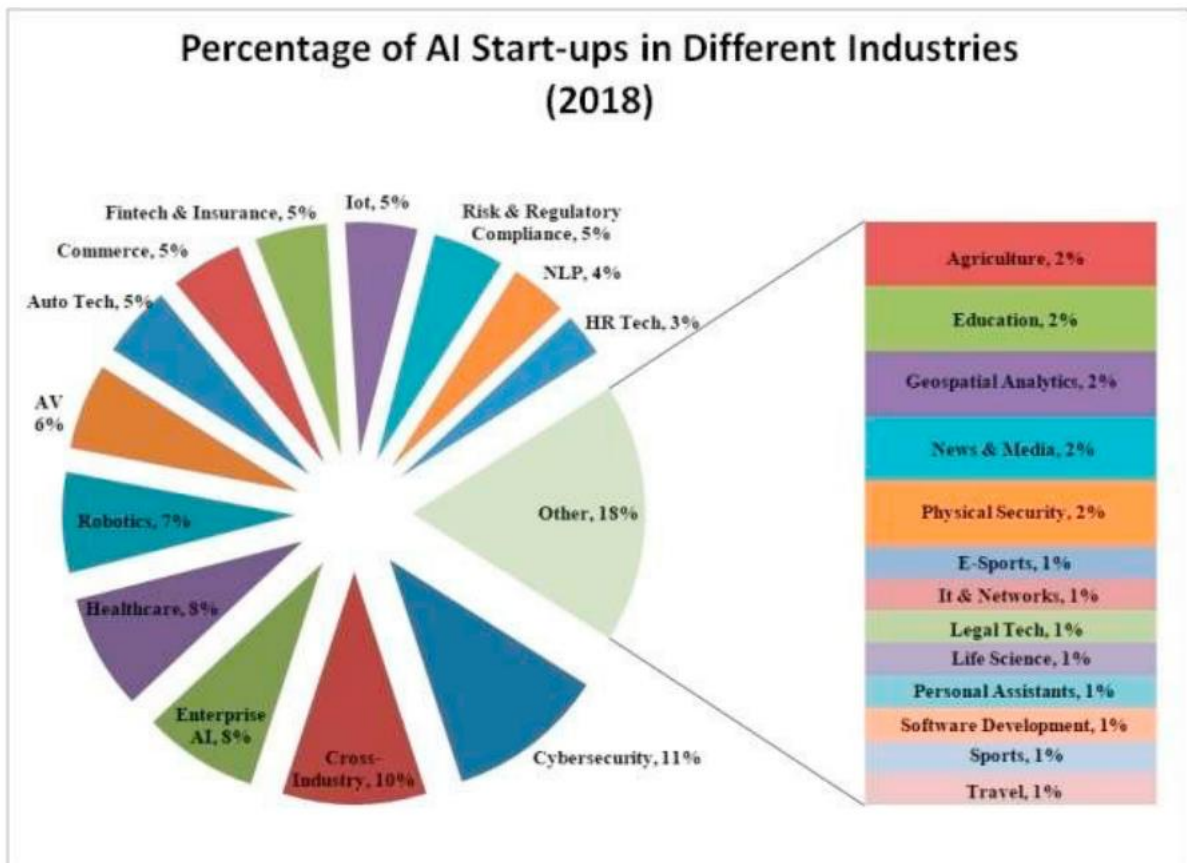
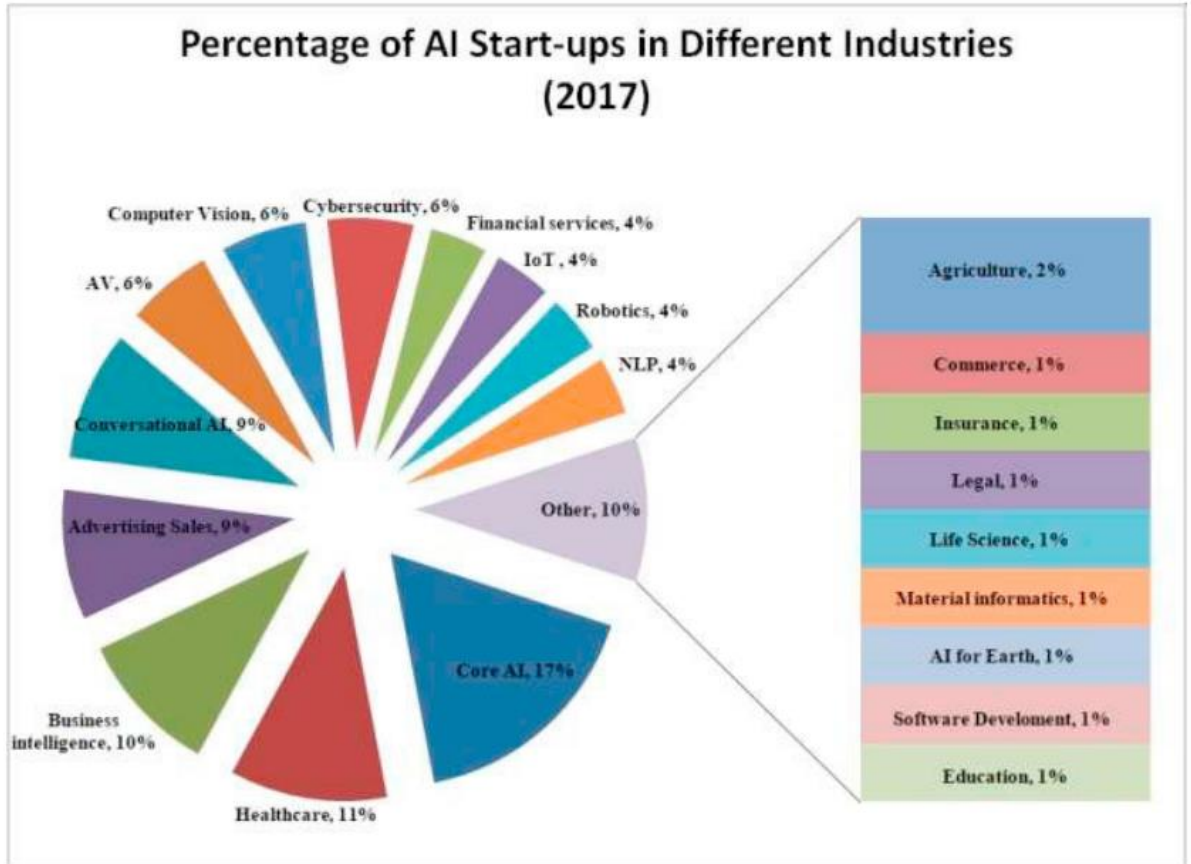


Table 1 Indian Startups in Artificial Intelligence

Startup	URL	Task
Edge Networks	www.edgenetworks.in	Matches the job seekers with jobs available
Fluid AI	www.fluid.ai	Provides customer information on the products in an interactive way
Flutura	www.flutura.com	Monitors health of machines to advise on maintenance
Heckyl	www.heckyl.com	Analyzes stock related information to advises on stock trading
Mad Street Den	www.vue.ai	Helps customers locate products using captured photos
ShopR360	www.shopr360.com	Video analytics solution which can distinguish staff and customers
SigTuple	www.sigtuple.com	Affordable diagnosis solution using a microscope, cell phone and cloud
Social Cops	www.socialcops.com	Interpretation of data
VPhrase	www.vphrase.com	Converts structured data such as graphs, etc into words
Freenome	www.zephyrhealth.com	Analyzes genetic material to find disease signature at an early stage

V. POLICY PLANNING PRIORITIES FOR THE FUTURE

The Way Forward

India currently possesses a once-in-a-lifetime chance. It is possible to replicate the success story of the IT industry by utilizing the talent available within the country. At the same time, if the appropriate procedures are not completed in time, the chance will be lost. AI can assist the government's important programs, such as Digital India, Make in India, and Skill India (Vempati, 2016; Ghosh & Mitra, 2017). To accelerate the growth of AI technology and applications, actions must be taken in the areas of applications and infrastructure development, policy and regulations, research and development, and human resource development.

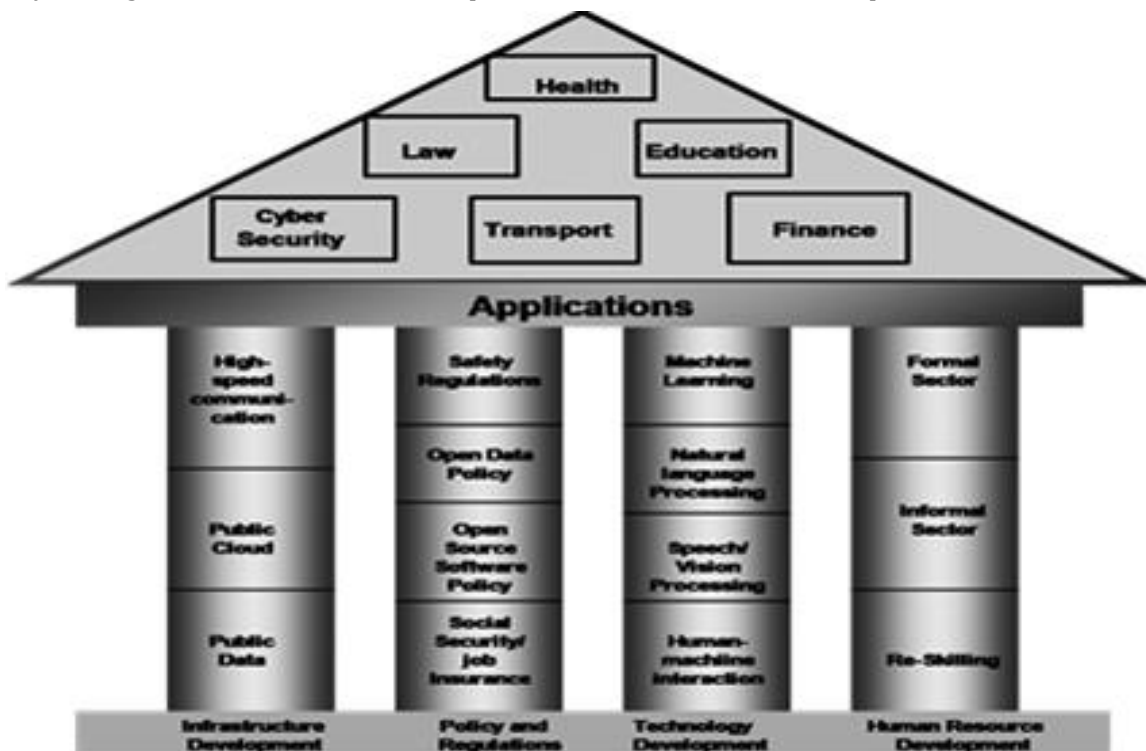


Figure No. 1: Way Forward for India

Infrastructure and Application Development

India, like other countries, may benefit greatly from the use of AI technology. Most apps established in other parts of the globe may also be developed in India. However, the applications must be tailored to the specific demands of the local community. As a result, the Indian government must invest in infrastructure to facilitate the development of AI applications.

Cloud computing is a vital infrastructure that is required for application development. AI applications need a vast amount of compute power, memory, and storage space, all of which are available in the cloud. Some solutions that were previously viable but could not be constructed owing to a lack of cloud infrastructure have now been deployed in the cloud. The Google translation technology is only feasible because the cloud is available. Several AI apps make use of public data that should not be stored or processed outside of the nation. If one utilizes cloud storage from a provider such as Amazon, Microsoft, or others, the data may be housed in another country; this is undesirable for a variety of reasons.

AI applications for public goods can only be developed if the necessary infrastructure is in place to make it available to developers. For concerns of privacy, public data is frequently withheld. Such information, however, can be anonymized before being made public. Another prerequisite for AI application development is a high-speed network. This is required for vast amounts of data to be collected and shared. While connection has improved in metropolitan regions, it remains a challenge in rural and distant places.

Constructing Regulatory Framework for Data Privacy and Security

Because AI applications affect so many elements of human life, rules are required to safeguard public safety, privacy protection, and so on. For example, if autonomous cars are to be authorized on highways or in the air, laws are required to protect public safety.

A self-driving automobile must account for a large number of potential road scenarios. When considering whether or not to allow autonomous cars to operate, it is vital to consider the possible dangers in both instances, namely when conventional vehicles are utilized and when AVs are employed.

Regulations might be tied to product performance. In this situation, continued usage is contingent on performance. More use may be authorized if AI-based apps and services are proved to be safer than human-based applications and services. If it is determined to be less safe, its usage should be restricted until technology advances further.

Regulations are required to allow the use of AI in crucial sectors such as healthcare, where autonomous systems are anticipated to advise on diagnosis and treatment, which may have an impact on the patient's recovery. People are generally uneasy with robots making such important judgments right now. It may be important to retain a human doctor in the loop at first so that judgments may be reviewed. Regulations must be enacted to guarantee that apps produced are not skewed toward a certain point of view. When the creator of the program incorporates biasing, it may be purposeful. It is sometimes integrated as a result of the training data set. that is possible that the developer did not do that on purpose.

VI. RESEARCH AND DEVELOPMENT

The government must play a significant role in sponsoring R&D and innovation programs. The majority of wealthy countries, as well as some emerging countries, are substantially investing in R&D and innovation in the field of artificial intelligence. India could launch a program to encourage R&D and innovation in this field. Industry involvement is required for supporting R&D projects. A key issue in India is that R&D achievements do not translate into commercial products. The lack of connection between R&D centres/academic institutions and industry is the primary cause of this predicament. It is vital to have conversations with the industry through frequent workshops/meetings in order to obtain their perspective. Industry associations can help in this situation. They can offer a condensed perspective of the corporations' positions on the topics.

Companies must be convinced to organize a consortium so that a common fund may be established to assist initiatives at R&D centres and academic institutions that conduct research and development on areas of mutual interest. Government agencies may offer additional financial assistance to these R&D centres and academic institutions in high-risk initiatives. Before beginning R&D or application development initiatives, feasibility assessments must be undertaken. The tasks and domains of AI initiatives determine their success.

Updating the Workforce on Par with New Age Employability

To deal with the issues caused by job loss, the workforce will need to be retrained to take on new sorts of occupations that may develop as a result of process automation. When people lose their occupations, they must be retrained and re-employed by providing the appropriate training. This necessitates an examination of education and training infrastructure and its re-alignment with current demands. Both formal and informal education systems should be reformed in order to develop workforce capable of meeting society's evolving requirements. It is tough for Indian startups to locate developers with AI backgrounds (Punit, 2018). There are several measures that must be taken. There is an urgent need to launch educational programs in this field. The majority of institutions in industrialized nations offer graduate programs in artificial intelligence.

In contrast, just a few colleges in India offer AI programs. Some educational institutes include AI as one of the subjects in their B. Tech. or M. Tech. programs. This is insufficient in an area like AI. The government must provide assistance to universities and technical education institutes in order for these programs to be launched. There is a need to entice talented students to conduct AI research. Doctoral and postdoctoral fellowships should be established and made available to persons interested in AI research. To attract exceptional students, fellowships should provide a greater stipend as well as additional incentives. These students should be encouraged to work on projects that have the potential to lead to meaningful applications.

VII. CONCLUSION

India has a rare potential to use technology to tackle some of its most pressing issues, such as a lack of healthcare facilities and poor educational quality. Conventional techniques cannot accomplish the goal of delivering good healthcare or great education. For example, the number of physicians required to deliver high-quality healthcare is so huge that it will take many years to reach. AI technology offers an alternate method of accomplishing the same goal. The research examined the nationwide state of artificial intelligence technology adoption. While technology has the ability to significantly boost the rate of economic growth. Based on this, it has proposed a strategy for India that includes infrastructure development, policy, legislation, R&D, and human resource development. All parties must get together to discuss these challenges.

The government has a significant role to play in infrastructure development, public-sector applications, policy and regulations, technological development, and human resource development. However, with industry cooperation, these may be accomplished. Though the paper highlights the importance of AI in Indian sectors, further research is needed to gather exact data for determining next steps in infrastructure development, regulatory framework construction, and technological development, among other things.

VIII. REFERENCES

- [1] Alluhaidan Ala. (2013). Recommender System Using Collaborative Filtering Algorithm. Technical Library. Retrieved from: <http://scholarworks.gvsu.edu/cistechlib/155>
- [2] Belgavi, Gandhi, and Kshirsagar. (2017). Fin Tech Trends Report – India 2017. PwC and Startup boot camp. Retrieved from:
<https://www.pwc.in/assets/pdfs/publications/2017/FinTechindia-report-2017.pdf>
- [3] Dalal. (2017). 10 standout start-ups taking an AI leap in India. Live mint. Retrieved from:
<https://www.livemint.com/Leisure/u7M3e5ymwmGf6QLaXBoAJ/10-standoutstartupstaking-an-AI-leap-in-India.html>
- [4] Dee Kanejiya. (2017). How AI will transform education in 2017. Retrieved from:
<https://venturebeat.com/2017/02/04/how-ai-will-transform-education-in-2017/>
- [5] Dhanrajani. (2017). Bracing for impact of AI led disruption. NASSCOM Community Blog. Retrieved from:
<https://community.nasscom.in/community/discuss/itservices/wcitnilf2018/blog/2017/12/05/bracing-for-impact-ai-led-disruption>
- [6] Economic Times. (2017). HSBC and IBM build cognitive intelligence solution to digitize global trade. Retrieved from <https://cio.economictimes.indiatimes.com/news/businessanalytics/hsbc-and-ibm-build-cognitive-intelligence-solution-to-digitise-global-trade/60004818/>
- [7] Fagella. (2017). Examples of artificial intelligence in education. Tech Emergence. Retrieved from:
<https://www.techemergence.com/examples-of-artificial-intelligence-in-education/>

- [8] Financial Express Online. (2018). Economic Survey 2017-18: India GDP growth rate seen bouncing back 7-7.5% in FY19. Retrieved from: <http://www.financialexpress.com/budget/economic-survey-2017-18-gdp-growth-indiagrowth-rate-rebound-arunjaitley/1034135/>
- [9] Ghosh, Sudipta, Mitra, and Indranil. (2017). Artificial Intelligence and Robotics - 2017: Leveraging artificial intelligence and robotics for sustainable growth. ASSOCHAM-PWC Report. March, 2017
- [10] Hitachi. (2017). Take on this unpredictable business age together with Hitachi AI Technology/H. Retrieved from: http://social-innovation.hitachi.in/solutions/ai/pdf/ai_en_170310.pdf
- [11] IANS. (2017). Indian scientists tap AI to identify aggressive breast cancer. Indian Express. Retrieved from: <http://www.newindianexpress.com/lifestyle/health/2017/jul/23/indianscientists-tap-ai-to-identify-aggressive-breast-cancer-1632477--1.html>
- [12] India Brand Equity Foundation. (2018). Manufacturing sector in India Analysis and forecast. Retrieved from: <https://www.ibef.org/industry/manufacturing-sector-india.aspx>
- [13] Jucikas and Tadas. (2017). Artificial Intelligence and the Future of Energy. Retrieved from: <https://medium.com/wepower/artificial-intelligence-and-the-future-of-energy105ac6053de4>
- [14] Kamakoti. (2018). Report of the Artificial Intelligence Task Force. Retrieved from: <http://dipp.nic.in/whats-new/reporttask-force-artificial-intelligence>
- [15] Kulkarni and Ganesh. (2017). Farmers look to harvest the fruits of AI. Hindu Business Line. Retrieved from: <https://www.thehindubusinessline.com/economy/farmers-look-to-harvestthe-fruits-of-ai/article9928335.ece>
- [16] Kumar. (2017). Army to get self-reliant, autonomous robots soon. Economic Times (Defence). Retrieved from: <https://economictimes.indiatimes.com/news/defence/army-toget-self-reliant-autonomous-robots-soon/articleshow/57466543.cms>
- [17] Mahalaskshmi. (2017). Augmenting ability: Microsoft using AI, smart glass tech to aid differently-abled. Financial Express. Retrieved from: <http://www.financialexpress.com/industry/technology/augmenting-ability-microsoft-usingai-smart-glass-tech-to-aiddifferently-abled/713096/>
- [18] MeitY. (2018). Technology Incubation and Development of Entrepreneurs (TIDE). Retrieved from: <http://meity.gov.in/content/technology-incubation-and-developmententrepreneurs>
- [19] Mendonca. (2018). Budget 2018: Government to push research efforts in artificial intelligence. Economic Times (Software). Retrieved from: <https://economictimes.indiatimes.com/tech/software/budget-2018-government-to-pushresearch-efforts-in-artificial-intelligence-says-arunjaitley/articleshow/62738437.cms>
- [20] Nair. (2017). 21-year-old IIT Madras student-entrepreneur's patented AI tech helps doctors predict future. Your Story. Retrieved from <https://yourstory.com/2018/03/iit-madrasentrepreneur-ai-tech-orbuculum/>
- [21] Perez and Sarah. (2017). Starbucks unveils a virtual assistant that takes your order via messaging or voice. Retrieve from: <https://techcrunch.com/2017/01/30/starbucks-unveilsa-virtual-assistant-that-takes-your-order-via-messaging-or-voice/>
- [22] PTI. (2017). Indian robot made in China steals the show at IT event. IBEF. Retrieved from: <https://www.ibef.org/news/indianrobot-made-in-china-steals-the-show-at-it-event>
- [23] PwC. (2017). Artificial Intelligence and Robotics 2017: Leveraging artificial intelligence and robotics for sustainable growth. Retrieved from: <https://www.pwc.in/publications/2017/artificial-intelligence-and-robotics-2017.html>
- [24] Sarkar. (2017). Robotic process automation in insurance industry. Nalashaa. Retrieved from: <http://www.nalashaa.com/robotic-processautomation-insurance-industry/>
- [25] Sharma. (2017). Now robots are coming after India's low-cost labour. Bloomberg Quint. Retrieved from: <https://www.bloombergquint.com/technology/2017/10/04/now-robotsare-coming-after-indias-low-cost-labour>
- [26] Simonite. (2017). Machine learning opens up new ways to help people with disabilities. MIT Technology Review. Retrieved from: <https://www.technologyreview.com/s/603899/machine-learning-opens-up-new-ways-tohelp-disabled-people/>

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- [27] Sunder. (2018). India economic survey 2018: Farmers gain as agriculture mechanization speeds up, but more R&D needed. Financial Express. Retrieved from: <http://www.financialexpress.com/budget/india-economic-survey-2018-for-farmersagriculture-gdpmsp/1034266/>
- [28] Sunil Kumar Srivastava. (2018). Artificial Intelligence: way forward for India, Journal of Information Systems and Technology Management, 15.
- [29] Tribune News Service. (2017). Surgical Robot visits DMCH, helps in invasive surgery. The Tribune. Retrieved from: [http:// www.tribuneindia.com/news/ludhiana/surgical-robotvisits-dmch-helps-in-invasive-surgery/500936.html](http://www.tribuneindia.com/news/ludhiana/surgical-robotvisits-dmch-helps-in-invasive-surgery/500936.html)
- [30] Umachandrani. (2017). How tech is making life easier for differently-abled. The Times of India. Retrieved from [https:// timesofindia.indiatimes.com/india/how-tech-is-making-lifeeasier-for-differently-abled/articleshow/61538902.cms](https://timesofindia.indiatimes.com/india/how-tech-is-making-lifeeasier-for-differently-abled/articleshow/61538902.cms)
- [31] Vempati, Shashi Shekhar. (2016). India and the Artificial Intelligence Revolution. Carnegie India.
- [32] Mukul Anand Pathak, Kshitij Kamlakar, Shwetant Mohapatra, Prof. Uma Nagaraj, Development of Control Software For Stair Detection In A Mobile Robot Using Artificial Intelligence and Image Processing, International Journal of Computer Engineering and Technology, 7(3), 2016, pp. 93–98.
- [33] S. RinaMaiti and Dr. L. Mishra, GIS and Sensor Based Rain Water Harvesting with Artificial Intelligence System for Free Landsliding, International Journal of Civil Engineering and Technology, 9(6), 2018, pp. 54–66.
- [34] Eldho Jacob Joy, Arjun S Menon and Biju N, Multi-Modal Parameter Based Delamination Detection In Composite Structures Using Methods of Artificial Intelligence. International Journal of Civil Engineering and Technology, 8(8), 2017, pp. 1105–1113.
- [35] Didi Faouzi, Nacereddine Bibi Triki and Ali Chermiti, Optimizing The Greenhouse Micro- Climate Management by The Introduction of Artificial Intelligence Using Fuzzy Logic, International Journal of Computer Engineering and Technology, 7(3), 2016, pp. 78–92.